Climate Smart Landscape Conservation Planning and Design Phase I Report

Approach, Methods and Conservation Design Workshop Results

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Executive Summary

In 2015 the Desert Landscape Conservation Cooperative (Desert LCC) made significant progress toward developing a climate smart Landscape Conservation Design for their geography. They developed a methodology for engaging interested partners in conservation planning, hosted two Landscape Conservation Design workshops (one in the U.S. and one in Mexico), developed an understanding of the highest impact pressures and stressors affecting focal ecosystems (springs, including aquatic and riparian resources, streams, including aquatic and riparian resources, and grasslands and shrublands), conducted outreach across the Desert LCC geography to familiarize partners with the Landscape Conservation Design approach and process, and selected three pilot areas in which to conduct further design work.

Key Outcomes

Conservation Design Workshops

Conservation design workshops were conducted in Tucson, Arizona, August 4-5, 2015 and in Aguascalientes, Aguascalientes (Mexico), October 6-8, 2015. There were 145 participants from over 45 organizations and agencies including federal and state agencies, local governments, non-profit conservation organizations, tribes, research organizations and private landowners. During both two-day workshops, participants engaged in discussions about high impact pressures and stressors that are interacting with or driven by climate change and are affecting specific resources, management goals and objectives and how they relate to climate change considerations, current and potential new climate change adaptation strategies, societal values associated with the focal resources, potential pilot geographies, and opportunities to work collaboratively toward longer term conservation goals. Workshops developed a wealth of information on springs, streams and grasslands in the Desert LCC geography.

Pilot Area Selection

Eleven pilot areas were nominated by partners through a structured process and evaluated by the Desert LCC Landscape Conservation Design working group. The following pilot areas were selected by the Desert LCC Steering Committee to be the focus of further landscape conservation planning in 2016-2017:

- Big Bend-Rio Bravo and Lower Rio Conchos
- Eastern Mojave
- Transboundary Madrean and San Pedro Watersheds

These pilot areas represent all three desert ecoregions found within the Desert LCC geography, have a diversity of partners already engaged in landscape-level collaborative efforts and encompass a diversity of conservation issues and opportunities.

Next Steps

The conservation design workshops and selection of pilot areas have built the framework for the Desert LCC and partners to pursue development of a conservation design. Collaborative work in the three

selected pilot areas is being initiated now and is expected to last roughly three years and will produce three unique landscape conservation designs, and support for collaborative implementation. Workshop results, presented here as individual appendices, provide in-depth information on individual resources and geographies and can be immediately used as stand-alone products to guide and inform conservation approaches.

Introduction: The Desert Landscape Conservation Cooperative and Landscape Conservation Design

The Desert Landscape Conservation Cooperative (Desert LCC) is an international partnership that brings together managers, stakeholders, communities and others to collectively address landscape conservation in the Mojave, Sonoran, and Chihuahuan Desert regions of the southwestern United States and northern Mexico. Through collaborative partnerships, the Desert LCC seeks to provide scientific and technical support, coordination, and communication to resource managers and the broader Desert LCC community to address climate change and other landscape-scale ecosystem stressors. In order to better understand the effects of climate change on natural resources and develop potential adaptation responses the Desert LCC is currently working to develop a Landscape Conservation Design through a collaborative process. By working with partners to incorporate climate change considerations and adaptation strategies into existing natural resource management decisions, we can collectively sustain ecosystem function and services and conserve natural resources for people and wildlife.

> **"Landscape Conservation [Planning and] Design is a process - to design - and a product - a design - that achieves partners' missions, mandates, and goals while ensuring sustainability of ecosystem services for current and future generations of Americans"**
>
> Landscape Conservation Design Minimum Standards Working Group 2014

The design will be focused on the following focal ecosystem types[1]:

- Springs, including aquatic and riparian resources
- Streams, including aquatic and riparian resources
- Arid grasslands and shrublands

Landscape design involves the integration of societal values with ecological goals to describe where conservation can best be achieved. Initial steps in 2015 included determining design priorities through workshops, compiling and curating existing information and resources, determining additional information, tools, and resources needed, and selecting pilot landscapes for further design work.

[1] Focal resources were selected based on input from the Desert LCC Steering Committee, Science Working Group, technical teams focused on critical management questions, Desert LCC partners and stakeholders and participants at an outreach meeting held in 2014 in Aguascalientes Mexico.

The Desert LCC's primary goal for landscape conservation planning and design is to add value to, and further our partner's ongoing work to build resource resilience in the face of climate change and other ecosystem stressors. Planning and design outcomes will include:

- spatially explicit data and information about focal ecosystem types
- new information on the effects of climate change and other landscape stressors on focal ecosystem types and other natural resources
- integration of social, cultural and economic information into our understanding of what these resources may look like in the future
- tangible, collaborative adaptation strategies implementable by our partners in pilot areas.

This report summarizes the methodology and results from Landscape Conservation Design work conducted in 2015 including pilot area selection, identification of highest impact pressures and stressors affecting springs, streams and grasslands, and convening conservation design workshops. More information about all aspects of the process is available through the Desert LCC website.

Methodology and Approach

Selection of Pilot Areas

The Desert LCC geography is large enough that it presents significant scale challenges to effective conservation planning (Figure 1). To address this, the Desert LCC is developing Landscape Conservation Designs in several smaller pilot areas within the Desert LCC geography. The pilot area approach provides a more manageable footprint and offers an opportunity to explore where partners are already most engaged in landscape-scale collaborations. The Desert LCC Steering Committee developed criteria for selecting pilot areas based on the goals and intended outcomes for Landscape Conservation Design. The Desert LCC requested partners nominate pilot areas for selection (see Appendix Q), and conducted outreach webinars in Spanish and English to engage partners and answer nomination questions. Steering Committee approved selection criteria were:

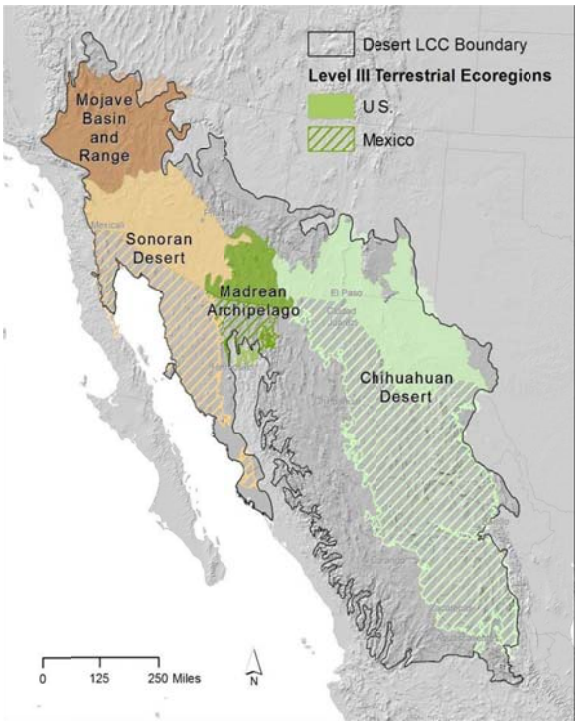


Figure 1. Map of Desert LCC geography and BLM Rapid Ecoregional Assessment ecoregions. BLM REAs are depicted in solid color and do not extend into Mexico.

- Nexus to Desert LCC mission
    - Conservation at landscape scale/tie to climate change and other stressors
- Potential to implement design

    - Partners, cooperation, and resources sufficiently present and ready to implement design
- Habitat and species diversity
    - Includes species and habitats of management interest and vulnerable to Climate Change
- Scalability to a larger geography/process
    - Results applicable to a larger geography and process concept is scalable
- All three conservation priorities addressed (springs/streams, riparian, grassland)

The Steering Committee also articulated the following design considerations or "practicalities" to inform the selection of a portfolio of multiple pilot areas with the idea that the group of selected pilot areas, if considered all together, would meet these characteristics:

- Bi-national Footprint - pilot area portfolio includes land in U.S. and Mexico
- Landscape scale - area is appropriate to meet the intent of a landscape scale analysis but dependent on management questions and indicators
- Data available for desired spatial analysis - to answer management questions and produce a spatial analysis product

The Desert LCC's Landscape Conservation Planning and Design working group utilized the Steering Committee's criteria to develop a scoring tool to evaluate nominated pilot areas and develop a recommended portfolio of pilot areas for Landscape Conservation Design. See Appendix P for full information on the final pilot area portfolio, scoring methodology and tool, and special considerations for each pilot area.

Identifying Highest Impact Pressures and Stressors

Prior to convening workshops, the Desert LCC team on monitoring (Critical Management Question 2 Team: Monitoring Species/Processes Relative to Climate Change and Related Threats/Stressors) developed a list of pressures and stressors (utilizing Salafsky et al, 2008) that are likely impacting ecosystems and species within the Desert LCC geography and that may be exacerbated or influenced by climate change. 14 main pressures and stressors and 75 associated sub-pressures (Appendix N) and stressors were identified as being highest priority in the region based on the following criteria:

- is induced or exacerbated by or otherwise related to climate change
- applies to resources across large landscapes within the Desert LCC geography (multi-focal or pervasive; threatening multiple areas)
- applies to rare, sensitive, or highly threatened habitats;
- will impact species and ecosystem services
- (severity) will destroy or eliminate conservation target vs. slightly or moderately degrade
- occurs frequency or has high probability of occurring
- is already occurring or likely to occur soon
- irreversibility/permanence
- is actionable; practical management actions to address threat exist

A complimentary goal of this work is to identify species and ecological processes that can be monitored to understand the overall effects on ecosystems, habitats and species. The team worked with Desert LCC

partners and practitioners to further refine the list of pressures and stressors by ecosystem types (Brown biotic communities, 1994). This work will allow the Desert LCC to identify the most appropriate species, ecological processes and services to be monitored to better understand the effects of these pressures and stressors in each ecosystem type. The outputs from this effort fed directly into conservation design workshops where participants utilized initial prioritization results to focus discussions on the highest impact pressures and stressors affecting springs, streams and grasslands. See Appendix N for the full list of pressures and stressors identified by the Critical Management Question 2 team.

Conservation Design Workshops

The Desert LCC convened two Landscape Conservation Design workshops in 2015: one in Tucson, Arizona in August, and one in Aguascalientes, Aguascalientes (Mexico) in October. Workshops brought together participants with extensive knowledge of the ecology, threats and management of springs, streams and grasslands and who comprise many of the practitioners that will use the results of the Landscape Conservation Design. Participants included 134 people representing over 45 different organizations and agencies from both the U.S. and Mexico. Workshops were designed to provide a structured, collaborative forum to engage key participants and partners; define planning purpose and scope, clarify existing conservation goals; identify conservation targets; develop geographic scope; and determine resource needs and availability. Workshop outcomes include:

- New coalitions and collaborative relationships to deliver conservation
- Identification of highest impact stressors and pressures on springs, streams, and grasslands that are interacting with or driven by climate change
- Identification of common management goals and objectives for streams, springs, and grasslands that are affected by these stressors and pressures;
- Identification of current and potential new adaptation actions to reduce vulnerability of these resources in the face of climate change
- Identification of potential pilot areas and combinations of pilot areas for future design work.

Figure 2. Participants at Tucson workshop discuss streams.

Workshops consisted of a combination of plenary sessions and smaller breakout group discussions organized by resources and geographies. Plenary sessions provided an introduction to the Landscape Conservation Design process and the Desert LCC, included presentations on tools and science relevant to springs, streams, and grasslands, and introduced all participants to nominated pilot areas. Plenary sessions were followed by active breakout group work which addressed the three focal resources and focal geographies.

Resource Breakouts

Participants worked in three resource breakout groups: springs, streams, and grasslands. They discussed an overarching goal for the resource and developed detailed tables outlining pressures and stressors, management objectives (what they are trying to achieve) and current and potential new adaptation actions. Discussion of the highest impact pressures and stressors was guided by the list pressures and stressors developed by the Critical Management Question 2 team and initial results of expert surveys. Discussion focused on the following questions:

- What stressors and pressures are having the highest impact on this resource?
- What management objectives do you have for this resource?
- How are these high impact stressors and pressures affecting what you are trying to achieve?
- What adaptation strategies and actions are you already implementing to reduce vulnerability of these resources? What new adaptation strategies and actions could you or your partners implement?
- Where are there strategic opportunities to work together for greater impact? Where are important gaps?

Geographic Breakouts

Geographic break out groups were determined by pilot area nominations received by the Desert LCC as well as where the participants' currently work. At the Tucson workshop, participants worked in four breakout groups: Lower Colorado River, Madrean, Mojave and Rio Grande/Rio Bravo. At the Aguascalientes workshop, participants worked in three breakout groups: Mojave/Baja California/Sonoran Desert; Chihuahuan Desert; Aguascalientes. These sessions were designed to gather information about additional natural resources relevant to the geography, examine current pilot areas, discuss how the focal resources are valued in each region for human and natural communities, and to identify which pressures and stressors are having the highest impact. Participants worked to answer the following questions:

Figure 3: Participants at the workshop in Aguascalientes.

- Additional Resources: What other major natural and cultural resource areas/biotic communities need to be included in a climate-smart conservation design?
- Values: Why do people care about these resources? How are people using these resources?
- What are the most important pressures/stressors in this geographic area and why?

- What kind of information would you need to inform management to address this stressor?

Partner Assessment

The Desert LCC is conducting an assessment to support partner identification and engagement in the Landscape Conservation Design process, as well as the broader Desert LCC network. The assessment will identify areas of overlap, possible gaps in programs, and opportunities for potential collaboration. The first phase of the assessment consists of an inventory of partners and potential partners working on grasslands, streams and springs throughout the Desert LCC geography and is ongoing at the end of 2015. The second phase will look more closely at existing efforts and collaboration opportunities within each of the pilot areas.

Figure 4: Participants at the Tucson Workshop engaged in partner mapping.

For the first phase, information about existing local work and partnerships was collected at conservation design workshops in Tucson and Aguascalientes. This in-person engagement is being augmented with a bi-lingual online assessment that explores the nature of partners' work, their primary resource areas of focus, the geographic scope of their work, who they view as key partners/collaborators and information sources, as well as suggestions for others to contact. The assessment will produce a comprehensive partner database for the entire Desert LCC and each pilot area, maps of partner program coverage, and partner network maps in each pilot area.

Summary of Workshop Outcomes and Key Findings

All of the information collected during the workshops provides essential context and scope for pursuing further planning and design development in selected pilot areas in 2016.

Resource breakout session outcomes include:

- Gathering feedback on the resource goal
- Refining the list of high impact pressures/stressors
- Identifying shared management objectives to address the high impact stressors
- Identification of current and new adaptation strategies
- Identification of collaboration opportunities and important information gaps to address
- Increased understanding of issues facing resource managers, and mutual learning among participants

Geographic breakout session outcomes include:

- Identification of resource values and objectives relevant to a geography
- A prioritized list of pressures and stressors
- Inventory of existing efforts and identify collaboration opportunities

Full detailed information on the results of each resource and geographic area breakout session from both the Tucson and Aguascalientes workshops is available in Appendix A-L.

Key Findings

The following is a synthesis of the recurring themes and key findings that emerged from comparing and contrasting conservation design workshop results from the Tucson and Aguascalientes conservation design workshops.

Springs

Cultural, indigenous, and community values: In both Aguascalientes and Tucson, participants discussed the need to explicitly include cultural and community values of springs. It was noted that indigenous cultures express different kinds of values for springs, and that they may value improving nature or maintaining the health of springs via cleaning them out. Cultural values also include religious festivals (particularly in Mexico) which are strongly connected to these ecosystems.

Groundwater nexus: Participants at both the Tucson and Aguascalientes workshops noted that a lack of understanding of the relationship between ground water and surface water at springs and the fact that springs are not clearly classified as groundwater or surface water resources hinders their conservation.

Need for accurate information about springs: Participants in Tucson identified key administrative/management challenges for springs that include lack of accurate spatial data on springs and lack of information sharing between different entities stewarding springs. This was also confirmed at the Aguascalientes workshop. Management objectives and adaptations strategies focused on monitoring, mapping and inventorying springs and integrating management across boundaries were discussed in detail in Tucson.

Streams

Flow to support ecosystem function: Participants in both Tucson and Aguascalientes discussed the importance of understanding and quantifying the amount of flow needed to support acceptable ecosystem function. Participants in both locations also noted the need to change perspectives around conserving water for the environment, making it desirable and helping managers, policy makers and others see its value. This is an area where participants noted that monitoring and enhanced understanding needs to inform policy and management.

Involvement of multiple entities across multiple jurisdictions: There was considerable discussion in Tucson and Aguascalientes about the diversity of entities that need to come together across multiple jurisdictions in order to effectively address stream conservation.

Springs and Streams

Planning at a watershed scale: It was noted in Aguascalientes that there is a lack of planning at the watershed scale and this type of landscape-scale planning is much needed for conservation of springs and streams. This will also begin to address the need to involve multiple entities and jurisdictions.

Understanding the rate and magnitude of groundwater pumping: Increased groundwater pumping was identified as a key pressure/stressor on springs in Tucson and springs and streams in Aguascalientes. Gathering better groundwater pumping data at regional scale as well as assessing different sources of pumping are critical next steps for spring conservation particularly in Mexico. This is an area where participants noted that monitoring and enhanced understanding needs to inform policy and management.

Grassland

Unsustainable cattle grazing: Unsustainable cattle grazing was identified as a high impact stressor discussed in detail by participants in Tucson and Aguascalientes. Participants from both locations expressed a need to better understand cattle carrying capacity and best management practices that will support desired grassland species and community structure and support ecosystem function.

Key different pressures and stressors affect grasslands in the U.S. and Mexico: Altered fire regimes and subsequent effects on grassland species composition and structure was discussed in Tucson but not in Aguascalientes, while overuse of water was discussed in Aguascalientes and not in Tucson.

Cross-cutting

Invasive species: Notably, the only high impact pressure and stressor that was discussed in detail for all three focal resources was: Spread of invasive non-native species and undesirable natives.

Desert LCC funding and actions may be most appropriately focused on things we can do in the next few years at a local scale (e.g. inventory springs, build databases) versus longer-term efforts to change policy. We need to understand where projects are on a continuum of bigger, long-term policy changes versus mountain range or site-specific actions that can be taken on a shorter time frame.

Links between springs, streams and grasslands: There were clear links between threats and potential adaptation strategies identified in Tucson and Aguascalientes for springs, streams and grasslands highlighting the importance of considering all of these systems together. In particular, participants noted the nexus between recharge of aquifers for springs and streams, and health of grasslands.

Potential Outcomes and Benefits of Conservation Design

At the end of the workshops, participants were asked to share their thoughts on how Landscape Conservation Design can help them in their work and potential outcomes and/or benefits they see arising from this work. The following information is a synthesis of recurring comments, suggestions, and recommendations.

Working at Multiple Scales

Participants noted there will not be a one size fits all solution, even though there are many similarities between geographies. There needs to be an appropriate balance between working at the scale of a pilot project area and a scale where information can be translated to individual decisions. Participants talked about working at different levels, for example scientific, executive, field work, and to prevent

desertification. They felt if we work together we can cooperate towards a common goal. Participants stressed the importance of considering both ecological and human connectivity for conservation.

Planning at Larger Scales
Participants stressed the importance of being in the room with varied perspectives and experiences which allowed them to share across organizations and jurisdictions and brainstorm new ways to collaborate and approach issues at a larger scale. Planning at larger scales is creating opportunity to solve long-standing challenges such as bringing together cross-boundary data. Consider landscape-scale conservation planning as an opportunity to address water issues.

Challenges
Participants shared that they are working with the Desert LCC and partners because they are dealing with issues too large to tackle as an individual jurisdiction, agency, or organization.

Opportunities
Landscape Conservation Planning and the Desert LCC partnership can provide a much needed landscape context to conservation work occurring in the geography. This includes helping to identify and bring together partners with the same interests and/or landscapes and with common objectives. By working with a diversity of partners and at multiple scales, the Desert LCC is bringing together partners who can contribute to conservation delivery by forming alliances, developing science, and implementing actions on the ground. Participants also noted the importance of a bottom up approach. This will be critical for developing solutions and plans that have an impact on the ground.

Learning Community
Participants recommended the Desert LCC develop a learning community around pilot projects. Participants recommended that the Desert LCC and partners articulate what success will look like and ways to measure it early in conservation design development. They also noted that by developing an inclusive, transparent and well-documented process, the Desert LCC will legitimize the approach.

Special Considerations for Mexico
Participants working in Mexico stressed it would be useful to have a Desert LCC that is integrated within planning and conservation processes in Mexico. They urged the Desert LCC to take into consideration the southern part of the ecoregion including Jalisco, Guanajuato, San Luis Potosí, Aguascalientes and Zacatecas. A particular gap in Mexico is management plans at the watershed and/or landscape level.

Participant Recommendations
Participants specifically recommended selecting pilot areas that intentionally cut across boundaries**.** They suggested the Desert LCC focus on documenting and sharing success stories and lessons learned to provide examples of what successful large landscape conservation looks like in application. Participants at the Tucson workshop recommended the Desert LCC host a “state of the knowledge” symposium within selected pilots (including policy and science) in order to develop clarity on research and restoration needs/opportunities.

Appendices A-E: Detailed Information from Conservation Design Workshops – Resource Discussions

The follow Appendices include detailed information collected during the three resource breakout groups (springs, streams and grasslands) held in Tucson and in Aguascalientes as well as tables delineating highest impact pressures and stressors, management objectives and current and potential new adaptation strategies.

Each chapter includes the following sections:

- Summary and Key Findings
- Participant List
- Resource Goal
- Highest Impact Pressures and Stressors Affecting the Resource
- Special Considerations for the Resource
- Management Objectives and Adaptation Strategies
- Strategic Opportunities to Work Together for Greater Impact

Appendix A: Springs, Tucson Workshop

Summary and Key Findings

The following information on springs was developed at the Desert LCC hosted Landscape Conservation Design workshop in Tucson Arizona. Spring breakout group participants in Tucson included a mix of representatives from research institutions, a diversity of U.S. federal and state agencies, U.S. local government, Native Nations, and conservation organizations (see Appendix M).

Participants highlighted the importance of addressing cultural values of springs as part of the springs goal statement. Participants choose to focus breakout group discussion on the following high impact pressures and stressors:

- Increased groundwater pumping (connected to water management)
- Changes in groundwater recharge
- Change in disturbance regime due to fire, drought, unsustainable/unnatural herbivory
- Administrative/management challenges, particularly lack of information sharing
- Change in precipitation type and seasonality

Participants noted that although springs are widely recognized as keystone ecosystems, they suffer from a lack of accurate spatial data documenting their location on the landscape

Participants identified a diversity of management objectives related to these high impact pressures and stressors. Recurring themes included: manage for ecosystem function, and ecological processes with a focus on maintaining water quality, community composition and natural variability at springs; manage to maintain threated, endangered and endemic species; maintain natural hydrology including sustainability of groundwater. There were also a number of management objectives focused on monitoring, mapping and inventorying springs and on integrating management across boundaries.

Springs - Tucson Breakout Group Participants

- Abe Springer, *Northern Arizona University*
- Alix Rogstad, *Arizona State Forestry*
- Anastasia Begly, *Northern Arizona University*
- Borris Poff, *Bureau of Land Management*
- Brian Powell, *Pima County*
- Claire Crow, *Bureau of Land Management*
- Deana Benally, *Bureau of Indian Affairs – Navajo Nation*
- Jeff Jenness, *Spring Stewardship Institute*
- Jeri Ledbetter, *Spring Stewardship Institute*
- Larry Stevens, *Spring Stewardship Institute*
- Laurie Simons, *U.S. Fish and Wildlife Service*
- Mara Weisenberger, *U.S. Fish and Wildlife Service*
- Wayne Balcher, *U.S. Geological Survey*

Springs Goal

Participants were asked to reflect on the previously developed goal statement for springs and provide feedback.

Goal: Resilient and functional spring ecosystems that support native aquatic and riparian biodiversity, natural ecosystem and cultural processes and services, and sustainable use.

Participants discussed the need to explicitly include cultural values of springs. It was noted that Native American cultures express different kinds of values for springs, and that they may value improving nature or maintaining the health of springs via cleaning them out. This is a different and important conception of supporting spring ecosystems.

High Impact Stressors and Pressures Affecting Springs

Participants reviewed the previously created list of 14 main stressors and pressures and 75 associated sub-pressures and sub-stressors (Appendix N). They then discussed what they feel are the highest impact pressures and stressors affecting springs in the Desert LCC and chose pressures/stressors to discuss in further depth during the remainder of the session. The following list of pressures and stressors is in order of prioritization by the group. Those in bold were discussed in detail. Those in italics were added by the group.

- **Increased groundwater pumping (connected to water management)**
- **Changes in groundwater recharge**
- **Change in disturbance regime due to fire, drought, unsustainable/unnatural herbivory**
- ***Administrative/management challenges, lack of information sharing***

- **Change in precipitation type and seasonality**
- Altered hydrology, including diversion of flow (pertains to water management actions/structures)
- Increased spread of invasive and native species including feral livestock
- Loss of ecosystem services
- Unsustainable herbivory including grazing
- Increased length and intensity of drought due to climate change
- Livestock, farming and ranching-competition for water resources with native species

In their discussion, participants noted that climate change tended to be wrapped into other stressors instead of being a direct stressor. Groundwater pumping was an all-pervasive issue for non-mountain front springs and for mountain-front springs herbivory/grazing issues rose to the top. The following *new* pressures/stressors were identified as being important to springs, but missing from the list:

Altered Water Quality
- groundwater pollution (mining, agriculture and forestry)
- salt pollution due to "ice suppression"
- urban development

Information Needs
- Lack of accurate geospatial locations for springs

Administrative Processes
- Lack of consistent lexicon to describe springs
- Unwillingness to share information
- Not clearly qualified as surface or groundwater so fall through the cracks

Special Considerations for Springs

Lack of Information and Coordination: Although springs are widely recognized as keystone ecosystems, they suffer from a lack of accurate spatial data documenting their location on the landscape, a lack of data describing their condition and the species they support, and from a lack of coordinated management. These issues were brought to the forefront of discussion in the spring session and are key issues that will affect development of a Landscape Conservation Design. Participants noted that we generally have good coverage of streams and grasslands in the Desert LCC but not for springs.

Grazing Impacts: Depending on the trophic dynamics and ecosystem context of a spring, it may either be suffering from over-grazing, or from a lack of natural grazing (e.g. in Mojave desert lack of grazing is causing loss of open water)

Water Quality: Participants noted that as water quantity decreases with increased aridity, it may exacerbate water quality issues.

Legal Context: Management decisions at springs may be driven or constrained by water rights. There is a significant challenge in Arizona due to a lack of legal connection between groundwater and surface water.

Participants in Tucson identified the following needs to improve management of springs:

- Many climate change threats were not ranking high for springs because there is a lack of information to assess potential climate change threats to springs
- Groundwater flow systems are more complex than surface water systems. Changes in temperature impact groundwater and may be very important to flow that immediately reflects precipitation
- Better understanding of degree of coupledness of trophic processes at different types of springs to understand if de-coupling due to climate change is threat
- Better understanding of range of natural variability at springs
- GIS coverage of springs that is accurate for the Desert LCC
- Economic assessment to document the value of springs (economic, cultural) similar to the AZ State Forestry work to value carbon sequestration
- Engaging state water agencies
- Obtaining more funding for inventory and monitoring of springs
- Compiling and making available legacy and historical information on springs
- Compiling standardized information on springs that is comparable for both the U.S. and Mexico

Management Objectives and Adaptation Strategies

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Increased groundwater pumping	**Collaborative management** Collect groundwater pumping data at regional scale	Current ● Work with local, state, federal partners and land managers on groundwater management plans and regional mitigation strategies to regulate activities that impact groundwater levels
	Maintain natural hydrology ● Manage groundwater-dependent habitat ● Maintenance of natural hydrology patterns of springs ● Sustain range of natural variability of natural groundwater flow and storage	Current ● Restore natural contours to springs and spring outflows ● Acquisition of water rights for the environment New ● Mitigate the effects of over-pumping by managed recharge and other practices
	Groundwater pumping management ● Increased level of protection by control of groundwater pumping ● Reduce water waste, commercial/agricultural/domestic needs, education, and regulation	Current ● Regulate water rights, including groundwater and surface - pumping ● Reduce water waste through regulation and education ● Audit groundwater pumping data, water rights, and use classifications for comprehensive report New ● Regulate water rights for discharge and recharge ● End the “use it or lose it” water rights and water quantification formula
Change in disturbance regime due to fire, drought, unsustainable/unnatural	**Water quality/quantity** water quality at spring emergence	Current ● Improve understanding of distribution and status of non-listed spring-dependent species

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
herbivory	**Ecological Processes** ● Sustain range in variability of natural disturbance processes ● Increase big predators – control ungulates	Current ● restore natural disturbance patterns ● maintain natural vegetative conditions around springs ● Exclude cattle from spring-influenced areas ● Improve wildlife management – direct reduction when necessary ● Restore rehabilitate springs to natural conditions ● Implement prescribed fire along management objectives ● Protecting springs where appropriate ● Improve understanding of distribution and status of non-listed spring-dependent species ● implement prescribed fire along management objectives (based on research and historic fire regimes) protecting spring where appropriate New ● Assess disturbances and effects on spring ● implement landscape-level predator management to mitigate herbivory
Changes is Groundwater Recharge	**Habitat Management**	None identified
	Ecosystem Function ● Obtain and retain proper functioning condition of ecosystems ● Resilient spring health and function ● Develop groundwater modeling throughout Desert LCC ● Sustainability of groundwater supplies and groundwater-dependent ecosystems ● Maintain ecosystem function ● Sustain range of natural variability in groundwater recharge	Current ● Apply results of groundwater models to water resource management ● Plan and implement upland land management for sustaining groundwater recharge New ● Improve management of recharge hotspots ● Maintain groundwater levels to support groundwater-dependent T&E plants associated with spring complexes

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Integrative Management Integrate groundwater management across administrative boundaries	
	Funding Obtain funding to accurately estimate recharge	Current ● Expand funding for springs mapping and inventory assessment, as well as information interpretation and archives ● Obtain funding to restore/improve spring habitat
Change in Precipitation Type/Seasonality	**Habitat management** ● Manage aquatic habitats ● Gain technical support from climate science organizations for reporting/data	New ● Reduce additional other stressors in patchy springs impacted by climate change ● Monitor changes at springs (by land and water managers) to keep a running record to see effects of climate change ● Examine regional climate indices and trends
Administrative and organizational challenges	**Inventories** ● Improve understanding of springs ecosystem ecology ● Conduct baseline monitoring ● Determine the location and monitor conditions of springs ● Identify and prioritize springs and their contribution to the DLCC objectives	Current ● Increase support for springs assessments and compilations of available data; data sharing (c) ● Evaluate spring health and function. Promote dissemination of self-guided set of instructions to measure parameters.
	Sustainable Management ● Sustainable use and management ● Assess ecosystem function and services, including cultural and ecological	Current ● Remove spring diversions and impoundments New ● Improve discussion among scientists and agencies about groundwater policy and management, and how to generate sustainable groundwater supplies prior to crisis. Some springs have water rights (from Tucson Audubon Society)

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Monitoring (flora and fauna) ● Monitor water and species adaptability (flora and fauna) (quantity and quality) ● Mapping springs distribution ● Fostering communication across agency boundaries within groundwater basins	Current ● Conduct state-of-knowledge review and continue to improve understanding of distribution and ecology of springs as a long-term practice for large land management ● Solicit input from scientific community, other agencies, and other organizations on monitoring and research methods ● Develop broad-based management plans that address multiple land management concerns (EX: DLCC state management plans, etc.) New ● Determine monitoring/actions needed to maintain healthy spring functionality relative to expected climate changes ● Increase collaborative efforts to leverage resource and standardize for landscape-scale data analysis ● Develop models that accurately simulate groundwater conditions to serve as a management tool
	Cultural Values ● Sustain traditional cultural knowledge and value of springs	None Identified
	Mapping Mapping springs distribution	
Pertinent to all 5 high impact stressors/pressures	● restoration to natural or near natural conditions ● restore springs to natural condition based on site hydrology ● maintenance of threatened endangered and endemic species ● maintenance of natural community composition and ecosystem services	New ● Protect threatened and endangered plants from herbivory ● Eradicate aquatic invasive species (crayfish, tilapia, etc.)

Strategic Opportunities to Work Together for Greater Impact

Participants suggested the Desert LCC may be able to play a role in bringing together the issues articulated here as a white paper or other report that could then be used to educate legislators and be used by Desert LCC members to seek funding.

Participants also expressed that within the opportunities to work together on springs, there are some big objectives, that may require policy changes and some objectives that require working within the system and are more site specific. The Desert LCC may be able to have a bigger impact with partners if they focus efforts on the shorter-term more site specific actions.

Other strategic opportunities to work together include:

- Locating existing legacy and historical information
- Landscape-level species management plan to help protect groundwater resources
- Plans/strategies for managing herbivory at a landscape scale (customized to local risks)
- Training springs managers to gather information at springs
- Video on springs in the Desert LCC (one short and one in-depth)
- Utilizing citizen science for less technical on-the-ground aspects of these strategies

Appendix B: Springs and Streams, Aguascalientes Workshop

Summary and Key Findings

The following information on springs was developed at the Desert LCC hosted Landscape Conservation Design workshop in Aguascalientes, Aguascalientes (Mexico). In Aguascalientes participants were combined to discuss springs and streams in the same breakout group. Breakout group participants in Aguascalientes included a mix of representatives from research institutions, U.S. state and federal agencies, and conservation organizations (see Appendix M).

Participants highlighted the importance of including cultural, community, socio-economic and social aspects as part of the springs and streams goal statement. Participants choose to focus breakout group discussion on the following high impact pressures and stressors:

- Decreasing water availability (including timing), affecting aquatic and riparian habitat
- Increasing groundwater pumping
- Decreasing water quality

Participants noted the importance of understanding how indigenous cultures value and manage springs, learning from their values and knowledge and adapting to their way of doing things. Participants also noted that the loss of traditional knowledge as a challenge for spring conservation. Participants stressed the importance of recognizing environmental uses of water and the need to change the current perception that conserving water for the environment is not an efficient of effective use of water.

Participants identified a diversity of management objectives related to these high impact pressures and stressors. Recurring themes included: promote the value of water for the environment and work for policies that secure water for the environment; conduct long-term watershed planning so that springs and streams are considered in a broader context; increase monitoring/regulation of water use to better manage water withdrawal and improve efficiency of water use.

Springs and Streams - Aguascalientes Breakout Group Participants

- Alfredo Rodriguez, *World Wildlife Fund*
- Armand Gonzales, *California Department of Fish and Wildlife*
- Aurora Breceda, *Centro de Investigaciones Biológicas del Noroeste, S.C.*
- Carlos Alfredo Flores de Anda, *Bosque de Cobos A.C.*
- Carlos L. Martinez
- Iris Banda, *Pronatura Noreste*
- Jeff Bennett, *Big Bend National Park, National Park Service*
- Junko Hoshi, *California Department of Fish and Wildlife*
- Louise Misztal, *Sky Island Alliance*
- Manuel Chavez Diaz, *World Wildlife Fund - México*
- Manuel Ortiz Perez, *Instituto de Geofísica de la UNAM*
- Noe Santos, *U.S. Bureau of Reclamation*

Springs and Streams Goal

*P*articipants were asked to reflect on the goal statement for springs and streams and provide feedback.

Goal: Resilient and functional spring/stream ecosystems that support native aquatic and riparian biodiversity, natural ecosystem and cultural processes and services, and sustainable use.

For both springs and streams, participants noted that the current goal is lacking cultural, community, socio-economic and social aspects. Participants noted that streams and springs should be able to sustain societies that have evolved together with them. In relation to springs, participants discussed the addition of language to get at the cultural importance and governance capacity and community capacity.

Participants emphasized the cultural and religious importance of streams and the value of these systems to communities. This group also discussed adding a statement about rivers supporting the recharge of superficial waters and aquifers (ecosystem function). Underground aquatic ecosystems were also discussed, and it was unclear to participants whether these are inherently included in either the springs or streams goal statements.

Following is a summary of further discussion on how the goal statement relates to participants' ongoing work.

Work with indigenous communities, cultures, etc.

- The Sustainable Tarahumara Project is seeking to discover how indigenous groups actually go from "valuing" a resource to management of the resource. There are cultural/spiritual issues that make these communities see management of springs very differently to the way westerners view this. It's not just about offering the best technical/scientific tools – it has to be socially/culturally adaptive.

- When working with indigenous communities we have to learn from them. Need to use technologies and materials that are familiar to them. We have to adapt to their environments and ways of doing things.
- This big goal relates well to the oasis work in Baja. We need to respect the cultures that have been there for hundreds of years living with this resource. The oases in Baja are very isolated, and have an important role within the cultures. They have been there for more than 300 years. They also provide refuge for fauna. These areas have been abandoned through a process of agrariation, which threatens their sustainability.
- The religious culture is also important. Religious festivals are an important aspect of the ecosystems (i.e. Dia de San Juan and Easter). People go to the rivers at these times. It may be important to include this religious aspect.

Underground aquatic ecosystems: There is little discussion about preserving underground ecosystems. What can be done to include the underground water and fish in this? This is also a big topic in Big Bend area. This may be covered in the resource goal as "aquatic and riparian diversity." But it may be necessary to add this to stressors.

Relationship of groundwater and surface water: In the desert we are accustomed to only looking at surface water. Challenges include using more water than we should be permitted to use and creating a deficit. In Big Bend participants are working with people about their perception of water – big issue about how to reach these people. Many people don't have understanding of relationship of surface water contamination and subsurface issues.

Perceptions about appropriate uses of water: Some of the public and authorities in Mexico have the perception that environmental/ecosystem uses of water (i.e. to promote resilience, river conservation, flows) are "wasted." While the government may still hold this view, there are new focus areas in the government (CONAGUA) that support ecosystem uses for water. The group agreed that this perception exists in both countries to some extent, although we are now seeing movement away from this.

In California there are laws related to bypass flows and habitat. There has been and should be evaluation of the values of flows for recreation, fisheries and the types of beneficial uses where bypass flows are necessary. It's important to define the economic benefits, tourist benefits, etc. of ecosystem uses of water. A standard indicator(s) across the LCCs would be useful.

High Impact Stressors and Pressures Affecting Springs and Streams

Participants reviewed the previously created list of 14 main stressors and pressures and 75 associated sub-stressors and sub-pressures (Appendix xx). The following table lists stressors and pressures in order of prioritization by the group. Those in bold were discussed in detail. Those in italics were added by the group.

SPRINGS	STREAMS
• **Decreasing water availability (including timing), affecting aquatic and riparian habitat** • ***Reduced water quality*** • *Change in land use* • *Lack of forest conservation leading to diminished base flows due to less infiltration* • Changes in ground water recharge • **Increased groundwater pumping** • Invasive species • *The loss of the traditional socio-ecological system and ancestral knowledge* • *Lack of regulations for priority hydrological areas and strategies* • Livestock, farming and ranching • *Connectivity between groundwater and surface water* • Climate change – changes in timing/intensity of flooding which affects structure and hydrology • *Vegetation – structure and species composition* • Changes to soil temperature and soil moistures • *Changes in use (groundwater, industrial, urban, etc.)* • *Reduced habitat* • *Connectivity (surface/ground water)*	• Altered hydrology (e.g., flow regimes, including changes in peak flow) • **Decreasing water availability (including timing), affecting aquatic and riparian habitat** • **Increased groundwater pumping** • Increased length, frequency and intensity of drought • Decrease in water availability to the ecosystem • Uncoupling of community relationships (e.g., host plant-insect, predator-prey relations, trophic or phenological mismatch) • *Degradation and deforestation of upper watersheds* • *Lack of forest conservation diminishes base flow due to less infiltration* • *Invasive species (flora and fauna)* • *Reduced water quality; contamination* • *Hydroagricultural infrastructure* • *Effects of climate change* • *Connectivity (flow, lateral, surface to ground)* • *Increased soil salinity* • *Increased sedimentation* • *Livestock, farming and ranching* • *Reduced habitat* • *Vegetation (structure species composition)* • *Annual and perennial non-timber crops*

Participants noted that invasive species was identified as a high impact stressor for springs, but not for streams, however, invasive species is the most frequently cited by researchers in terms of negative impacts to riparian areas. Because management of invasives is not just local, it is a good opportunity to work together. In Mexico there is a big invasive fish species issue that is a secondary effect from government programs that promote these invasive species

Special Considerations for Springs

Planning at the watershed level: One of the biggest errors in water planning (including springs, streams, and riparian areas) is to look at them in isolation. Participants stressed the importance of working together at the *landscape level* for the overall management of the ecosystem. This includes recognizing the connection between ground and surface water, which is of particular importance in the desert.

Human dimension challenges: Participants discussed a number of human dimension challenges or stressors on springs and riparian areas. One stressor noted was the loss of traditional knowledge. They also mentioned that a lack of regulation can lead to abuse of these areas, for example in the U.S. an abuse of dry arroyos on private land.

Recognize environmental uses of water: Aguascalientes participants stressed that environmental uses of water are not widely recognized or valued. This is problematic when attempting to protect these critical ecosystem services. Mechanisms that redistribute economic benefits of water (i.e. payment for ecosystem services) may be an effective way of helping achieve this.

Invasive species: Invasive species have a particularly high impact in riparian areas. Because management of invasives is often indirect, and not local, participants felt this presents an ideal opportunity to work together in a larger landscape for maximum impact.

Special Considerations for Streams

Perceptions about water use: Participants discussed challenges presented by perceptions of appropriate uses of water. There are still some agencies and people in both countries who feel environmental/ecosystem uses (i.e. bypass flows) of water are wasted. It is important to continue challenging this perception.

Lack of planning and research: There is a lack of long-term planning for streams, particularly in light of climate change, and many policies are out dated. There is also a lack of studies on the effectiveness of government policies in promoting sustainability. Scientific studies are not accessible to the general public.

Management Objectives and Adaptation Strategies

Participants discussed ideas and strategies for addressing three high impact stressors affecting springs, streams and associated aquatic and riparian habitat.

Stressor: Decreasing availability of water (*This stressor was identified as high impact for both springs and streams)*

- Identify and educate on the value of ecosystem services provided by springs and streams.
- Work for policies that secure water for the environment.
- Support and promote water harvesting in urban planning.
- Stream restoration work focused on addressing over-logging.

Stressor: Increasing groundwater pumping (*This stressor was identified as high impact for both springs and streams*)

- Long-term planning that incorporates desired future conditions and an assessment of different sources of pumping

- Work with water districts to change the regulation of water (management of agriculture is not regulated).
- Improve efficiency of water use – water harvesting, water recycling, increasing irrigation efficiency
- Transition to crops that require less water
- Water banking to help control the balance of groundwater

Stressor: Reduced water quality *(This stressor was identified as high impact for springs*)

- Increase public education and awareness
- Increase supervision/regulation about where wastewater is going
- Look for common strategies amongst different disciplines – Water quality is a health issue as well.

Aguascalientes participants spent five minutes writing short statements about the goals of their own work related to springs, streams and associated aquatic and riparian habitat. These were collected:

- The DLCC goal is compatible with the California State Wildlife Action Plan, differences are:
    - In regional strategies we specify key ecological attributes to direct the improvement of the ecosystems.
    - Aspects of human dimensions are only in high level goals
    - These key attributes are standardized across the state and across the vegetation communities.
    - Stressors/pressures are also standardized as above.
- Springs
    - Protect biodiversity at springs
    - Protect functioning springs as climate refugia
    - Restore non-functioning springs to support species
    - Protect riparian corridors for movement of wildlife
    - Understand indigenous values of springs and their use of springs to inform ecological goals
- Working on resilience
    - Water supply and demand studies under historic and future projected climate conditions
    - Studying the impacts of special reservoir release hydrographs on native/invasive species
    - Real-time streamflow monitoring
    - Drought conservation planning
- Sustaining functional stream ecosystems that support <u>native</u> aquatic and riparian biodiversity (values should include recreation, fisheries, and cultural uses).
- Underground aquatic ecosystems
    - Conserve underground aquatic ecosystems, not just the above ground
    - Biologic inventories of underground aquatic ecosystems in Aguascalientes
    - Implement a sustainable administrative plan for the watersheds in southern Chihuahuan desert (underground and above ground)
    - Leveraging resources (technological, human and political) for the integrated conservation of the watersheds in the southern Chihuahuan desert (south of S.L.P., Zacatecas, Aguascalientes and Jalisco)
- Secure water for coastal environments and ecosystems, as well as aquifer recharge
- Ecosystem restoration

- Good science for decision makers
- Articulate impacts
- Characterize groundwater dependent ecosystems
- Have ecological flow the river needs in order to maintain its ecosystem and functions
- Ensure conservation of water recharging spaces through conservation of forests in the area. This will allow the presence of springs, which are a product of underground discharge.
- Rational management of water use to support conservation of biodiversity and ecosystem services through: public policy: water rights, volume management; restoration and management of recharge areas and wetlands; governance

Strategic Opportunities to Work Together for Greater Impact

Aguascalientes participants stressed the importance of finding allies and formalizing alliances to help ensure long-term sustainability. This includes identifying common goals with partners across all sectors and disciplines. The group discussed the need to improve communication and education with the general public. "We need to seek out best practice examples of how to most effectively communicate research talk to public and decision-makers." This is particularly important in terms of communicating the results of monitoring and the likely impacts of climate change.

Participants also suggested that the worldwide trend towards cuts in the environmental sector could be seen as an opportunity to combine efforts, look for strategic partnerships, and start meaningful grassroots work. Helping to form partnerships and alliances, and highlighting work happening at the local level, are all appropriate roles for the Desert LCC.

Appendix C: Streams, Tucson Workshop

Summary and Key Findings

The following information on springs was developed at the Desert LCC hosted Landscape Conservation Design workshop in Tucson Arizona. Streams breakout group participants in Tucson included a mix of representatives from research institutions, a diversity of U.S. federal and state agencies, U.S. local government, Native Nations, and conservation organizations. Please note that Springs and Streams were a combined breakout group in Aguascalientes and Aguascalientes participants are listed with the springs breakout group.

Participants discussed the streams goal: **Resilient and functional stream ecosystems that support native aquatic and riparian biodiversity, natural ecosystem processes and services, and sustainable use.**

They noted a need to be clear about what streams we are referring to, perennial, ephemeral, intermittent headwater, natural vs. functional, etc. Participants choose to focus breakout group discussion on the following high impact pressures and stressors:

- Decreased water availability
- Increased habitat loss/fragmentation (including human uses like development, immigration, and recreation)
- Invasives (non-natives, undesirable natives)
- Altered hydrology
- Climate variability

Similar to discussion in the springs breakout group, participants brought up the importance of the nexus between groundwater and surface water in streams. Also similar to discussions about springs and streams at the Aguascalientes workshop, Tucson participants noted the need to develop and utilize policies/procedures to conserve water for the environment, and to invest water saved through efficiencies back into streams.

Participants identified a diversity of management objectives related to the above listed high impact pressures and stressors. Recurring themes included: identifying acceptable “base flow” to support ecosystem function and protecting it through policy, regulation, voluntary water conservation, protection of groundwater, habitat restoration and other means; the importance of streams in supporting riparian habitat and the importance of riparian habitat in for wildlife connectivity; addressing decreased water availability by promoting recharge through restoration and other efforts, increasing efficiency of water-using activities (e.g. agriculture), decreasing or at least not increasing groundwater pumping, and by developing and utilizing policy mechanisms to secure water in streams and for the environment; and understanding riparian areas status and key habitat areas in order to prioritize protection and restoration activities. Generally adaptation strategies discussed for streams include a combination of developing and implementing policy/regulatory tools to preserve land and water and on the ground work focused on restoration and recharge in specific areas.

Participants repeatedly identified the need for multiple agencies and entities to be working across jurisdictions to address stream needs. There were clear links between threats and potential adaptation responses for streams and those for grassland/shrubland highlighting the importance of considering all of these systems together.

Streams - Tucson Breakout Group Participants

Note: Aguascalientes breakout group participants are listed with Springs group, as these resource topics were combined in Aguascalientes.

- Aaron Wilkerson, *Bureau of Land Management*
- Ben Lomeli, *Bureau of Land Management*
- Bill Radke, *U.S. Fish and Wildlife Service*
- Chris McVie, *Tucson Audubon Society*
- Colleen Dwyer*, U.S. Bureau of Reclamation*
- Diane Lausch, *Lower San Pedro Watershed Association*
- Elaine Johnson, *U.S. Fish and Wildlife Service*
- Elna Otter, *Lower San Pedro Watershed Association*
- Erica Stewart, *Bureau of Land Management*
- Jeannie Wagner-Greven, *U.S. Fish and Wildlife Service (retired)*
- Jennifer Holmes, *Northern Arizona University - Colorado Plateau Research Station*
- Jessica Fraver, *Arizona Land and Water Trust*
- Jon Cooley, *Arizona Game and Fish*
- Julia Fonseca, *Pima County*
- Junko Hoshi, *California Department of Fish and Wildlife*
- Kelly Mott-Lacroix, *Arizona Water Resources Research Center*
- Kenneth Nowak, *U.S. Bureau of Reclamation*
- Larry Fisher, *University of Arizona – School of Natural Resources and the Environment*
- Martha Cooper, *The Nature Conservancy*
- Matt Clark, *Tucson Audubon Society*
- Matthew Johnson, *Northern Arizona University*
- Noe Santos*, U.S. Bureau of Reclamation*
- Norm Meador, *Cascabel Conservation Association and Lower San Pedro Watershed Association*
- Pamela Nagler, *U.S. Geological Survey*
- Peter Else*, Lower San Pedro Watershed Association*
- Sally Hejl, *National Park Service*
- Scott Wilbor, *Cascabel Conservation Association*
- Seth Shanahan, *Southern Nevada Water Authority*
- Tricia Gerrodette, *Huachuca Audubon Society*
- Tzeidle Wasserman, *Ecological Restoration Institute*

Stream Goal

Participants were asked to reflect on the stream goal statement and provide feedback.

Goal: Resilient and functional stream ecosystems that support native aquatic and riparian biodiversity, natural ecosystem processes and services, and sustainable use.

Participants in Tucson discussed the need to be clear about what streams we are referring to, perennial, ephemeral, intermittent headwater, natural vs. functional, etc. Participants generally agreed for discussion "streams" includes perennial, ephemeral and intermittent.

High Impact Pressures and Stressors Affecting Streams

Participants reviewed the previously created list of 14 highest impact pressures and stressors and associated sub-pressures and stressors as identified by initial results of a survey to prioritize these (see Appendix D). They prioritized the follow pressures and stressors for the purpose of continued work and discussion at the workshop. Pressures and Stressors are listed in order of prioritization. Those in bold were discussed in detail. Those in italics were added by the group.

- **Decreased water availability**
- **Increased habitat loss/fragmentation (including human uses like development, immigration, and recreation)**
- **Invasives (non-natives, undesirable natives)**
- **Altered hydrology**
- **Climate variability**
- *Phenological changes*
- *Altered water quality*

Management Objectives and Adaptation Strategies

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Habitat loss/fragmentation	**Enforcement** ● Develop/continue/increase enforcement of regulations for habitat protection	Current ● Develop and submit comment packages to regulating authorities regarding sustainable use of riparian resources for specific proposed actions ● Work with federal agencies (DHS) to work through the NEPA process in an efficient manner rather than legislate circumvention of environmental laws New ● Complete vegetation data across all land status of the riparian area to accurately plan into the future
	Education and Outreach ● Encourage voluntary reductions in water use ● Public outreach and education to influence surface/groundwater interaction ● Promote water conservation	Current ● Restore natural contours to springs and spring outflows ● Acquisition of water rights for the environment New ● Mitigate the effects of over-pumping by managed recharge and other practices
	Livestock Management ● Keep cows/ORVs out of riparian area	Current ● Ranch conservation program, Pima County ● Careful control of cattle with fencing to protect riparian vegetation, Cascabel, Saguaro-Juniper Corp.
	Development ● Configuration of any development to avoid/minimize/mitigate – including wildlife crossings/connectivity ● Halt developments that fragment habitats and corridors	Current ● Fight habitat fragmentation by opposing roads, Cascabel Conservation Assn., Lower San Pedro Conservation Alliance ● Ranch conservation efforts, Pima County ● Conservation land system guideline, Pima County ● Native plants program, Pima County ● (Current and new) Provide opportunities for industry and private landowners to contribute to long-term conservation (e.g., CCAAs - candidate conservation agreements with assurances), AGFD

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Habitat loss/fragmentation continued	**Rehabilitation** ● Burned area rehabilitation to reduce current and new invasive species ● Reduction in total impact area while it's temporary, instead of long-term /permanent impacts	Current • Identification of key habitat areas including critical habitats and wildlife corridors (multiple entities) • Bird surveys in important bird areas (encouraging citizen science), Tucson Audubon • Conservation acquisitions (easements, fee), ALWT • Purchase land in riparian corridors, TNC • Develop and implement monitoring programs for wildlife in key habitat and connectivity corridors, LSPWA • Develop new opportunities for conservation easements and educational centers • Pima County/COT, Conservation Lands System, MSCP implementation, conservation effluent pool • Coalition for Sonoran Desert Protection – land use planning, wildlife corridor protection/restoration
	Restoration and Protection ● Prioritize landscape linkages & ensure habitat ● Ecological reconciliation through urban and wildland bird habitat creation/restoration ● Prioritize landscape linkages and ensure conservation of connectivity ● Restore native riparian vegetation and wildlife ● Protect important bird areas from threats ● Avoid/minimize/minimize impacts to CLS ● Maintain wildlife corridors and habitat connectivity to promote viability of native species across range (historic) ● Protection of riparian/floodplain habitat - which buffers effects of altered hydrology	Current ● Implement species conservation plans among landowners that directly influence habitat/ecosystem integrity, AGFD ● Reclamation with states of multi-species conservation plan, (BOR and States) ● Work with federal, state and private landowners to protect landscape-level ecosystems and sustainability on 800,000 acres in SE AZ/SW NM, Malpai Borderlands, USFWS, NRCS, USFS ● Flood control riparian restoration program, Pima County ● Removing tamarisk, planting cottonwood, willow, altering flows to improve restoration outcomes ● Monitoring effects on SW Willow Flycatcher and yellow-billed cuckoo, Matthew Johnson, Gila Watershed ● ACE ILF mitigation for 404 impacts, Tucson Audubon, AGFD

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Habitat loss/fragmentation continued	**Water levels** ● Maintain groundwater levels to sustain riparian vegetation by minimizing water use ● Maintain natural flows that support native species	None identified
	Land Conservation ● Establish conservation easements to help maintain habitat connectivity ● New deed restrictions and/or conservation easements ● Preservation/restoration of riparian habitat through land acquisition ● Protect key open space/wildlife movement corridors and habitat (long-working ranches) ● Protect important habitat areas for key species (e.g., critical habitats) ● Establish a refuge on the lower San Pedro River to protect riparian habitats	None identified
Decreased Water Availability	**Base flows** • Maintain base flow through fewer users and land acquisition • Protect base flows to river, regional aquifer sustainability • Maintain flows in the river, rather than 100% diverted • Maintain/increase instream flows	• Quantified groundwater storage in relation to floods, flow pulses, and downturn of storage, TNC, NMDF • Promote unused water for conservation • Litigate federal reserve water rights for riparian areas, Pima County • Water impacts review of proposed developments, Pima County • Improve agricultural water management and infrastructure improvements, TNC, Verde • Monitoring and reporting, Pima County
	Promote Recharge • Increase groundwater recharge by holding water on the landscape • Low impact development • Water harvesting • Enhanced recharge	Current ▪ Recharge projects, both stormwater and wastewater, to maintain riparian conditions, TNC, BLM New • Use checkdams/water retention structures in smaller drainages, Cascabel Conservation Association • Examples of watershed based water harvesting techniques, Josiah and

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	• Watershed improvements • Watershed-based water harvesting techniques and erosion control • Increased soil moisture, instream flows, and rainwater harvesting • Install/maintain erosion control structures to maintain water on the landscape • Properly functioning watersheds and aquifers produce a natural and sustainable rate of sediment and water availability and maintain good water quality base flows.	Valer Austin Ranches, Cuenca Los Ojos, SIA, Tucson Audubon, Borderlands
	Efficiency • Increase availability through efficiency • Increased water efficiency and water management by the ag sector • Promote crops that are compatible with water availability • Line canals to reduce water seepage to increase water accountability • Ensure water availability for sustainable human needs at critical times	Current ▪ Dust on snow research, forestry management practices, weather modification, BOR • Fund water conservation and reductions in water use
	New Science • Map sources of streams and characterize behavior • Identify relationships between water availability and riparian vegetation and wildlife	None Identified
	Flow Management: provide more effective hydrodynamic	• Water impact reviews during reviews for new development • Monitoring and reporting • Risk assessment • Conservation effluent pool

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Water Rights: Acquire water rights	Current • Sever/transfer ag water rights to instream flow, Salt River Project • Instream flow water rights, Pima County • Alter ADWR policy to provide more credit for instream recharge, process instream flow applications New • Establish federal water rights in our most critical and biodiverse riverine ecosystems • Change State water laws to effect better water conservation, DWR, other organizations • Change AZ water law to recognize relationship between surface and ground water
	Land Conservation: Protect and conserve riparian corridors	Current • Protect/restore riparian and wetland habitat that helps store groundwater and release it slowly (store water in the aquifer, rather than reservoirs), TNC preserves • Acquire and manage land along important riparian areas, Pima County
	Decrease groundwater pumping • Decrease groundwater withdrawal to sustainable levels • Prevent new landscape-scale groundwater pumping • Encourage reduction of groundwater pumping in shallow groundwater areas	Current • Promote rainwater harvesting • LID (low impact development) – recharge enhancement, net-zero development codes, stormwater harvesting regulations, conjunctive management of surface and groundwater • Groundwater monitoring and modeling – water conservation, effluent reuse and recharge, groundwater recharge, outreach, education • Rainwater harvesting and protection of shallow groundwater areas by decreased groundwater pumping (City of Tucson, Tucson Water) New • Short-term water conservation transactions with farmers, ranchers – forebearance agreements, changes to more water efficient crops or irrigation systems, ALWT • Groundwater mitigation banking to benefit streams (transactions)

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Partnership and coordination: Work with partners to add water back into the system and focus restoration efforts at/near those locations	Current Collaborate with water rights owners on water and resource conservation planning, SIA
Invasives (non-natives, undesirable natives)	**Restoration** ● Burned area rehabilitation post fire to reduce invasives, both current and new populations ● Restore native vegetation along Gila River (200 acres) in anticipation of tamarisk beetle ● Restoration of native riparian vegetation and ecosystems by removing tamarisk and altering hydrology ● Restore/increase native riparian habitat – primarily cottonwood and willow (along Lower Colorado River) ● Manage buffelgrass to maintain ecosystem structure and function	Current • Create regional watershed-level management plans (current and new) • Non-native aquatic fish removal, NMGFD • Buffelgrass removal and weed ordinance, Pima County • Reduce invasives through various means (herbicides, mechanical treatments), AFWD, BOR • Plan and implement collaborative restoration projects, LSP watershed alliance • Remove invasive species to replace with natives • Removing tamarisk, restoration of cottonwood and willow habitat, Gila Watershed Partnership • Monitoring effects on SWFL and yellow-billed cuckoo, Matt Johnson, GWP • Changing hydrology to improve restoration outcomes
	Identification and Science ● Mitigate adverse impacts (risks) from invasive species upon native species ● Connect native plant experts/enthusiasts to encourage learning and leverage resources ● High resolution mapping of native vs. invasive species; quantify there water use ● Identify regions with future altered climate that would rapidly benefit native species ● Maintain natural flows to support native species	Current • Promote understanding of the impact of invasive species to the ecosystem, including ecosystem services • High resolution mapping of non-native species • Develop and enhance capability to detect introduction of new species • Track movement of leaf beetle New • Get science results on riparian water use out to broader audience than the science literature currently allows
	Livestock Management: Keep cows and ORVs out of riparian areas	Current • Water for wildlife on ranches • Monitor for cows and ORVs in riparian areas

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Altered Hydrology (flows, eco-flows, land-use planning)	**Functioning Aquifers:** Proper functioning of aquifers and watersheds that yield a natural rate of sediment and high quality water to maintain sustainable baseflows	New ● Commit to net zero water use going forward (no new groundwater depletion)
	Land Use Planning ● Watershed-based harvesting techniques, erosion control, increase soil moisture and instream water flow ● Minimize floodplain encroachment to protect people ● Create setback levees ● Encourage low impact development (Pima County) ● Minimize impacts to groundwater recharge functions due to floodplain development	Current ● Limits to encroachment of flood plains and erosion hazard zones – land acquisition in flood plains, hydrological analysis, LID manual, Pima County ● Removing sub-division that are vulnerable ● Protect increasingly scarce riparian wildlands ● Partnering to combine funds to implement objectives ● Planning projects with multiple use benefits, LCR partnerships
	Flows ● Protect base flows (aquifer to stream) ● Maintain natural hydrograph, floods and flow pulses ● Restore stream variability ● Reduce losses due to erosion through erosion hazard setbacks	Current ● Improved 1 – 2 year forecasting/water availability, BOR, NOAA, others ● Conduct field-based assessments of current hydrological conditions, TNC, Pima County ● ACE LIF mitigation for 404 impacts in Southeast AZ, Tucson Audubon, AGFD ● Evaluate opportunities for beaver restoration, AGFD New ● Mimic natural flow regime on dammed or altered river systems ● Monitoring of existing beaver restoration to understand whether it helps water availability or promotes invasives , AGFD ● Water harvesting requirement for development – education and outreach, native plant and gardening ordinance, watershed and stream restoration, riparian protection ordinances, conjunctive management of surface and groundwater ● Natural Channel Design projects/structures designed to spread water out, soak in, and reduce accelerated erosion, Tucson Audubon/Borderlands Restoration

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Ecological Flows ● Robust operations to meet flows for endangered species ● Identify critical levels of alteration that would yield a significant impact to landscape, wildlife, and ecosystem services ● Ensure water availability for key ecosystem functions and services at the critical "phenological" stages ● Consider flow quantity and annual variability in understanding ecological flow needs	Current ● Describe flow needs of riparian and aquatic species, TNC ● Pulse-flow opportunities on Lower Colorado River (current and new), BOR/Mexico ● Flow recommendations for T and E species (Current and new) ● Binational cooperation to promote environmental restoration through river operations, BOR
Climate Variability	**Cross-Sector Planning** • Adjust restoration design to the current and/or future system needs for natural/minimal human management • Reliable delivery of water for human and ecosystem needs • Help agriculture and urban sectors plan/prepare for more erratic water supply • Integrated planning (data integration, landscape-level approach, upstream-downstream coordination, collaboration)	Current ● Align similar efforts to reduce redundancy, and set aside the funding/HR for collaboration costs ● Set up monitoring protocols to integrate data at regional scale, and see relationship of climate exposure and response ● Long-term planning and partnership building, BOR/partners ● Create long term water use plan ● Develop watershed-wide monitoring effort – "State of the Watershed" (Current and New), Cienega Watershed Partnership
	Other	Current ● Climate science research (BOR/NCAR) – downscaling, hydrology monitoring, ensemble development guidance ● Study and promote climate change research in CO basin (BOR) ● Conservation easements, coupled with safe harbor agreements with private landowners along the Leslie Creek watershed in the Chiricahua Mountains to maintain endangered species habitats being impacted by climate change (drought) USFWS ● Bird surveys – migration, timing, phenology – to inform climate response, indicators of habitat status , Tucson Audubon

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
	Increase groundwater recharge Slow runoff, increase groundwater recharge, provide for overbank flooding	See section on Decreased Availability of Water above
	Thermal refuge Provide riparian cover to create thermal refuge	None Identified
	Species Support • Recover beaver population • Migration timing/phenology informative, climate response. Indicators of habitat status (Tucson Audubon bird surveys)	None Identified

Strategic Opportunities to Work Together for Greater Impact

- Creating/maintaining strong relationships with water users
- Need to work together to change State water law regarding connection between surface and ground water
- Work with educators to produce videos, etc., that communicates water science to schools
- Enhanced collaboration among NGOs, and between NGOs and agencies – for on-the-ground restoration work, conservation, monitoring

Gaps/Needs to Improve Management

- Identify the relationship between water availability and riparian vegetation/wildlife
- Continuous vegetation data/habitat types from LCR/Lower Gila and transition into Sonoran Desert
- Downscaled projection of flows (current BOR scale too large – what is the desirable resolution?)
- Central information database
- What is the response of species/systems to climate change?
- Analysis of existing data (riparian/stream) to share across partners
- Spatially explicit data on distribution of species and habitat
- Explore appropriately priced water – water markets (Kathy Jacobs, Robert Glennon)
- Wildlife corridors/linkage planning at county level
- Baseline surveys for vegetation/wildlife
- What is best way to do restoration? Analysis of lessons learned from partners doing this work (what works best/what doesn't work)
- Working group/database to share and communicate lessons learned
- Research on mesquite (Why some are dying off? How do we ensure diversity without stopping planting of some species? Ensuring diverse seed sources?)
- Ag irrigation structures (pros and cons) – permanent diversion structures
- Investigate the functionality of "detention basins" in truly benefiting groundwater recharge.

Available Information and Resources

- California State Wildlife Action Plan 2015 update (chapters 5, 6) addresses CA deserts, has stress/pressures, key ecological attributes, and strategies for desert wash, riparian, scrub, alkaline wetlands, springs/cienegas
- Pima County's Sonoran Desert Conservation Plan library, draft MSCP – stressors, key ecological attributes, strategies, socio-economic data
- TNC ecoregional assessments – Apache Highlands (contact Dale Turner, Rob Marshall, Jennifer Ruyle)
- TNC priority areas for restoration

Appendix D: Grasslands, Tucson Workshop

Summary and Key Findings

The following information on springs was developed at the Desert LCC hosted Landscape Conservation Design workshop in Tucson Arizona. Grassland breakout group participants in Tucson and Aguascalientes included a mix of representatives from research institutions, a diversity of U.S. federal and state agencies, U.S. local government, Native Nations, and conservation organizations as well as a private land owner.

Participants discussed the following grassland goal statement: **A desert landscape that sustains high-functioning grasslands that provide ecosystem services to support human cultures, native species, and ecological processes.**

They talked about the need to better define what "high functioning" means for grasslands, as well as possibly focusing on "economic vitality" rather than the less specific idea of "human cultures." Participants choose to focus breakout group discussion on the following high impact pressures and stressors:

- Spread of invasive non-native and undesirable natives
- Unsustainable grazing
- Changes in biotic community composition
- Changes in habitat connectivity
- Altered fire regimes

Participants noted that changes in community composition goes beyond undesirable natives or non-natives increasing, it also includes native species shifting range. Participants showed a strong and detailed understanding of how altered fire regimes are changing grassland ecosystems but did not discuss management objectives and adaptation strategies to address these changes in detail. This may be an important gap in grassland conservation and restoration

Participants identified a diversity of management objectives related to the above listed high impact pressures and stressors. Recurring themes included: importance of supporting the rehabilitation of native plant communities; and ongoing need to understand what grazing carrying capacity, regimes and practices will support desired grasslands species and structure; ensuring grazing management practices are wildlife friendly; maintain unfragmented grasslands wherever possible, and utilizing restoration techniques to restore native plant communities and control erosion.

Many of the identified adaptation strategies for grasslands were focused on developing information and monitoring necessary to support the goal and management objectives. Examples include: understand relationship of prescribed fire with invasive grass species cover, understand vulnerability of species to increased temperature and evapotranspiration, develop and recommend sustainable grazing management plans, identify grazing regime/practices that maintain functioning ecosystems, when invasion can't be reversed, look at how new community provides ecological function.

Grasslands – Tucson Breakout Group Participants

- Allison Shaw, *Rocky Mountain Bird Observatory*
- Amelia Underwood, *Bureau of Land Management*
- Bill Lamb, *Quadstate*
- Cameron Becker, *Arizona Land and Water Trust*
- Carianne Campbell, *Sky Island Alliance*
- Carol Beardmore, *Sonoran Joint Venture*
- Elroy Masters, *Bureau of Land Management*
- Esther Rubin, *Arizona Game and Fish Department*
- Frances O'Donnell, *Northern Arizona University*
- Holly Barton, *Tohono O'odham Nation*
- Homer Mills, *02 Ranch*
- Jennifer Ruyle, *Coronado National Forest*
- John Munderloh, *Town of Prescott Valley*
- Juan Carlos Bravo, *Wildlands Network*
- Karen Simms, Bureau of Land Management
- Kathryn Thomas, *U.S. Geological Survey*
- Lawrence Yazzie, *Bureau of Indian Affairs*
- Marcos Robles, *The Nature Conservancy*
- Pam Benjamin, *National Park Service – Intermountain Region*
- Rana Tucker, *Arizona Game and Fish Department*
- Rance Marquez, *Bureau of Land Management*
- Roy Averill-Murray, *U.S. Fish and Wildlife Service*
- Ruben Cu:k Ba'ak, *Tohono O'odham Nation*
- Russell Martin, *Texas Parks and Wildlife*
- Sally Flatland, *U.S. Fish and Wildlife Service*

Grasslands Goal

Participants were asked to reflect and provide feedback on this draft goal statement.

Goal: A desert landscape that sustains high-functioning grasslands that provide ecosystem services to support human cultures, native species, and ecological processes.

Participants discussed needing to better define "high functioning" as compared to functioning, as functioning may be limited by parent soil or other site conditions. "High functioning" might be better replaced with "sustainable" or "resilient" in order to be less vague. There was a suggestion to replace vague "human cultures" with "economic vitality." One participant noted we shouldn't be limited to "desert" grasslands, since we want to include subalpine grasslands.

High Impact Stressors and Pressures Affecting Grasslands

Participants reviewed the previously created list of highest impact pressures and stressors and associated sub-pressures and stressors as identified by initial results of a survey to prioritize these. They then prioritized the follow pressures and stressors for the purpose of continued work and discussion at the workshop (bolded items denote highest priority for participating group). Additional stressors added by the group are shown in italics.

- **Spread of invasive non-native and undesirable natives**
- ***Unsustainable grazing***
- **Changes in biotic community composition**
- **Changes in habitat connectivity**
- **Altered fire regimes**
- Decrease in water availability
- Increased length, frequency, and intensity of drought
- Warmer temperatures
- Desertification
- *Changes in habitat connectivity*
- *Increased temperatures*

Management Objectives and Adaptation Strategies

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Spread of invasive non-natives and undesirable natives: ● fire increases beyond natural (pre-historic?) levels ● invasive woody species reduce groundwater recharge ● increase in woody native species reduces open grasslands, affects plant & wildlife habitat characteristics, and may lead to loss of open grassland species	**Reduced encroachment of woody species:** ● reduction of invasive natives ● At LCNCA, <5% canopy cover, up to 5-10% basal perennial grass cover, depending on ecological sites ● watershed restoration by mechanical removal of woody invasive species ● Develop & implement habitat management projects to control invasive brush species on private lands	Current ● mechanical mesquite removal, herbicide resprouts, prescribed fire to maintain, monitor ● Provide landowner incentives to address invasive plant species on their land ● chemical/mechanical control of undesirable natives on selected soil sites (Lykes) ● Cutting and stockpiling biomass from invasive woody plants ● Developing marketable use of biomass from woody plans ● Changing state land policy for removing woody veg New Evaluate watershed/NCA for restoration needs (landscape eval) using tools such as Lidar, satellite, etc. with ground truth
Spread of invasive non-natives and undesirable natives: ● land out of possible production means reduction of income stream. Also, recovery of restoration costs is unobtainable in many cases. ● loss of species and genetic diversity to build/maintain resilient communities ● invasive shrubs reduce carrying capacity of grasslands for birds of management concern ● reduced quality of habitat for obligate species ● invasive species = unnatural fires = more invasive species ● Lehmann's lovegrass becomes majority cover type in some pastures ● suppressed diversity of native species ● invasive plant species degrade habitat quality for wildlife (e.g. reduced palatability, reduced forage quality, etc.)	**Restore Native Species/Communities** ● Creating islands of diverse native vegetation within areas of heavy infestation ● maintain sufficient habitat to overwinter current population of Baird's sparrow	Current ● Citizen science projects to document changes and remove invasives (SIA) ● Build a collective will to use effective tools safely, i.e. herbicides ● Map priority invasive species to determine best and most effective locations to expend resources ● Bring together science knowledge to guide removal and control strategies to reduce invasive species (don't know if current or new) New ● When invasion can't be reversed, look at how new community provides ecological function and processes Purchase and loan to ranchers mechanical shrub/brush cutters because demand exceeds equipment available (RMBO)

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Spread of invasive non-natives and undesirable natives: ● decision makers' inability to get on the same page in terms of who's wrong or who's right. These are rangers, government agencies, community officers, etc. ● lack of public awareness & education contribute to increase of invasives ● multiple jurisdictions affect effectiveness of invasive species management (i.e. right of ways)	**Increase Understanding** ● understand interactions between invasive and native species understand feasibility of biological control	Current ● monitoring with GPS (current) ● Survey and monitor buffelgrass and other invasives - interagency collaboration ● conduct routine inventory and monitoring of invasives and attack early and often ● reduce soil disturbance, and other BMPs, for all projects (SIA) New ● assessment of buffelgrass control opportunities in Sonora (New - Wildlands Network)
Unsustainable Grazing: ● removing too much biomass (forage) from grasslands repetitively will kill grasses ● livestock may selectively remove native species, changing plant composition ● produces negative effects to plant communities rather than positive ● associated with unsustainable carnivore management ● inability to implement effective treatments to provide for livestock deferment/ rest ● loss of protective groundcover and increasing erosion ● overgrazing eliminates wildlife habitat (e.g. reduced forage availability & cover, direct competition,) ● grasslands degraded or converted due to unregulated usage from individual ranchers ● negative image for ranching/grazing community ● opportunity cost to landowners -lost revenue due to deferral/removal of livestock ● soil compaction ● reduced cover of native vegetation ● reduces % of grass and height which decreases capacity for most grassland birds results in less habitat structure and fewer food items	**Increase sustainable grazing** ● improve grazing lands on 500,000 ha in Valles Centrales & Janos, Mexico ● grazing that varies by soil type & grassland productivity ● alter grazing methods from free range to more sustainable methods ● help achieve sustainable grazing through adaptive multi-paddock grazing, sequestering carbon back into soil, help restore healthy soil onto Tohono O'odham lands in both US and Mexico ● provide education on sustainable grazing practices ● manage livestock post-treatment until site reaches 30-50% herbaceous cover	Current ● Grazing deferral/rotation; total resto of about 285,00 acres (02 Ranch) ● Supporting sustainable grazing through improved infrastructure (fences, watering, etc.) (AGFD) ● Develop and recommend sustainable grazing management plans that are flexible and adaptive, on private land ● Conservation plan for carrying capacity ● Eliminate or mitigate restrictions to the use of grazing management practices that improve landscape condition ● Support in managing protected grasslands (private) (Wildlands Network) ● Hire private lands biologist to work on grazing management plans with ranchers and ejidos (RMBO) ● Participate in public comment process on Resource Management Plans (SIA) ● Identify grazing regime/practices that maintain functioning ecosystems New ● Secure funding to compensate ranchers that follow long term sustainable grazing management plans (New)

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Unsustainable Grazing	**Policy**	● Strengthen public policy support for long term commitments to working landscapes - stability in long term grazing permits New ● Reform grazing policies on public lands to target sustainability of grasslands
	Adaptive Management	Current ● Biological planning process to implement adaptive management of grazing and implement Coordinated Resource Management Plan (BLM, LCNCA) New ● Develop adaptive management strategic plan to tie in with ongoing restoration Implement pilot programs to test various ranching/grazing practices that allow resting periods and produce consistent landcover, and also restore the soil biodiversity on top as well underneath
Changes in Biotic Community Composition: lack of appropriate science leads to ineffective (or inappropriate) use of resources (staff & money)	**Increasing Knowledge and Tools** Understand soil microbes necessary to maintain sustainable grassland systems (and how this might change with changing climate)	Current ● Monitoring basal area cover, native and non-native species ● Incentivize restoration practices, i.e. make it easier for landowners to restore grasslands ● Increase awareness and knowledge of ava-fauna and bird-habitat relationships in grasslands. ● Understand vulnerability of species to increased temperature and increased evapotranspiration ● Citizen science efforts to document change and feedback to partners and agencies (Sky Island Alliance)
Changes in Biotic Community Composition: ● non-native competition against native species ● loss of keystone & extirpated species impacts grassland diversity & composition ● availability of restoration quality plant materials ● produces an overabundance of one species or monocultures	**Restore/maintain native community composition** ● Reintroduction of extirpated species, e.g. black-tailed prairie dogs ● Improve habitat conditions for grassland passerine birds ● Restore grasslands to stabilize and/or	Current ● Evaluate habitat for species reintroductions and work with AGFD and USFWS to reintroduce when suitable (BLM - Current/New) ● Use aeration implement to stimulate soil, retain moisture and increase plant diversity (USFWS) ● Combine mechanical treatment in grassland (i.e. mesquite

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
● loss of species diversity and functional groups ● reduced resiliency & increased vulnerability to stochastic events ● loss of suitable habitat for grassland species ● changing communities result in species losses or gains that often result in more generalists rather than endemics ● change to bottom line for private landowners	increase grassland bird assemblages ● Restore native grasslands to prevent local extinction of native species from unsustainable grazing ● Restoration for diverse native grassland habitat for native wildlife (grassland birds, including quail, and pronghorn, deer)	removal) with prescribed burning (USFWS) ● Collect seeds and work with local nurseries to produce restoration plant materials (SIA: Current - US, New - Mexico) ● Coordination of restoration across jurisdictions (Current/New) ● Restore "fertile islands of native species" (seeding/out-planting) within burned landscapes (USFWS - Current/New) ● Employ BMPs that lead towards desired community and condition (RMBO) ● Implement grass restoration program ● supporting rehabilitation of natural plant communities (brush management, seeding, grazing management, etc.) (AGFD) ● Increasing prescribed burns (02 Ranch) ● Work with partners on erosion control projects to benefit the entire watershed New ● Evolve management objectives from species composition to ecological function (TNC)
Changes in habitat connectivity: ● reduced permeability for wildlife migration & dispersal ● creates barriers to movement ● habitat fragmentation jeopardizes population viability of wide-ranging species (e.g. pronghorn) because inability to access resources or to adapt to climate change ● less connectivity results in insular populations & low genetic diversity ● adds stress and concentrates species, which can impact body condition and survival ● loss of connectivity results in loss of larger animals from grassland ecosystem.	**Address Infrastructure Issues**	Current ● change to wildlife friendly fence ● Support work to remove physical barriers between habitat patches, and increase number and size of habitat patches (AGFD) ● Wildlife passages across highways to counteract fragmentation (Wildlands Network) ● Development of additional water sources for wildlife ● Un-roading to repair watershed function and reconnect habitat ● Keep infrastructure projects away….intact landscapes ● Reduce fragmentation through conservation, aquisition, or restoration ● Work across jurisdiction to collect wildlife movement data and include crossings in linear projects (SIA)

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
		● Provide landowner incentives to modify fencing and make them wildlife friendly New ● Removal of border infrastructure (Wildlands Network)
Changes in habitat connectivity: adjusting to technology & policy, with no conscious connection to land, people stop caring what happens to it or how their food is produced, how energy is delivered to their home, and their individual impact to land in terms of voting with their dollars and lifestyle	**Connect people to the land**	New ● Design programs that produce role models in land management, grazing management, water management. Set the bar higher for these programs and get youth involved in hands-on opportunities, get community involved. Don't give up! (BIA)
Changes in habitat connectivity	**Preserve and Protect Land** ● preservation of open space and working landscapes ● conservation acquisitions and easements to improve connectivity and water/land function ● protected/important grassland designations ● Improve grassland condition for migratory birds across GPCAs ● Maintain and restore connectivity for wide-ranging species like pronghorn	Current ● land protection through facilitation of conservation easements and fee-title acquisitions (AZ land and Water Trust) ● Designate development areas and conservation areas to maintain connectivity in Mojave Desert (FWS) New ● Secure funding to preserve and restore high priority areas
Changes in habitat connectivity ● land protection through facilitation of conservation easements and fee-title acquisitions (AZ land and Water Trust - Current) ● Designate development areas and conservation areas to maintain connectivity in Mojave Desert (FWS - Current) ● Secure funding to preserve and restore high priority areas (new)	**Ecological Function**	None Identified

High Impact Pressure/ Stressor	Management Objectives	Adaptation strategies
Changes in habitat connectivity ● reduced ability of landscape to support rural livelihoods (ranching, farming, etc.) ● reduced capacity for landscape scale management (prescribed fire, livestock & wildlife management) ● fragmentation of ownership reduces ability to manage fire to restore grasslands	**Improved grassland condition**	Current ● Identify partners, funding and priority landscapes to implement conservation programs (RMBO - Current) New ● Identify high priority areas for conservation or restoration (New) ● Secure funding to preserve and restore high priority areas (new)
Changes in Habitat Connectivity	**Erosion Control**	Erosion control and arroyo restoration (Current/New)
Altered Fire Regimes: ● lack of fire leading to shrub encroachment, less grassland and less fire ● Increased fuel loads ● increased erosion ● increases or decreases in frequency & severity of fire alter infiltration capacity of soil and sediment loading in surface runoff ● fire benefits invasive exotic grasses and reduces chance of improving native grassland ● fire removes shrubs needed to sustain certain species ● fire doesn't impact mesquite long term and doesn't open up grasslands ● either grass/forbs end up too thick (or too thin) for survival of focal species	**Logistical Support for Burning**	Current ● return low-intensity fire as management and maintenance tool via policy change and land-owner acceptance (i.e. liability) ● Change policy to reduce liability of prescribed fire, and increase insurance options New Prescribed fire council for technical and logistical support for burning
	Education	New ● provide education on value of natural fire regime to support native plant community (dispel "fire is bad" myth) Public service announcements about smoke from managed/prescribed burns and the importance of burns to ecosystem health (New)
	Replicated Natural Fire Regimes Identify resilience as a new approach to fire management for grasslands and shrublands	Current ● break invasive grass/fire cycle (shrublands) ● understand relationship of prescribed fire with lovegrass increase New ● pre-emergent herbicide application along roads in shrublands (USFWS)
	Support Native Plant Community	None Identified

Special Considerations for Grasslands

- Some stressors are root causes, others are results of causal stressors, but in some situations causality may be reversed
- Changes in community composition is more than just undesirables increasing, it also includes native species shifting range
- Lack of awareness and bad public policy (e.g. fire suppression) and lack of enforcement of good policy are often the root cause of stressors, but these indirect causes should be addressed under strategies, not direct cause stressors

Appendix E: Grasslands, Aguascalientes Workshop

Summary and Key Findings

The following information on springs was developed at the Desert LCC hosted Landscape Conservation Design workshop in Aguascalientes, Aguascalientes (Mexico). Grassland breakout group participants in Aguascalientes included a mix of representatives from research institutions, Mexican and U.S. conservation organizations and a U.S. state agency. Participants discussed the following grassland goal statement: **A desert landscape that sustains high-functioning grasslands that provide ecosystem services to support human cultures, native species, and ecological processes.**

Participants noted that the term "ecological services" may not be understood by a wider audience. Participants choose to focus breakout group discussion on the following high impact pressures and stressors:

- Changes in land use
- Inadequate/unsustainable cattle ranching and agriculture
- Changes in vegetation structure and composition and resulting changes in wildlife habitat and erosion
- Overuse of water

The group discussed the challenges posed by a lack of environmental awareness, education and appreciate for grassland ecosystems. This also extends to (Mexican) organizations, not just general public. Government and policy-making also presents challenges. In Mexico, public policies do not encourage responsible use of grasslands. This is exacerbated by high turnover, limited budgets and corruption.

Participants identified a diversity of management objectives related to the above listed high impact pressures and stressors. To address changes in biotic community composition the group discussed the need for methods and technologies to control/manage invasive species, and noted that little is currently being done. Training and policy improvements were discussed. Developing a native seed banking program was also suggested. To address changes in land use participants discussed the need for education and outreach to promote awareness and improve grazing practices. In particular they focused on the importance of training to share best practices and strategies with ranchers. Developing incentives for providing grassland environmental services was also mentioned, as was the creating subsidies for conversion of farmland to grassland. To address overuse of water the group primarily discussed economic strategies incentives such as payment for environmental hydrological services and the elimination of subsidies to producers. These should be coupled with stronger regulations and increased surveillance and fines on offenders. Participants also mentioned the role of increasing efficiency of water use and spreading this through improved education and outreach to communities.

The group discussed some collaboration opportunities to support progress in Mexico toward many of the ideas discussed during the session. One such opportunity is to work together to advocate for policy changes, in particular the creation of subsidies for conversion of farmland to grassland, as well as land

buy-outs. The group also talked about working together to help create public awareness of environmental services and campaigns for preservation. Participants also suggested a role for the DLCC in helping empower those who work on the land. Some ideas included a DLCC administered “green seal of approval” for sustainably ranched products, as well as including existing landowners as “citizen scientists” contributing to DLCC science.

Grasslands - Aguascalientes Breakout Group Participants

- Abraham de Alba Avila, *Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias*
- Abraham Diaz Romo, *Universidad Autónoma de Aguascalientes*
- Adrian R Quero-Carrillo, *Colegio de Postgraduados en Ciencias Agricolos Texcoco, Edo. de Mexico Campus Montecillo*
- Andrea Conti-Gorza, *Pronatura Noreste Aguascalientes*
- Benjamin Garcia, *Universidad Autónoma de Aguascalientes* y *Asesoria Ganadera*
- Duane Pool, *Bird Conservatory of the Rockies*
- Ernesto Flores Ancira, *Universidad Autónoma de Aguascalientes*
- Federico Godinez Leal, *Reserva de la Biosfera El Pinacate y gran Desierto de Altar*
- Hernando Cabral Perdomo, *World Wildlife Fund*
- Jose Antonio Alvizo Plava, *Asesorio Ganadera*
- Maria Eugenia Gonzalez Dias, *Ecosistemica AC*
- Miguel Pavon, *Texas Water Development Board*
- Nancy Hernandez Rodriguez, *IMC Vida Silvestre Aguascalientes*
- Vianney Beraud Macias - *Centro de Investigaciones Biológicas del Noroeste*

Grasslands Goal

Participants were asked to reflect and provide feedback on this draft goal statement.

Goal: A desert landscape that sustains high-functioning grasslands that provide ecosystem services to support human cultures, native species, and ecological processes.

In Aguascalientes, participants felt the term “ecological services” might not be understood by a wider audience. They noted that “human cultures” and dynamics are always changing, and this should perhaps be reflected. In the Spanish translation “soporten” should be changed to “mantienen.” As in Tucson, they discussed the use of the word “desert,” and suggested “semi-arid” as a possible alternative.

High Impact Stressors and Pressures Affecting Grasslands

Participants reviewed the previously created list of highest impact pressures/stressors and associated sub-pressures/stressors as identified by initial results of a survey to prioritize these. They then prioritized the follow pressures/stressors for the purpose of continued work and discussion at the workshop (bolded items denote highest priority for participating group). Additional stressors added by the group are shown in italics.

- **Changes in land use**
- **Inadequate/unsustainable cattle ranching and agriculture**
- **Change in vegetation structure and composition, and resulting changes in wildlife habitat and erosion**

- **Overuse of water**
- Desertification
- Habitat and land fragmentation
- Invasive species
- Shifting of climate zones/envelops
- More frequent drought
- *Accelerated loss of genetic biodiversity (animal and plant)*
- *Lack of environmental conscience and education*
- *Groundwater pumping*
- *Lack of public policies to halt deterioration of grasslands*
- *Skewed subsidies - bad incentives*

Challenges in addition to stressors (human dimension)

Engagement

- Lack of environmental awareness/education
- Lack of cultural and political appreciation of grasslands
- Lack of engagement from important Mexican organizations

Government/policy

- Lack of public policy to stop grassland degradation
  - New federal government does not recognize value of natural resources
  - Skewed subsidies, bad incentives for land use
  - Laws that contradict and undermine each other
  - Policies that encourage making natural grasslands into farmland
- Governmental turnover - Mexican government changes every 6 years, which makes it hard to have a lasting impact on policies.
- Limited government budgets
- Corruption of decision makers
  - Currently, government charges to provide water to the public, but the people who own the water resources do not gain any revenue.

Other

- Agricultural producers controlling the ecosystems, which changes the identity of the lands

Discussion on pressures/stressors

- Lack of policies encouraging responsible/balanced harvest of grasslands
  - Example: Policies that encourage irresponsible harvest of grasslands in a way that worsens the soil.
- Overexploitation should be stressed on the list. This is not only the overexploitation of grasses, but the overharvest of water. Both the “unsustainable grazing” and “groundwater pumping” should be included in the stressors list.

- Cumulative effects: Mining, agriculture, and other stressors compound stressors. These cumulative effects are important, but cannot be counted as different stressors.
- Soil is everything to grasslands.
- Lack of education and culture in Mexico leads to littering and lack of caretaking of grasslands.
- Communal grazing is a large problem in many areas - Tragedy of Commons scenario.
- There is a lack of representation by rural people in decision-making. Most of Mexico is still rural. Decisions on the rural aspects should be made by people who have rural experience. However, many policies are still developed by non-rural people.
- As people leave agricultural jobs for other professions, the grasslands become abandoned and unhealthy.
- Desertification, the original highest stressor, is an *outcome* of the other threats.

Management Objectives and Adaptation Strategies

Stressor: Changes in land use

The group discussed a variety of legal and policy tools including eliminating federal and state subsidies that encourage damaging land use, reassessing permitting for groundwater mining that enables land use change, and developing stricter legal instruments to regulate land use changes. Better planning, including detailed analysis of expected consequences, was also suggested.

Law and policy

- Revisit legal frameworks and enforcement to affect both land use change and permit payments, and groundwater mining that supports or enables land use change.
- Adequate public policies (eliminate federal and state subsidies) so as to stop encouraging erosive or unproductive land use.
- Stricter legal instruments to regulate change in land use.
- Lack of a law that typifies grasslands and forces environmental impact manifest before change in land use takes place. Public policy.

Planning

- Analyze consequences, risks and benefits before deciding to change land use.
- Spatial planning (program and application)
- Education

Stressor: Inadequate/unsustainable cattle ranching and agriculture

Education and training to promote awareness and improve practices

- Extensionism and promoting better farming practices.
- Advertising campaigns for consumption of local products with practices
- Training and sharing technology with ranchers
- Promoting adequate agriculture and ranching techniques through trainings
- Better water use practices through trainings
- Better management through trainings
- Develop programs to saturate the high-risk, high-impact areas with education. outreach, and incentives to change management practices for range

Economic/funding

- Incentives for grassland environmental services.

- Funds to support better farming techniques and practices.

Other

- Adjust stocking capacity.
- Change in SAGARPA policy about agricultural production regarding promoting bad practices.

Stressor: Change in vegetation structure and composition, and resulting changes in wildlife habitat and erosion

- Control and manage invasive species - nothing is happening currently
- Change and apply policies to protect native species
- Apply more technologies
- Train on handling of ecosystem for controlling invasion of new species
- Reforest and farm with native species, and make a program for banking the seeds of native species where they exist.

Stressor: Overuse of water

- Combining market mechanisms (payment for environmental hydrological services) with more severe legislation on rational water consumption mainly for industrial and agricultural sector
- Require by law for geological water users to restore pastures before abandoning the land
- Economic incentives for producers who practice proper use of groundwater
- Link-educate communities and urban areas re: the impacts of neighboring groundwater mining on their own access and cost of water
- Increase the efficiency of water use for productive practices → change in irrigation systems, use of troughs, etc.
- Eliminate subsidies in water fees to producers -->pay what the water is worth. Restrict concessions.
- Increased surveillance and fines on offenders
- Promote water culture, efficient irrigation and conservation

Stressor: Desertification

- Native grass establishment.
- Think globally act locally in strategies to regulate ecological footprint. Walk, use a bike…
- Look for economic aids to help biodiversity

All areas

- Apply laws and rules very strictly - laws are already written, need to be enforced
- Propagate native grasslands and plants in areas where people are already farming and ranching
- Be specific to require the right volume of water use- get right information for decision making
- Studies that help finance environmental extensionism
- Demonstration projects that show how BMPs benefit and how to implement them
- Implement public policies such as land use planning that takes into account natural corridors, areas of importance for wildlife, urbanization and the development of agriculture
- Implementation of the regulations associated with land use
- Propose and consolidate a Mexican DLCC (with Mexican $$)
- Communication and coordination among policymakers that includes different scenarios and the economic impact of not implementing sustainable policies

- Permanent campaign for the conservation culture
- Mainstreaming between policies

Collaboration Opportunities

Discussion on initial ideas for action

Economic and financial tools

- **Create subsidies or incentives** regarding carbon capture, water, and other areas
- **Charge for water, carbon,** etc.
    - Model after programs in which water users pay an extra amount of water bill to the producer of water - Veracruz, etc. Voluntary programs for reforestation and maintenance of natural resources
- Consider voluntary incentives instead of relying on the government
- **"Magical Commons" -** Copy the Mexican "Magic towns" programs in which towns receive funding from the government to restore cultural resources. Apply these programs to natural landscapes
- Recognize ecosystem services - Influence government to **change approach to funding and recognize ecosystem services** other than agriculture
- **Program to monetize benefits of responsible resource management**
- Begin to change the identity of the ecosystems by **increasing local ownership of the land, instead of giving all the power to producers**
- Use public and private resources to **invest in natural lands** - Public resources and researchers are already looking at solutions at land preservation, but the federal government, which is acquiring lands, could invest in [natural] lands for perpetual preservation.
- Get **funding from private sources** for science and other projects.
    - For example, Bill Gates recently gave millions of dollars for the development of corn for fuel.

Changing agricultural lands to grasslands

- Maintain or copy the American conservation program **(CRP),** which changed farmlands into grasslands, which avoided water shortages.
- **Create disincentives** for changing grasslands into farms
- Buy out farms and replace land use with sustainable practices. Identify conservation buyers in Mexico who can do this.

Other

- **Communicate with The Nature Conservancy and other charitable organizations** - to develop opportunities for conservation.
- Create a **certification program** for leading producers to be recognized for the proper management of resources, which would increase communication between leader producers. Producers must recognize the importance of responsible practices amongst themselves

- **Young people talking with decision makers** in Mexico, and also becoming decision makers
- **Decrease corruption of decision makers** - create punishments for people embezzling money, etc.
- **DLCC lobbying** - DLCC should go out with groups in Mexico to lobby decision makers. They will not listen to the public, but with the weight of an international body, we could lobby much better. UNEC has no power.
- **Make tie between political decisions of urban areas, and the water and resources** that are provided by the natural areas to the urban areas.
- Create awareness in the population about environmental services

Top Priorities for Desert LCC

- Promote technology for native species revegetation
- Create seed banks to preserve native plant genes
- Signed letter from Aimee and Genevieve as USFWS and BOR representatives to show support for local individuals as DLCC members
- Environmental awareness and educational campaigns, media including local producers (videos)
- Join or contact Mexico Resiliente

Other Actionable steps for the Desert LCC

Advocate for Policy Changes

- Subsidies for new conversion from farming to grasslands
    - WWF has been looking for years for opportunities to make these changes. International governments have tried to do this, but frequent turn-over in Mexican government makes it difficult.
    - Could make a specific proposal that avoids the perverse subsidies (no resources given to incentivize unsustainable practices). Mexican people would have to work hand-in-hand with the DLCC, so that the government would recognize that outsiders' views are legitimate.
    - Create a public policy strategy, that includes ideas for different players to act.
- Land buy-outs
    - Would be difficult because NGOs have run out of money since the global recession

Education and Awareness

- Create public awareness of environmental services.
- Culture campaigns for preservation - should occur at all levels of people and decision-makers.

Empowering those who work on the land

- Establish a process for assessing ranchers' technology and the improvements they can make. (Example: A PhD student is proposing a call center to advise livestock producers.)

- DLCC could give a “green seal of approval” for cattle ranchers to display on their product, so people know it was from a sustainable source
- DLCC could act as an intermediary between experts and high-level policymakers. Need a local mediator to build relationships between DLCC and high-level organizations
    - CONAFOR, CONABIO, CONASA, CONANP, Resilient Mexico should all be involved.
        - Attend quarterly CONANP meetings; engage Andrew Russ, Climate Change Director.
        - DLCC should be part of the platform of Resilient Mexico. It may be the only truly functional conservation organization in Mexico that implements actions.
- Ask existing land owners and managers to undertake DLCC science on their own lands (citizen science), rather than using additional staff to start new projects. DLCC would act as trusted moderator to build bridges between universities and landowners.
- Build on payment for environmental services programs. These have generally been successful.
- More leverage would be available for DLCC members if they had a letter from the USFWS saying he is representing them. This should be signed by Aimee and other coordinators representing institutions.

Appendices F-L: Detailed Summaries from Conservation Design Workshops – Geographic Area Discussions

The follow Appendices include detailed information collected during the geographic breakout sessions held in Tucson and in Aguascalientes. Participants discussed the following geographic areas at the Tucson workshop: Lower Colorado River, Madrean, Mojave/Baja/, Rio Grande-Rio Bravo and Lower Rio Conchos; and discussed the following geographic areas at the Aguascalientes workshop: Mojave, Chihuahuan Desert, and Aguascalientes.

Each geographic area Appendix includes the following sections:

- Breakout Group Participants
- Additional Resources in this Geography
- Resource Values Relevant to this Geography
- Highest Impact Pressures and Stressors
    - Rationale for Selection, Existing Information and Outstanding Needs
- Collaboration Opportunities
    - How Landscape Conservation Planning and Design Can Help
    - Pilot Area Discussion (modifications or new nominations)

Appendix F: Big Bend-Rio Bravo and Northern Chihuahuan Desert, Tucson Workshop

Breakout Group Participants

Breakout group participants include nominators from the Big Bend-Rio Grande and Northern Chihuahuan Desert proposed pilot areas.

- Abe Springer, Northern Arizona University
- Homer Mills, 02 Ranch
- Junko Hoshi, California Department of Fish and Wildlife
- Kelly Mott-Lacroix, Water Resources Research Center – University of Arizona
- Mara Weisenberger, U.S. Fish and Wildlife Service
- Pam Benjamin, National Park Service – Intermountain Region
- Russell Martin, Texas Parks and Wildlife

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. They identified the following additional resources:

BBRB =Big Bend-Rio Bravo (Tucson)
NCD = Northern Chihuahuan Desert (Tucson)

- Shrub encroachment (NCD).
- Cultural resources - archeological, (historic, prehistoric) and cultural (contemporary), including ranching landscapes (U.S. portion of BBRB and NCD)
- Mexico partners emphasized connection between natural resources and human dimensions during pilot nomination (BBRB)
- "Preserving ranching activities protects subdivision of ecosystems"
- There are current Tribal resources in the New Mexico area
- Dif. private landowners have dif. economic values, practices, goals; including Mexico (CEMEX) (BBRB)
- Priority resources:
- Sky Islands in Texas(BBRB) - Ponderosa woodlands, Black bear, Bighorn sheep
- Black bear-recent records, Bighorn sheep (NCD)

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Grasslands Values - Why people care:

- Ranching (BBRB - NCD)

- Recreation - hunting/ecotourism-birding (BBRB - NCD)
- Watershed services - water quality, recharge, erosion, erosion control (BBRB)
- Open space, undeveloped - intrinsic values (BBRB - NCD, large coalition in Otero Mesa)
- Grassland productivity and biodiversity
- Connectivity
- Ecological restoration can turn into economic opportunity
- Carbon sequestration (BBRB - NCD)
- Pollination (BBRB - NCD)

Streams Values:

- Most of values from grasslands translate to stream values (nutrient cycling, instead of carbon sequestration)
- Water quality
- Farming/agriculture (BBRB - NCD)
- Municipal-domestic use (BBRB - NCD)
- Cultural use - tribal ceremonies (BBRB - NCD)
- Flood and sediment control - riparian buffer (BBRB - NCD)
- Human health (BBRB - NCD)

Springs values:

- Resident, migratory and breeding birds (NCD)
- Water quantity: oasis, and recharge of streams (BBRB - NCD)
- Supports biodiversity, endemism (BBRB - NCD)
- Cultural values of sites (BBRB - NCD) / Traditional use values by Tribal entities
- Recreation (ecotourism, birding, hot-springs, etc) (BBRB - NCD)
- Remote water sources (cultural and ecological value) (BBRB - NCD). Localized, domestic use, cultural

Cultural Resources Values: Prehistoric, historic and cultural landscapes

- Understand human history, behavior and land use over time. Insight into climate, and response to changes in time.
- It's like a Museum: learning about the past. Paleoecology. "We've got charcoal deposits going back to 13,000 years"
- Significance for tribes (spiritual, historic, etc.)
- Understanding sedimentation, flow events, etc.
- Traditional use of natural resources (candelilla, agave, etc.)

Human Communities Values: (Apply to both BBRB - NCD)

- Recreation
- Ranching
- Stewardship responsibility
- Educational (human history, resource and ecological systems), historical values, ecoliteracy
- Scientific inquiry/understanding how systems work

Montane Sky Islands values:

- Recreation

- Mountain-block recharge
- Biodiversity
- Refugia and connectivity
- Aesthetics/viewshed
- Tribal areas of significance (NCD*)*

Highest Impact Pressures and Stressors

Participants utilized the list of highest impact priority pressures and stressors for springs, streams and grasslands that came out of the resource breakout session. The following pressures/stressors were identified as being highest priority for spring, streams and grasslands in this region.

Spread of invasive non-native and undesirable natives

- Conversion of ecosystems by invasives has high impacts on natural communities that need landscape level and systematic management protocol. Interactions of invasive species/climate change/fire issues.
- Altered fire regimes as a result of invasive species (native and non-native). Concern about non-native grasses moving into Pilot area, altering timing of natural fires or effects on resource objectives.
- Existing research. dis place natives/ create monoculture.
- Reduces native biodiversity and alters ecosystem processes (fire, water availability, nutrient cycling). Has bearing on most stressors below.

Habitat loss/fragmentation

- Human pressures can be more immediate threat than climate.
- Inability for spp to migrate to meet life-cycle needs in response to climate change impacts.
- Management opportunities.
- Transcends across all resources.

Altered hydrology

- Loss of unique systems/species; shifting of water availability during critical portions of spp. life cycles.
- Impact to aquatic ecosystems can encourage non-natives.
- Interaction of surface and groundwater. Water resource is key for human and natural systems

Changes in biotic community composition

- Transcends across all resources.
- Concern about shrub encroachment into grasslands and how various taxa are affected including available habitat and ecosystem health and functionality.

Climate variability

- Threatens the sustainability of associated surface water and groundwater systems
- Concern about climate change effects on springs, long term spring variability, effects on avifauna (resident and migratory) and other wildlife, and how we can manage for those changes

Change in disturbance

- Considering the potential to human disasters as well as the importance for the natural system.
- Upland disturbances impact the dependent hydrological processes and downstream sustainability.

Increased groundwater pumping

- Pumping threatens the baseflow-dependent rivers and spring permanence.
- Alters surface use, spring flow, etc.

Decreased water availability

- Transcends across all resources

Collaborative Opportunities

- Connecting Big Ben Rio Bravo and Rio Conchos pilot areas
- Wildlife management in neighboring areas (Pronghorn, black bear, Yellow-billed cuckoo, Montezuma quail, Southwest willow flycatcher)
- Some communication/coordination through Bighorn council and other networks (NPS research and I&M)
- There is some potential to combine Big Bend-Rio Bravo and Northern Chihuahuan Desert. If they are not combined, Desert LCC should include liaisons from one pilot area to another. Include Guadalupe Mountains for sky island connectivity.

Appendix G: Lower Colorado River, Tucson Workshop

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area.

- Sonoran Desert Scrub
- Mojave Desert Scrub
- Aquifers
- Areas of Critical Environmental Concern
- Blythe Intaglios: Cultural site
- Sonoran Desert Tortoise & other T&E species
- Habitat Connectivity (including Important Bird Areas)
- Dune Habitats and Associated Species
- Interior Chaparral
- Wildlife habitat

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Springs

- Municipal water supply (e.g. City of Prescott depended on Del Rio Springs)
- Agricultural water supply - Nevada example
- Wildlife water sources
- Habitat for endemic and other species
- Livestock water sources
- Cultural sites associated with springs -cultural value, religious value
- Sources of perennial streams - Grand Canyon example
- Recreation and ecotourism values - Grand Canyon example
- Lower CO River downstream of Hoover Dam
- Research and education

Streams

- Include all of the above for springs
- Hydropower
- Movement corridors for some species - for example, fish and birds
- Sediment & nutrient transport
- Water purification
- Water storage
- Flood control
- Fire suppression

- Germination - transporting seeds downstream
- Natural barrier - during fires, for invasives, and in general
- Groundwater recharge
- Treaty agreement
- Jobs
- Mining

Grasslands

- Wildlife habitat - recreational value, hunting, angling
- Habitat connectivity
- Erosion control
- Flood control
- Air quality
- Grazing
- Microclimate control
- Water availability (if lost and replaced by invasives that use more H20)
- Fire regime changes

Sonoran Desert Scrub

- Open space
- Recreation
- Water rights in general
- Wildlife habitat & habitat connectivity - for recreation
- Recreation
- Non-fire adapted system - find fire in the desert thanks to this
- species
- High potential for solar power development
- Agriculture & livestock grazing
- Erosion control / air quality

Mojave Desert Scrub

- Protected under CA endangered species act (whereas Sonoran desert scrub is not protected) - the act is a management tool
- High potential for solar power development
- Open space
- Recreation
- Water rights in general
- Wildlife habitat & habitat connectivity - for recreation
- Recreation
- Non-fire adapted system - find fire in the desert thanks to this species
- Agriculture & livestock grazing
- Erosion control / air quality

Aquifers

- Long term water supply
- Support streams and springs & their associated benefits

- Water purification
- Support the land - depletion may cause subsidence
- Support vegetation communities

Areas of Critical Environmental Concern
Summarized above
Blythe Intaglios: Cultural site, only one in the world like (summarized above)

Sonoran Desert Tortoise & other T&E species

- Benefits of wildlife summarized above
- Jobs, intrinsic value and ecosystem function
- Regulatory compliance

Habitat Connectivity (including Important Bird Areas)

- Population resilience
- Genetic diversity
- Recreation corridor
- Contiguous fire regime
- Habitat corridors can be buffers for other purposes - community service - Flagstaff example
- Navigation of people
- Includes multiple microhabitats - riparian, open water, marshes

Dune Habitats and Associated Species

- Recreational and wildlife values from above
- Water purification
- Interior Chaparral

Wildlife habitat

- Items mentioned above

Highest Impact Pressures and Stressors

Participants utilized the list of highest impact priority pressures and stressors for springs, streams and grasslands that came out of the resource breakout session. The following pressures/stressors were identified as being highest priority for spring, streams and grasslands in this region. The bolded items were discussed further.

- **Decreased water availability (including groundwater, recharge, etc.)**
- **Increased spread of invasive and non-native species, and undesirable spread of native species**
- **Altered fire regimes**
- **Habitat loss and fragmentation**
- **Climate variability, including precipitation and temperature changes - affects seasonality**
- Change in disturbance regimes (due to fire, drought, and unsustainable/unnatural herbivory)
- Changes in habitat connectivity
- Unsustainable grazing

Rationale for Selection, Existing Information and Outstanding Needs

Participants discussed their reasoning behind why certain pressures and stressors were identified as highest impact in this geography. They also discussed existing resources to address high impact pressures and stressors, as well as outstanding information and other needs that may be hindering response to these pressures and stressors.

Decreased water availability (including groundwater, recharge, etc.)

Rationale

- The problem of decreased water availability is of utmost importance in this region for both ecological and cultural values
- Decreased water availability, groundwater pumping, decreased recharge. Aquifers depleted, affecting springs, streams, grasslands, wildlife, and humans. Unnecessary waste.
- Loss of groundwater is important because it affects human and wildlife/ecosystem resources. Important to do something soon to stop overdraft because it will be difficult to reverse.
- Growing population = more demand. Future precipitation and temperature regimes will negatively affect existing communities.
- Decreased water availability is caused by unsustainable (cultural and ecological) practices AND climate change
- Decreased water availability, groundwater pumping, drought→ our land will not be the same; no more grassland, riparian, etc.
- Greatest impact on entire region - both ecosystem and population
- Decreased water availability is also due to increase in non-natives. Unsustainable water supply.
- Huge stressor from humans, water overallocated, need water supply for plants, animals, humans
- Reducing water availability for wildlife, and increasing stress due to drought
- Conflict over usage
- Management is critical for sustainability

Water availability/seasonality rationale discussion

- Precip seasonality is linked to fire regimes, and will affect resource management
- Precip also affects groundwater availability. Can theoretically use precipitation info to predict groundwater, but relationships are not well understood. NAU and UA are looking at groundwater models.
- Groundwater studies are often funded by a project; the quality of the study depends on the motivation for the project. For a good-quality study, most data take years to develop.

Resources

- NOAA /NWS
- BOR uses CMIP 3 and 5 for Climate analysis + climate change team that does modelling - is this public? - results available through BOR basin studies/ Climate change team
- Groundwater models - DWR, USGS
- DWR - AMAs
- USGS Groundwater levels in NWIS
- Wells - AMAs have pumping data; wells outside of AMAs may report to other sources.

Needs

- More info about recharge dependence on precipitation & getting information about linkages between climate change and groundwater availability into hands of water managers
- Many different information sources - need to coordinate
- Better data on groundwater recharge

Increased spread of invasive and non-native species, and undesirable spread of native species

Rationale

- Changing climate could be beneficial for invasive species. More invasives can be introduced as human interference increases.
- Spread of non-native species, invasive species, feral livestock, elk - non-native plants increase unnatural fire livestock and ungulates trample springs and streams. Non-native invertebrates, vertebrates, and plants outcompete natives
- Important because it causes so many other issues: increases fire regime changes, decreases habitat quality, invasives outcompete native plant species. Invasives like burros have negative impact on many species. Invasive species like Tamarisk use lots of water, etc.
- Spread of invasives has considerable impact on native ecosystems and critical infrastructure with significant associated costs (monetary and otherwise)
- Invasive species spread by boats to other streams
- Changed ecosystem demands places greater stress on existing resources
- Loss of natural ecosystem and habitat detrimental to supporting natural diversity
- Altered ecosystem processes
- Decreases biodiversity
- Increased spread of invasives alters fire regimes, affects water quality, changes the biotic community, and can alter microclimates.

Resources

- Weeds database NISIMS
- Cal Weed Mapper
- Tom Stohlgren CO State/USGS - models
- Tamarisk Coalition
- USGS Tamarisk map in lower colorado
- BLM Local knowledge - not digitized
- Forest Service / ADOT - EAs, EISs getting done or in progress - most along roadways
- REAs - lists what data was available at the time the assessment started
- WRP GIS
- DOD base-specific information
- BOR R&D office
- AZGFD

Needs

- Digitizing BLM invasives records
- Model future distribution
- Effective methods to reduce invasives
- Effective methods for restoration of native species - Idaho example - removed invasive and it is replaced by another invasive. Area-specific guides on eradication/restoration would be helpful.

- Pulling together lessons learned - Placement of diversion structures, for example. Published & unpublished.
- Advanced detection techniques, for example Environmental DNA using PCR
- Readily available information - After a fire have 10 days to turn around a 3-year plan
- Reference/baseline conditions map for the region - select resource maps available
- Maps and info on where species are moving
- Info issues: Scale, some species not digitized, some species too widespread to be useful on a map.

Altered fire regimes

Rationale

- Loss of native habitat for T&E [species] and/or benefit T&E in marsh habitats
- Allows invasion of invasive species
- Alters hydrology from lack of rehab post fires
- Allow propagation of non-natives
- Increased fire reducing habitat for riparian species
- Undermines grassland health/resiliency

Existing resources

- Land fire
- HDMS (AZGFD database)
- NISIMs (weeds database)
- REA data - landscape scale
- Burned area stabilization reports and monitoring data
- Prescribed Fire Council
- Ecological Restoration Institute
- SW Fire Consortium - developing new info
- University of Arizona - classes/research on fire ecology
- MSCP
- Agency fire plans
- Individual species data on behavior/needs for fire
- Tamarisk guide - CHECK WHO WROTE THIS
- Local experts
- Wildland Fire Decision Support System - maps and other tools
- GeoMap - info on current and historical fires, updated daily
- Southwest Coordination Center (Albuquerque)

Needs

- Better coordination among agencies
    - Resources advisors on land that are not BLM-managed or federally managed - for example, BOR, BLM, FS, NPS, Tribes - where are the splits? How does each agency fight fire?
    - Risk assessment, communication, and planning before the fire - where are the risks? What are different agencies' priority resources?
    - Better pre-fire coordination with private landowners - get documents about resource values

    - Within one agency, what is the reality of the cost, time, people and equipment that are needed to fight a fire in Lower Colorado vs other parts of Colorado or nation?
    - *Regional* coordination on fire preparation - Need widespread info quickly when fires happen
- Name/standard for fire regime of the Lower Colorado River
- More integrated fire plans (considering multiple landowners/managers and their resource values)

Ways to address these needs

- Collaborate to be ready with information regarding fire needs
- Make fire management plans readily available for each jurisdiction involved (in lieu of or in addition to an advisor from each partner)
- More integrated fire plans - input from adjacent private landholders
- Southwest Coordination Center
- BIG NEED: there's a lot of information but haven't really had the time to pull it together and see how it applies to day-to-day management

Habitat loss and fragmentation

Rationale

- Fragmentation - limiting habitat availability for priority wildlife species
- Loss or fragmentation of a key species can have significant ecological effects and cascades
- Impacts species important to ecosystem and populations need to be maintained
- Given growth of Southwest over the past century, further habitat loss may prove dire for many species
- Important because influence resilience of populations and allow natural processes to occur
- Affects conductivity and corridors. Desert habitats very difficult to restore.

Specific to Springs and Aquatic Species

- Springs have the highest biodiversity - crucial to maintain
- Species-specific - which species do we need more data on? Example: Yuma ridgeway rail aka clapper rail. Some species get more attention than others, indicator or T&E species.
- Subhabitat – marsh, if not in a natural system needs human manipulation for it and the species in it to be maintained, overgrown, and flooding doesn't clean it out.

Existing Information

- Agency environmental analyses (ex: USFS/ADOT roadside projects)
- Western Regional Partnership
- Tamarisk Coalition
- AZGFD

Information issues

- Scale of digitized data
- Some data not digitized at all
- Some species so widespread that maps are ineffective.

Needs

- Where species are moving

- effective methods for reducing certain species
- guidance on restoring native species in different localities
- Area-specific guides on eradication and restoration would be helpful.
- Readily available information for fires and other quick planning

Climate variability, including precipitation and temperature changes

Rationale

- Water is already a strained/stressed resource. These changes have high likelihood to decrease availability, increase demand, and make management more challenging.
- The most widespread effect.
- Lower Colorado River Basin is dependent upon water supply, and changes in supply for an over-taxed system are expensive
- Shows higher temperatures and reduced precipitation in upcoming years. Can **c**hange/shift population of area.
- Driver for prosperity of existing life and culture. Projected changes will negatively affect existing life and will force a change in day-to-day values.

Change in disturbance regimes (due to fire, drought, and unsustainable/unnatural herbivory)

Rationale

- Changes in disturbance regimes from human-caused management decisions (e.g. unsustainable grazing) causes changes in biotic community compositions, connectivity, fire regimes, spread of invasives, and altered hydrology
- Springs - drought, disturbance, herbivory (trampling) provide base flow for nearly all streams, provide water for wildlife, endemic species

Other Pressures and Stressors

Altered hydrology (including dams): Has led to invasives, loss of native wildlife, especially native fish, affected marsh and backwater habitats (degraded), change in biotic community, affected conductivity Altered habitat and species distribution and populations.

Unsustainable grazing: No more food; some culture will be alternate; no more jobs

Need for genetic diversity of native veg being re-planted or used in restoration→ is this a lack of sources of diverse genes, or a result of agency habits to use a single source of plant materials?

- How to determine appropriate levels of genetic diversity?
- Need to track genetic components of plant materials used in the LCR, and coordinate among partners to maintain diversity
- Lessons learned from partners doing research/restoration re: genetic diversity- what's worked and what hasn't

Appendix H: Madrean, Tucson Workshop

Breakout Group Participants

- Aaron Wilkerson, *Bureau of Land Management*
- Amy Markstein, *Bureau of Land Management*
- Ben Lomeli, *Bureau of Land Management*
- Bill Radke, *U.S. Fish and Wildlife Service*
- Brian Powell, *Pima County*
- Carianne Campbell, *Sky Island Alliance*
- Carol Beardmore, *U.S. Fish and Wildlife Service*
- Chris McVie, *Tucson Audubon Society*
- Claire Crow, *Bureau of Land Management*
- Diane Laush, *Lower San Pedro Watershed Alliance*
- Elna Otter, *Lower San Pedro Watershed Alliance*
- Jeannie Wagner-Greven, *U.S. Fish and Wildlife Service(retired)*
- Jeff Jenness, *Spring Stewardship Institute*
- Jennifer Holmes, *Northern Arizona University*
- Jennifer Ruyle, *U.S. Forest Service*
- Jessica Fraver, *Arizona Land and Water Trust*
- Jonathan Horst, *Tucson Audubon Society*
- Juan Carlos Bravo, *Wildlands Network*
- Karen Simms, *Bureau of Land Management*
- Larry Stevens, *Springs Stewardship Institute*
- Marcos Robles, *The Nature Conservancy*
- Martha Cooper, *The Nature Conservancy*
- Matt Clark, *Tucson Audubon Society*
- Norm Meador, *Cascabel Conservation Association*
- Peter Else, *Lower San Pedro Watershed Alliance*
- Rana Tucker, *Arizona Game and Fish Department*
- Ruben Cu:k Ba'ak, *Tohono O'odham Nation*
- Sally Hejl, *National Park Service*
- Sammy Hammer, *Sky Island Alliance*
- Scott Wilbor, *Cascabel Conservation Association*

Additional Resources in this Geography

Participants were asked to reflect on the geographic area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. Participants identified the following additional resources:

- Upland Sonoran Desert
- Madrean pine-oak woodland
- Wildland urban interface
- Critical wildlife movement corridors
- "Carni-scape" (many large migrating carnivores)
- Transboundary biodiversity hotspot

- Xeric riparian
- Caves and talus slopes
- Grasslands (Sacaton/floodplain grasslands)
- BLM REareas of high ecological integrity
- Playas
- Socio-economic, cultural resources
- Transboundary aquifers
- Old growth ironwood forest

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Springs

- Expression of ecosystem condition
- Water for wildlife in an arid region
- Human consumption
- Perennial water in the desert
- Water quantity for people and the environment

Streams

- Groundwater recharge
- Rivers as reference systems – still functioning
- Biodiversity conservation
    - Stream-related avian migration and breeding corridors
    - Intact native riparian ecosystems – biodiversity, migratory corridors
    - Support exceptionally high biological diversity associated with rivers/riparian areas
- Working landscapes
    - Water for ranching, farming

Grasslands

- Working landscapes – open space, working landscapes (grazing, ranching, tourism), stewardship
- Forage – food supply, mescal/sotol
- Unfragmented landscapes – support wildlife (e.g., antelope), habitat for regionally endemic grassland birds, functioning landscapes

Recreation/Tourism

- Opportunities for solitude
- Natural beauty
- All types of recreation
- Tourism – bird watching and wildlife viewing, hiking, nature, aesthetics
- Hunting
- Economic values of eco-tourism and wildlife viewing
- People care about resources because they support abundant bird migration

Biodiversity

- Nectar species and pollinators - hemispheric migratory and pollinating corridor
- Endemism
- T & E species of concern (habitat)
- Ecological refugia – e.g., springs, streams, caves, talus slopes, limestone outcrops
- Rare intact native biological communities
- Mt. Graham: Sacred mountain, Mt Graham Red Squirrel, great observatories, beloved recreation site
- Critical to long-term adaptation to climate change for all species
- Bi-national cooperation and focus on shared resources, immigration, border security impacts, including border fencing (in the face of biological and hydrological fragmentation)
- The Madrean region is valued for its rich biological and cultural diversity
- Tremendously diverse habitats in close proximity to each other

Cultural/spiritual

- Traditional ecological knowledge
- Cultural diversity
- Native food harvest (saguaro, prickly pear, mushrooms)
- Cultural heritage – ruins, old villages, sacred sites
- Sovereign rights
- Food security/supply

Transboundary

- Biological corridors
- Training and capacity building
- Opportunities for cross-cultural work (USA-Mexico)

Other

- Large tracts of undisturbed habitat or unregulated streams
- Restoration potential – areas suitable for effective treatments
    - Water resources important for multiple ecological functions supporting natural and human values
- Ecosystem services
- Scientific hotspots: Mt. Graham, Kitt Peak
- Refuge (for species and people)
- Recreation
- Pine-oak forest
- Air and open space conditions that support unique military missions
- Jaguars and ocelots
- Mining as an important human endeavor (copper and other metals)
- Dark skies (astronomy)
- Native seed reservoir
- Cooler, moister micro-climate for animals and plants

Highest Impact Pressures and Stressors

Participants utilized the list of highest impact priority pressures and stressors for springs, streams and grasslands that came out of the resource breakout session. The following pressures/stressors were identified as being highest priority for spring, streams and grasslands in this region. The bolded items were further discussed

- **Habitat loss/fragmentation**
- **Decreased water availability (including groundwater pumping, drought)**
- Changes in precipitation type and seasonality
- Increased spread of non-native species and undesirable native species
- Altered hydrology
- Administrative and management challenges (information sharing)
- Unsustainable grazing

Rationale for Selection, Existing Information and Outstanding Needs

Participants discussed their reasoning behind why certain pressures and stressors were identified as highest impact in this geography. They also discussed existing resources to address high impact pressures and stressors, as well as outstanding information and other needs that may be hindering response to these pressures and stressors.

Habitat loss/fragmentation

Rationale

- Development pressure – rapid growth along existing road infrastructure
- Need to protect species biodiversity
- Failing cross-boundary gene flow
- Disrupts wildlife, reduces value for recreation
- Need for maintaining species diversity and viability
- Few unfragmented lands left in the Southwest
- Threats to migration
- Overarching effect of many stressors
- Carnivore biodiversity highly impacted
- Increases risk of extinction erosion and degradation
- Maintaining species diversity is essential to climate change resiliency
- Reduced biodiversity, resiliency, and adaptability increases the risks of extinction, erosion, and degradation
- Fragmentation threatens plants' and animals' ability to move and shift ranges in response to changing climates and ecosystems.
- Influences emigration, immigration, and gene flow.

Existing Information

- Sonoran Joint Venture analysis of transboundary birds (vulnerability, habitat needs)
- MAR – REA analysis
- TNC analysis of the region -
- Coronado "wall to wall" data from SE AZ, ILAP, includes veg

- Multi-spatial LIDAR on Virgin, Gila
- SWFL habitat mapping, range-wide US, NDVI
- CPA – data and tools to analyze
- Conceptual map of policy pertaining to environment in Mexico (Wildlands Network)

Needs

- Better understanding of connectivity for flying animals (birds, pollinators)
- List of transboundary species (insects, mammals, birds)
- Synthesis of habitat loss/fragmentation for this ecoregion
- Need to look at a mix of management at finer scale for species connectivity
- Better defined movement corridors with data to support it
- Other counties to develop conservation plans that show corridors
- Cutting red tape
- More/better inventory of smaller scale ecosystems – like springs
- Need to find a way to bring down or modify the border infrastructure – the key barrier to connectivity across the US-Mexico border, especially in Mexico
- Could actually "move" genes across in interim for priority species
- Basic inventories in riparian areas – DLCC bring data together
- Tools for data analysis (spatial) – bringing together often used data, but need to update continually
- Perennial water distribution and shallow groundwater models
- Expand LIDAR data to Upper Gila and New Mexico
- Coordination among various
- "State of the knowledge" symposium for each region – include focused work on mapping, on species lists, etc.
- GIS marathon – data sharing needs
- Information management process

Decreased water availability (including groundwater pumping, drought)

Rationale

- The single most limiting factor
- Ability to adapt to, or be resilient to climate change and drought requires a focus on water availability and groundwater pumping
- Eliminates rich riparian plants and wildlife
- Loss of biodiversity and ecological processes
- No water – no plants, streams, springs; no forage, recreation, consumption, etc.
- Endangers stream flow, which threatens avian migration
- Overallocated water is the major contributor to insufficient water supply, especially in the face of climate change
- Source of surface water for people and nature
- Historic losses of streams and springs that flowed in the past
- Groundwater capture from spring/stream discharge
- No more streams and springs if aquifer level drops too low

Existing Information

- USGS San Pedro study – connection between Upper and Lower San Pedro
- USGS study of Santa Cruz and San Pedro in US and Mexico using NASA GRACE
- USGS groundwater conceptual model for Sonoita and Patagonia watershed
- Gila and Virgin study of available groundwater to inform restoration (Stillwater Science)
- Upper Cienega watershed conceptual model (BLM, TNC)
- Norman et al. study on restoration and retention in watersheds
- ARS study on mesquite storing water
- San Pedro River study on bank drying and flood storage

Needs

- Modeling of groundwater supply and distribution
- Mexico and US agencies agree on some spatial and data conventions, e.g., a minimum set of consistent data for pilot areas
- Lack of shallow groundwater info/mapping to inform restoration
- Understand effect of removal of mesquite on shallow groundwater
- Upper and lower elevation tree lines and ecotone dynamics – what is going to happen with upper and lower tree line due to climate change
- Understand how large precipitation stored in riparian system and techniques to increase
- Gaps in knowledge about how to implement these things (knowledge bank of tools and techniques)

Rationales for Other High Impact Pressures and Stressors

Changes in precipitation type and seasonality

- Because many species may not be able to adapt
- Climate variability will drive some high elevation species to extinction
- Key driver of water availability
- Major shifts in wildlife loss
- Will significantly change all three resources (streams, springs, grasslands) over time

Increased spread of non-native species and undesirable native species

- Buffelgrass
- Replaces species communities with new ones
- Something can actually be done about it with available resources
- Reduces biodiversity, alters disturbance regimes, reduces value to people
- Tends to fracture communities of species
- Reduces habitat availability for native species
- Causes altered watershed function and increased sediment loads to streams from uplands (grasslands)

Altered hydrology

- Affects water availability
- Impacted hydrology will facilitate invasion of non-native exotic species
- Overarching control on condition and potential of aquatic and riparian resources/streams
- High impact to native diversity
- Is a huge driver that influences the trophic system

- Anthropogenic changes (development) in watersheds altering hydrology/geomorphology of streams

Administrative and management challenges (e.g., information sharing)

- #1 obstacle to sustainable resource management is failed administrative policy
- No solutions with bifurcated water law thinking
- Funding and resources available to deal with all of these management issues
- Resource-conflicting policies
- The public values these resources but funding does not necessarily align because of the lack of awareness

Unsustainable grazing

- Causes irreversible change
- With open range laws, much private land in riparian areas are being overgrazed
- Something can be done about it with resources that are available
- Pervasive and significant stress that management can change
- Affects soils, hydrology, vegetation, can threaten carnivores, leading to trophic cascade alterations

Altered fire regimes

- Fire is important for maintaining grasslands

Changes in groundwater recharge

- Related to reduction in surface water and water availability
- Need a healthy aquifer to have springs and streams

Changes in biotic community composition

- The "new normal" for natural
- Monoculture = lack of diversity = threat of extinction of species
- Grasslands are key to resilience/persistence
- Influences landscape characteristics and land management decision making

Change in disturbance regime

- Lack of disturbance results in more costly solutions in the long term (e.g., increase in undesirable plants)

Collaboration Opportunities

Participants were asked strategic collaboration opportunities/needs in this region.

Collaboration Opportunities

- Bringing the political and ecological elements together
- Work with Mexican partners cross-boundary
- Needs to come from the feds
- Look for areas where there is already successful collaboration (San Pedro, Gila watersheds)
- Learn from other watersheds in how they collaborate

- Work with existing international collaborators (SJV, Rio Grande)
- Pay attention to drivers for other stakeholders (e.g., economic issues)

How Landscape Conservation Planning and Design Can Help

- Need a neutrally facilitated, science-based forum that brings everyone to the same table (e.g., Lower San Pedro)
- Climate analysis from LCPD will be useful in bringing together agencies
- Transboundary modeling for corridors for suite of agreed upon species (and springs)
- Identifying areas to focus our resources on conservation and restoration – working together with other non-profits and agencies to pool science and funding
- Laying the groundwork for payment for ecosystem services
- The design process should focus on where we need to be working to have the greatest impact for resiliency and connectivity
- List of species at risk from climate change to inform management practices
- Where to do restoration, protection, conservation
- Important to identify areas where we have problems that affect the larger landscape – e.g., Cananea mine in Sonora. Do we focus there? Or stay away?
- Plan can result in a more proactive approach to influencing development
- Engaging a broader constituency
- Opportunity to better inform agency decisions, especially at the federal level, re mitigation, conservation
- Achieve higher data resolution in these areas

Pilot Area Approach Discussion

Participants were asked to discuss where would be a good place (and scale) to do conservation design in the Madrean Sky Islands.

- Have to think big!
- Site where we have existing data sets
- Site where we can do bi-national comparisons
- A good example: Sky Island Restoration Collaborative
- Where groups are already working collaboratively, or hoping to
- Range of elevation and latitude – because of species mobility
- Look at ecosystem type across scales, highlight cross-jurisdictional issues, also expand to understand status of resource across whole DLCC – e.g., TNC assessment of Madrean as biodiversity hotspot
- Flexible, updatable tools at multiple scales
- Connect conservation at local scale to larger scale
- San Pedro offers opportunity for more localized analysis, but needs to be part of a larger bi-national design - also an international river with headwaters in Mexico, captures ecological, socio-economic and other issues common to the Southwest
- Transboundary Madrean provides a mix of all the issues
- Select landscape with whole suite of stressors

Appendix I: Mojave, Tucson Workshop

Breakout Group Participants

- Bill Lamb, *Quadstate*
- Boris Poff, *Bureau of Land Management*
- Duane Pool, *Bird Conservancy of the Rockies*
- Frances O'Donnell, *Northern Arizona University*
- Laurie Simons, *U.S. Fish and Wildlife Service*
- Roy Averill-Murray, *U.S. Fish and Wildlife Service*
- Wayne Belcher, *U.S. Geological Survey*

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. Participants identified the following additional resources:

- Mojave Desert Tortoise
- Aquifer

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Springs

- Associated T & E and other endemic species
- Importance to migratory wildlife
- Recreation, e.g. backpacking
- Education/interpretation
- In Death Valley, use for water supply
- Historic importance
- Indicator of water table
- Protected designations
- Spiritual importance

Streams

- Amargosa Wild & Scenic River
- Recreation, e.g. hiking
- Intrinsic and aesthetic value
- Aquatic species (e.g. pupfish)
- Riparian species (e.g. SW willow flycatcher, yellow-billed cuckoo, clapper rail)

- Protected designations
- Traditional uses (e.g. mesquite)

Grasslands/Shrublands

- Mojave Desert Scrub
- Habitat for Mojave Desert Tortoise
- Scenic value
- Recreation (e.g. OHV)
- Renewable energy (solar)
- Mining
- Traditional uses (e.g. mesquite)

Aquifer: critical for wildlife habitat **,** human use**,** source of mitigation funds**,** federally protected**,** charismatic megafauna.

Mojave Desert Tortoise: source of mitigation funds**,** federally protected**,** charismatic megafauna**,** "ecosystem engineers" creating burrows as habitat for multiple species (species diversity).

Highest Impact Pressures and Stressors

Participants utilized the list of highest impact priority pressures and stressors for springs, streams and grasslands that came out of the resource breakout session. The following pressures/stressors were identified as being highest priority for spring, streams and grasslands in this region.

- Springs: increased groundwater pumping
- Streams: decreased water availability (including groundwater pumping, drought, etc.)
- Springs: change in disturbance regimes due to fire, drought, unsustainable/unnatural herbivory
- Grasslands: changes in habitat connectivity
- Springs: changes in groundwater recharge
- Springs; administration and management challenges
- Springs: change in precipitation type and seasonality
- Grasslands/Shrublands: Unsustainable grazing
- Grasslands/Shrublands: Changes in biotic community composition

Rationale for Selection, Existing Information and Outstanding Needs

Participants discussed their reasoning behind why certain pressures and stressors were identified as highest impact in this geography. They also discussed existing resources to address high impact pressures and stressors, as well as outstanding information and other needs that may be hindering response to these pressures and stressors.

Springs: Increased Groundwater Pumping

Rationale

- Groundwater withdrawals exceed recharge

- Increased pumping decreases spring flows, which decreases riparian & spring habitats
- Increased pumping can decrease spring flow, which impacts everything
- Groundwater dependent species are being impacted by over-appropriation, which is the primary problem for springs

Highest impact of increased groundwater pumping is occurring at regional valley springs (not mountain springs)--

  - Ash Meadows
  - Amargosa/Tacopa
  - Muddy River Springs
  - Death Valley

Needs

- List of affected species--see USFWS, NPS, DOE, DOD, BLM, DOT, NDOW, CA Fish & Wildlife, CHAT, DataBasin, Western Resource Partnership
- Regional groundwater flow map & model--see USGS, DOE, BLM, NPS
- Input/output scenario modeling--need additional models and source data
- Monitoring of water level in wells
- Monitoring of spring discharge--see USFWS, other feds, counties, states
- Monitoring of affected species

Streams: Decreased Water Availability (including groundwater pumping, drought, etc.)

Rationale

- Stream flow is needed for habitat
- There is no biology without hydrology
- High elevation forests are a major source of runoff and are threatened by climate change

The highest impact of decreased water availability is occurring at the following locations:

  - Muddy River
  - Virgin River
  - Amargosa (springfed)

Needs

- Flow data for major streams--see USGS gaging stations, counties, water authorities
- Groundwater monitoring wells
- Groundwater flow models with and without climate change projections
- List of affected species--see USFWS, NPS, DOE, DOD, BLM, DOT, NDOW, CA Fish & Wildlife, CHAT, DataBasin, Western Resource Partnership
- Environmental flow and temperature requirements of species
- Invasive species response to decreasing flow rates and increasing temperatures

Springs: change in disturbance regimes due to fire, drought, unsustainable/unnatural herbivory

Rationale

- Vegetation dynamics affect habitat suitability for aquatic T & E species, but this can be managed
- Invasive species have changed the vegetation where it's more susceptible to fire. This removes shrubs necessary for species survival. Actions need to be taken to reduce fine fuels and/or eliminate invasion of undesirable plant species

Needs

- Better understanding of vegetation dynamics and effects on T & E species (springs snails may be listed soon)
- Riparian species
- Reference conditions
- Herbivore impacts, especially introduced species (horses, burros, elk)
- Natural role of fire--increased fire beyond historical frequency & intensity outside of springs

Grasslands: Changes in Habitat Connectivity

Rationale

- Fragmentation of tortoise populations leading to reduced population viability and gene flow
- Habitat connectivity problems are increasing rapidly for tortoise and other Mojave species causing genetic and demographic effect

Highest impacts to habitat connectivity:

- Potential bottlenecks for tortoise
- Ivanpah Valley
- North of Spring Mts
- Mormon Mesa to Lake Mead
- All highways, esp. Death Valley

Needs

- How connected are quality habitats?
- Projection of future development
- Species population models--low resolution model available for tortoise
- What connectivity is for individual species--how wide do corridors need to be to maintain connectivity for each species?
- Understanding what are the real barriers to connectivity
- How will climate change scenarios affect Mojave Desert Scrub?--info gap
- How management practices impact resources to develop models for targeting BMP's

Other High Impact Pressures and Stressors

Springs: changes in groundwater recharge: Less recharge = less water = less habitat = less diversity = more listings (T&E) = more extinctions = more work

Springs; administration and management challenges: Mojave Desert has many ownerships with different needs and uses. Bringing this together is almost impossible, and will require persistence to accomplish landscape goals

Springs: change in precipitation type and seasonality: change in precipitation patterns = less recharge (see above to changes in groundwater recharge)

Grasslands/Shrublands: unsustainable grazing -soil compaction, reduced vegetation diversity Spread of invasive plants.

Grasslands/Shrublands: Changes in biotic community composition: Conversion of desert scrub to mediterranean grassland (applies to spread of invasives, changes in biotic community, and altered fire regimes).

Collaboration Opportunities

- Missing link: funding for implementation of all the plans so that we can see on-the-ground results
- Holes in monitoring coverage
- Lots of models available that we need to be taken to next level: scenario planning including stressors like climate change, etc.
- Better understanding of species-specific connectivity requirements
- Remaining research question: how will climate change affect Mojave Desert Scrub?
- Understanding of roles of fire and herbivory in maintaining species composition of springs & streams

Appendix J: Chihuahuan Desert: Aguascalientes Workshop

Breakout Group Participants

- Alfredo Rodriguez, *World Wildlife Fund*
- Andrea Conti-Gurea, *Pronatura Noreste*
- Iris Banda Villanueva, *Pronatura Noreste, Aguascalientes*
- Jeff Bennett, *National Park Service - Big Bend National Park*
- Manue Chavez Diaz - *World Wildlife Fund*
- Miguel Luna Luna, *Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias*
- Miguel Pavon, *Centro de Información de la Frontera Texas/México*
- Nancy Hernandez Rodriguez, *IMC Vida Silvestre*

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. Participants identified the following resources:

- Forests
- Sky Islands (not the Sierra Madre, but dispersed throughout the Sierra Alta plain)
- Thornscrub/ Matorrales
- Cuatro Cienegas
- Aquifers

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Springs

Water: fresh water for agriculture, water for the ecosystem, water quality for humans**,** aquifer health including drinkable water**,** water for livestock.

Native/endemic species: native vegetation, origin of native cactus.

Wildlife - habitat and corridors: corridors for wildlife and plant movement**, r**efuge for megafauna**, h**abitat for migratory species

Other: recreation**, i**ndicator for health of aquifers, resources for consumption and commercial use.

Streams

Water: for wildlife communities, for construction materials and drinking water for human populations.

Native/endemic species - native communities and vegetation

Wildlife – habitat/corridors: recharge for aquifers for wildlife, corridors for native flora and fauna fish habitat.

Other: Indicator for health of aquifers, recreation.

Grasslands

Water: Infiltration of water**,** water for ecosystems**,** water for agriculture.

Human/cultural: recreation, archaeological and historical values, traditional uses, hunting.

Other: bird and wildlife habitat, stromatolites (origin of life), carbon sequestration, erosion control, endemism with different evolutionary processes.

Other Resources

Forests: water infiltration, refugia for flora and fauna, recreation, uptake of water, refuge for wildlife, integrated management for proper operation of middle and lower watershed.

Sky Islands: speciation, recreation (hiking/camping), bird habitat, endemic species, genetic reserves, refugia for climate change, host boreal forests and other ecosystems, foster wildlife connectivity, connects wildlife corridors, landscape and ecotourism.

Cuatro Cienegas: ethnic values, technological values, ecotourism, endemic species, historic and archaeological value, landscape.

Aquifers: water for life, recharge for human consumption**; s**upport of springs, streams, and grasslands ecosystems**;** water for base stream flow; water for agriculture and ranching; water for ground stability; obtaining resource for consumption and/or commercial uses.

All: preservation of natural resources for future generations, ecotourism – know in order to protect, support vegetation communities important for pollination.

Collaboration Opportunities

Science and Data

- Geospatial data that delineates where resources are located – species and vegetation maps, condition maps, etc.
- Inventorying and organizing existing information, in addition to generating new models and technologies for the maps
- Establish shared methodologies for inventory and monitoring
    - First identify parameters – what needs to be measured on both sides of border
    - Make a working group to standardize methodologies
    - Build off of springs effort
        - NOPS has protocols for springs, streams, and uplands (grasslands/shrublands/forests) which could be a template
    - Consider using pilot areas to standardize methods locally, instead of trying to standardize for entire DLCC first

- Need monitoring database of all species across the DLCC to help avoid duplication. Many southeast US states have species databases at universities or government agencies.
- Citizen science – ask people to enter the flora and fauna they observe
- Groundwater recharge resources:
    - Dr. Scanlon - University of Texas, Austin
    - National Commission for water banks - Arizona.
    - Physical Assessment Project on utilities - Dr. McCain (University of Texas) and Senovalsoles (UC Davis)

Tools Needed

- Platform for collaborating and capturing information, with ability to set dates and times for completing work
- Tools to design future landscapes, which take into account local areas sedimentation, carbon capture, water quality
- List of best management practices for Springs, Streams, and Grasslands that pertains to desert ecosystems

Communication, engagement, collaboration

- Communicate to diverse stakeholders about the value of ecosystem services
- Workshops in the next 2-3 years – participate as a group
- Use the DLCC to combine knowledge and best practices of different organizations

Governance

- IMC-US – identifying areas where they want to restore the natural area
- Vote for environmental governance, so that people adopt responsible environmental practices

Funding and resources

- More funding for staff, project management, science
- Guidelines for avoiding duplication of projects/funding expenditures

Other

- Create and increase social and policy support for the science
- Share strategies on controlling invasive plants
- Expand the model of cattle ranching developed by ProNatura

Partners and stakeholders

Organization/ People	Where they are working	What they are doing
DLCC	All over region	Meet once a year
Sister Parks – CONANP and NPS	National parks in US	Adapting spring monitoring protocols in US to Mexico; identifying whether they apply to needs in Mexico. Currently writing proposal
BLM USFS, US States		Developing same monitoring methodologies
USDA	US – non-desert areas	Best practices and treatments that could be used as a base for desert methods
WWF, NPS	High area of Sierra	Locating areas to be part of a relationship

	Tarahumara and lower area of Sierra Cuenca	with Big Bend.
WWF	Rio Conchos	Bi-national project on water management and social inclusion (human health, nutrition, and wellbeing in this area)
WWF, UNAM, FCS, UANL, Profauna, IMC-US, Bird Conservancy of the Rockies, and TNC		Conservation and management of grasslands
WWF	Tarahumara	Studying the biodiversity and ecosystem services of the area
WWF, UNAM Ecological Services Institute, UANL, Profauna, IMC-US, Bird Conservancy of the Rockies		Preservation of grasslands
IMC-US	Valles Centrales	Grassland conservation and management, environmental education
NPS		Creating a plan to monitor effectiveness of vegetation management and aquatic flows. Will implement part of the plan this year.
NPS		Investigate management actions on aquatic fish and birds
Pronatura	Valles Centrales, El Takio, Mapi mi, Malores del Carmen, Cuatro Cienega	Grassland conservation, public policies, sustainable ranching
Pronatura		Wetland (springs and streams) preservation

Pilot Area Discussion

Participants discussed the possibility of combining the Lower Rio Conchos and Valles Centrales nominated pilot areas into one pilot area.

Challenges of expanding and combining areas -- the combination of the two areas has already changed the dynamics of the potential project, and expanding it further could be too much.

Separate geographies – are there relevant ecological links? Although Valles Centrales is one of the most important in Chihuahua, Rio Conchos and Valle Centrales are geographically different basins. There are various functional links between the lower Rio Conchos and the Rio Grande, but not as many links between the Rio Conchos and Valles Centrales. The functional links will determine the science, which will define the science and management processes. Without sufficient functional links it will be complex and difficult to meet the DLCC pilot area objectives.

Timing – communicating between the Rio Conchos and Valles Centrales is a great idea, but it could take two years to implement the results of even a small pilot project. Valles Centrales needs to make improvements fast - they are running out of water for ranchers who depend on grasslands.

Incongruent objectives

- Not sure whether the Rios Conchos desired future conditions would be the same as Valles Centrales. This could make the areas difficult to combine.
- Attempting to compile a large number of issues across the two geographies could be insurmountable for a small pilot project.
- The project is supposed to deliver a set of desired future conditions, or conditions that we can measure that are acceptable to all the stakeholders. Common monitoring protocols and quality GIS layers could be other objectives.

Opportunities combining Rio Conchos and Valles Centrales - They are right next to each other. Collaboration will be useful in the future so why not start now? There are only two water reserves in Chihuahua. Since January 2015, the World Wildlife Fund has been developing strategies through workshops for implementing the preservation and defense of water reserves for Casa Grandes River. This effort is related and will need many participants to develop it.

Conclusions from pilot area discussion

- Participants are unsure about the pilot areas selection process and objectives for implementation.
- The Rio Conchos/Rio Grande and Valles Centrales groups need to talk with decision makers at the DLCC about the aims of pilot projects, and whether functional links can be found between the two areas.
    - Very little time for revise the application before the deadline. If the groups do want to combine on an application, the conversation needs to happen soon.
- It is important that the local residents inform the pilot area process. Other LCCs have used scientists to determine the pilot areas from top-down. Because the partnership directs the process, the DLCC is looking for guidance from diverse participants. The idea of pilot areas is to find whether a certain approach works in the area; and then over time, that approach can be expanded to other areas. The idea is to find a process that will work over many areas.

Appendix K: Mojave/Baja California/Sonora, Aguascalientes

Breakout Group Participants

- Aurora Breceda, *Centro de Investigaciones Biológicas del Noroeste, S.C.*
- Armand Gonzales, *California Department of Fish and Wildlife*
- Federico Godinez, *Comisión Nacional De Áreas Naturales Protegidas*
- Gabriela Caloca Michel, *Pronatura Noreste*
- Juan Carlos Leyva Martinez, *Pronatura Noroeste A.C*
- Junko Hoshi, *California Department of Fish and Wildlife*
- Noe Santos, *U.S. Bureau of Reclamation*

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. Participants identified the following additional resources:

- Oases
- Tropical dry forest
- Dune (interior and coastal)
- Desertscrub - Alkalai, xeric, and general (Matorral Desértico - Alkalai, Xerófilo y general)
- Desert wash
- Cienegas (Natural and artificial)
- Washes
- Salt flats (salitrales)
- Artificial wetlands
- Volcanic landscape
- Tinajas (*Note: Reserva Pinacate has this data)*

Resource Values Relevant to this Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Wetlands/Ephemeral Washes/Rivers (Humedales/Arroyos Efimero/ Arroyos)

Cultural

- Wetlands in particular are associated with presence of ancestral communities

Biodiversity

- High species richness
- Washes - one of the highest biodiversity habitats in the deserts. Why does it matter? → Doesn't just include rare or endangered species. It's all species. Ecosystems depend on biodiversity. One of the most important values

- Ephemeral washes – help sustain wildlife and livestock
- Washes – provide habitat to many species of birds, and have higher biodiversity than other desert habitats

Corridors/habitats

- Washes – often are main movement corridors
- Rivers/washes – critical habitat for fish and macro invertebrates; biologic corridors
- Important for migratory species
- Wetlands – provide fisheries, and refuge for local and migratory wildlife
- Bird habitat
- (rivers/streams) biological corridor for different river species

Water quality

- Routes sediment
- Artificial wetlands - environment services (improves water quality)

Recharge

- (rivers) recharging of aquifers

Oases/Springs/Cienegas/Tinajas (Oasis, Manantiales, Cienega)

Cultural landscapes

- Oases and springs are always linked to ancestral cultures. Needs to be researched and communicated.
- Oases - Biocultural areas with many endemic species. Cradle of agriculture and wildlife in the desert.
- Source of water and life
- Butterfly used in traditional dance (mariposa cuatro espejos)
- System of pathways that connect tinajas; and many associated cultural artifacts

Endemics

- Oases - Endemic agro-biodiversity which is threatened
- Very important part of biodiversity
- Habitat for many fish species: Long valley speckled, Owens speckled dace, Owens pupfish. These are often the only surface water areas available to desert species.
- Tinajas – Water reserves very important to wildlife. (Pinacate has database)
- Habitat for endemic species
- Point source springs – endemic species value

Migration

- Habitat for migratory birds (Cienegas)

Temperature

- Help to regulate temperature

Grasslands (Pastizales)

- Erosion control; stabilize soil
- Connectivity / species corridors

- High species richness
- Carbon fixing

Coastal environment/Salt Flats (Ambientales Costeras)

- Protection to coast
- Coastal wetlands - Protect coast and are reserve for many threatened species
- Salt flats - Extreme environments and are very old places; sources of life. Mining areas for salt
- Important areas for nesting marine birds along the coast

Tropical dry Forests (Selvas Secas)

- Very old ecosystems, rich in species, transition areas between desert and tropical.
- They sustain a large rural population and these areas have been transformed
- Retention of water to recharge the aquifer
- Selva Baja California – high rates of endemic species
- Migration sites for neotropical birds

Dunes

- Mobile dunes are exceptional landscapes. They have a landscape value. Aesthetic value. Intrinsic value
- Popular for recreation
- Coastal dunes - vegetation is an important protection against erosion

Endemics/biodiversity

- Habitat for many endemic species which are very adaptable
- Offer habitat diversity
- Habitat for endangered fringe-toed lizard (under pressure from recreation users), and flat-tailed horned lizard.
- Help protect the coast. Very fragile ecosystems, with many endemic species

Desert Scrub/Alkalai Desertscrub/Matoral Xerófile

- Desertscrub - Important habitat for desert species such as desert tortoise and Mojave ground squirrel. Under development pressure for renewable energy and fragmentation from roads, transmission lines and water cannels. Supports monarch butterfly migration
- Alkalai desertscrub – Habitat for desert tortoise. Pressure from non-native burro and horses. Warmer and more rain than Mojave.
- Many vegetation types occur and provide habitat diversity
- Habitat for endemic species
- Provide corridor/connectivity
- Xerofile Desertscrub – Most extensive vegetation type in the region. Performs multiple ecosystem services such as soil protection, sustaining livestock. Has species that have evolved in arid conditions. It is a buffer/transition zone

Volcanic Environment

- Exceptional landscapes, with an intrinsic value that is very important to preserve in perpetuity. Majority are not impacted, so aesthetic value is quite high
- Harbors unique species

General

- All areas of water are extremely important in the desert!

Main themes across resource types

- Water
- Biodiversity
- Endemics
- Connectivity
- Cultural aspects
- Landscape aesthetics
- Erosion control
- Working Lands

Values that might come into conflict

- Dunes and recreation: culturally dunes have a recreational value, but it is also a threat for these dunes. Uncontrolled recreation is really the problem. Walking, hiking, bird-watching is not the problem. When we talk about recreation, it all depends on the type. Some things degrade habitat, but others do not.
- Development of renewable energy and agriculture can lead to habitat loss or fragmentation
- Agriculture (and water used for agriculture) can lead to loss of habitat
    - Agriculture does create habitat loss, but at times it can create artificially high populations of some species like burrowing owl or hawks that have no other place to go.
- There has been recent research which suggests the conservationists' efforts to translate everything into economic value, leaving out aesthetic value, is counterproductive. Aesthetic value is what motivates people.

Collaboration Opportunities

Stakeholder assessment

- Find the experts. Those here today know about specific things, but there are those who work with the stressors/pressures we've identified. We need to identify the people who are experts in these topics.
- Make a map of the stakeholders that work within the geographies (this is already being done)
- Cataloguing of partners
- Utilize existing information. Look at what is currently being done, what initiatives are already happening; what is working well. Identify these on a map. Look for areas where there has been success. Look at overlapping areas and gap areas.
- Establish channels for collaboration/cooperation. Being here together is important.

Identify priority areas/factors

- Make a map of high priority areas and provide map to local planning agencies and local governments. For example: Map the important resources (those we've discussed), by convening groups of experts to zero in on the *most* important.

- The list generated today of high values, can lead to delineation of high priority areas. Start working on this kind of product. Use the information we have right now.
- Systematic approach - Identify most important ecological factors for conservation. And extrapolate the goal from there.

Identify common ground and common interest
Current examples of this:

- California State Wildlife Action Plan: Identified common interests and funding resources
- Pronatura: Workshops to identify issues at the basins, and then achieve formal commitments in the watershed/basin area
- Protected areas have assessment committees. Example: In Pinacate Biosphere Work for consensus. Conflict situations are dealt with by a multi-disciplinary assessment committee (3 levels of government). There are also collaboration agreements at different levels bi-laws, etc.
- Oasis group – Researchers network for multidisciplinary study of oases

Involve decision-makers

- Get decision-makers in this conversation. It's too bad that Mexican government agencies are not represented at this meeting. Need to involve Conafor, CONANP, UNESCO, CONABIO, etc.
    - DLCC is having these discussions and working to align higher level engagement.
- Consider public policies that are working and how we integrate and work with these.

How Landscape Conservation Planning and Design Can Help

- We would like to see a systematization of information. There are so many layers of information. We want to learn about existing tools and technologies that we can use.
- Alignment at multiple levels
- Want information about what is going at large landscape level with climate change.
- LCC's are good at supporting research. It would be useful to get support for the development of management plan, that would lead to more actionable ideas/outcomes.
- Hard to understand how this (DLCC –LCPD) can help us in a practical way. What is the issue with funding?
    - Pilot projects will match up actions with potential funding sources. The hope is that the plans will help leverage funding that is specific to individual partners' goals.

Appendix L: Aguascalientes, Aguascalientes Workshop

Breakout Group Participants

- Abraham de Alba Avila, *Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias*
- Abraham Díaz-Romo, *Universidad Autónoma de Aguascalientes*
- Adrian Raymundo Quero-Carillo, *Colegio de Postgraduados en Ciencias Agrícolas*
- Carlos Alfredo Flores de Anda, *Bosque de Cobos A.C.*
- Cid Leana Morales, *Universidad Autónoma de Aguascalientes*
- Ernesto Flores Ancira, *Universidad Autónoma de Aguascalientes*
- Vianney Beraud, *Centro de Investigaciones Biológicas del Noroeste*

Additional Resources in this Geography

Participants were asked to reflect on the area under discussion and identify additional resources (additional to the Desert LCC focal resources of springs, streams, and grasslands) that will be important to consider and incorporate in landscape conservation planning in this area. Participants identified the following additional resources:

- Lakes – river communities and economic effect of these resources on communities
- Shrubs and dry forests
- Temperate forest (Oak and Pine)
- Human dimensions
- Cienegas
- Reconverting areas: restoration of grasslands – that were previously used for agriculture
- Migratory birds and tropical birds that are locals but move seasonally
- Endemic amphibians and reptiles (e.g. turtles, rattle snakes, frogs)
- Native fish

Resource Values Relevant to This Geography

Participants were asked to discuss the socioeconomic values of springs, streams and grasslands, as well any additional important resources in the geography. They discussed why people care about these resources and how they use them.

Springs

- Wildlife use
- Conservation of fauna
    - Refuge for reptile and amphibian species
- Indicators of opportunities – conservation and health
- Water for human use/ consumption
    - Urban
    - Rural
    - Economic - sustainable production of springs for agricultural and other uses
    - Needed for drinking for locals – potability
- Aesthetic
- Regulation of climate

- Recreation

Streams

- Provide hydrological bank - recharging rainwater
    - Recharging aquifer through permeable surfaces
- Tourism
    - Recreation
- Water for livestock
- Biological corridor - continuity bridge – spaces that allow continuity of life
- Refuge for fauna y flora
    - Fauna are concentrated here
- Biodiversity

Challenge – urban runoff, "black water"

Grasslands (*50% of the land here)*

- Providing genetic diversity
- Habitat for species
- Production
- Function and structure of the ecosystem as a whole
    - Carbon capture
    - Production of oxygen
- Cultural Values - Traditions
    - Music, corridos, related to the human traditions of using grasslands
    - Food - production of meat
- Conservation of land as open space
- Protection of land

Other Values in this Geography

- Aesthetic
- Historical
- Cultural
    - Music
    - comida
- Paisaje natural spiritual
- Carbon sink
- Ethnobotanical plants, medicine plants
- Environmental value s
    - Migrations of animals, corridors
    - Water recharge

The group discussed environmental services including restoration, biodiversity, productivity of grasslands and that a service of the grasslands is protection of the land including protection of the soil and all the biotic communities.

Highest Impact Pressures and Stressors

- Fragmentation is affecting all of these values
    - Planning at a broad scale is very difficult because land is broken into small parcels
    - Fragmentation of biological connectivity
- The use of the land for recreation
- Changes in land use
- Lack of awareness and sense of place for residents that use and live near springs, streams and grasslands in Mexico
    - We need the public to be conscious of these resources and feel proud that Mexico is the place of origin of many species – the government and research institutions have not recognized it
    - Need to feel proud about endemic species
    - Lack of awareness and sense of place in country as a whole from government down to land unit
    - Need to understand how Mexico's resources and species have value for all of north America
- No indigenous people in Aguascalientes so missing some of that connection, in other places of the country there are indigenous groups that have these values
- Overexploitation
        - Need to adjust the amount of cattle to what the land can handle
- Lack of habitat management
- Climate change
- Increase of population worldwide – increasing demand for food production which affects grasslands, springs, streams
- Lack of scientific understanding of grassland production and how to link it with conservation
- Lack of understanding and documentation of the cost of food production to grassland and water ecosystems (e.g. how much grassland is linked to producing a single cow, how much cost, how many people eat that cow etc.)
        - Understanding cost/benefit of utilizing grasslands, streams, springs to produce meat
        - Quantifying total cost of cow production, environmental cost
- Mexico is not united, have had many changes in government, need to join together to solve,
- Mexico does not invest (except industry/education) in high technology for the grasslands - there is money but it is not being applied – for better production and/or conservation

Collaboration Opportunities

- Public policies are needed to solve the problems that exist in ecoregion
- Messages need to get out to a larger audience - massive diffusion – radio/television, this also needs to include education at all levels
- FODA - a tool to identify analysis of threats, strengths opportunities, weaknesses
- Movement in Mexico called Resilient Mexico – decision makers are there from MX agencies and have, is new: DLCC can have chair at these meetings to address important conservation issues

Develop functional Alliances to address grassland and water conservation issues

- There is a need for cross-cutting efforts to look at advancing grassland production in Mexico

    - Suggestion for a center of investigation to bring together entities currently working independently
    - Address problems with CONACIT – national commission on science and technology
- A union of researchers and ranchers to work together is needed
- Extension organization here INEFAT - Organization that supports landowners with information – depending on budgets and policies – INEFAT is hierachcical
- Agricultural producers do not think about springs/streams/grasslands as different resources
- Management of the landscape (integrated) – know where we are and where we are going – monitoring
- Help native species recover by resting grasslands
  Individuals – property owners are essential

To Address Fragmentation:

- Look to societies where this issue has been addressed such as Mongolia for strategies and approaches
- The Federal Extension Service no longer exists, NGOs are needed to fill this roll of coordination and knowledge dissemination

To Address Water Challenges:

Pollution

- Flow is being diverted for industrial uses such as mining, fracking and agriculture, and polluted, before it reaches downstream communities who can no longer use the toxic water (e.g. San Luis Potosi, a Mill factory polluting water to be subsequently used for cattle/agriculture)
- In Calles have the biggest dam in Mexico, San Pedro River changed its flow, now river goes through Aguascalientes (problem from Dam to city) but also from basin down to Jalisco,

Other Issues

- Lack of planning at the watershed level
    - CONAGUA legislates use of water
    - Water is cheap – but water could be priced appropriately to foster preservation
- Lack of effective tools for citizens and organizations to address water issues – lawsuits don't go anywhere
- Value retention of vegetation to mitigate/respond to climate change
    - Xeriscaping and native vegetation here versus the gardens currently here that are being watered, on Aguascalientes University Campus. It is not just about looking nice but about modeling this as aesthetic to the students.
    - We need a scheme of communication that is very simple so an accountant or lawyer can understand what species is adequate to use or how to conserve water/soil – maybe need portal with simple information on how to slow climate change and protect native plants.
    - Water is a scarce resource so need to charge for it adequately – why is the water used for irrigating plants like corn and alfalfa instead of irrigating for milk farms,

To Address Other Challenges

- Increased production of meat conflicts with other values such as preservation of grasslands, springs and streams
    - Need equilibrium of use that respects ecological values

    - The agricultural producers need information, and financial support to address these issues
    - There is resistance to change among producers
    - Many producers that take cattle off, don't wait until the grassland actually recovers so the government tells them to plant buffelgrass – this is in conflict with grassland ecosystem preservation
- CONAFOR has a program they copied from BLM and are paying producers to let the land rest, plant some plants but producers don't have the knowledge so introduce plants like buffel grass, but it is a problem.
- We need a new economic model for Mexico, the current one is old and worn out, based on oil and fuel, industries – not on grassland preservation. For example in Spain they follow ecosystem cycles, don't have high technology, just use common sense and natural cycles.
- There is a lack of education and new people working in agronomy., more of a focus on science and technology for manufacturing. To progress we need to help young people develop basic skills for producing food (e.g. cattle ranching)

How Landscape Conservation Planning and Design Can Help

- Identifying and magnifying success cases – Oaxaca is an example where there are community programs, people respect management of lands and the grasslands are returning.
- Making contacts with the agencies so the DLCC can be present and have opinions about policies (e.g. Mexico Resilient, some NGOs, Cattle National Organizations CNOG)
- Construct/build joint projects – like the pilot areas, or "magical ejidos"
    - Highlight Ejidos with successful management and how to replicate it
    - Ejido project where getting paid for carbon sequestration, recharging water etc.
    - The DLCC can work with local and state authorities and also bring the information to Universities, government and society.
    - Invite/include producers (land owners) in the DLCC cooperative
    - Horizontal integration, between Mexico cooperatives and entities and the Desert LCC
        - CONANP and INEC have expressed that they don't want to make a Mexican LCC because then it is not integrated
- An LCC leadership exchange between the Desert LCC and Mexico partners so Mexican partners can understand the structure of DLCC and so the Desert LCC can understand how things work in Mexico in order to work better together
- Presenting about the Desert LCC at grassland conferences – being there, being in front of the experts and letting them know about the process
- Share experiences between members of the DLCC
- Improve information available on environmental services and provide strategies for valuing environmental services
    - How can private producers (who own 60% of land in Aguascalientes) be incentivized

Appendix M: Workshop Participant Summary

Participants are summarized by workshop Location.

Tucson Workshop Participation

Total participants in Tucson: 93

Federal Government (35)

- Bureau of Land Management
- U.S. Forest Service
- U.S. Fish and Wildlife
- U.S. Geologic Survey
- National Park Service
- Bureau of Reclamation

Organization/Association (22)

- Arizona-Sonora Desert Museum
- Bird Conservancy of the Rockies
- Cascabel Conservation Association
- Huachuca Audubon Society
- Lower San Pedro Watershed Alliance
- Sky Island Alliance
- Southern Nevada Water Authority
- The Nature Conservancy
- Tucson Audubon Society
- Wildlands Network

University/Research Unit (13)

- University of Arizona
- Northern Arizona University
- Water Resources Research Center (University of Arizona)
- Spring Stewardship Unit (Museum of Northern Arizona)

State Government (6)

- Arizona Game and Fish Department
- Arizona State Forestry
- California Department of Fish and Wildlife
- Texas Parks and Wildlife
- Southern Nevada Water Authority

Tribal Government (6)

- Hope Tribe

- Tohono O'odham Nation
- Navajo Nation
- Bureau of Indian Affairs

Local Government (4)

- Pima County
- City of Tucson
- Town of Prescott Valley

Independent/Other (7)

Aguascalientes Workshop Participation

Total Participants in Aguascalientes: 41

Organization/Association (17)

- Arizona-Sonora Desert Museum
- Bird Conservancy of the Rockies
- Bosque de Cobos, AC
- Ecosistémica, AC
- IMC Vida Silvestre, AC
- Pronatura Noreste
- Sky Island Alliance
- World Wildlife Fund - México
- World Wildlife Fund

University/Research Unit (10)

- Centro de Información de la Frontera Texas/México
- Colegio de Postgraduados en Ciencias Agrícolas
- Instituto de Geofísica de la UNAM
- Springs Stewardship Institute, Museum of Northern Arizona
- Universidad Autónoma de Aguascalientes
- University of Arizona
- Water Resources Research Center, University of Arizona
- Centro de Investigaciones Biológicas del Noroeste

Federal Government (6)

- Big Bend National Park, National Park Service
- Comisión Nacional De Áreas Naturales Protegidas
- Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias
- U.S. Bureau of Reclamation

State Government (4)

- California Department of Fish and Wildlife
- Secretaría de Medio Ambiente y Desarrollo Territorial (Jalisco)
- Secretaría de Medio Ambiente Nayarit

Other (2)

Appendix N: Main Pressures and Stressors

(*Identified by Desert LCC Critical Management Question 2 Team*[2])

Main Pressure/Stressor	Sub-pressures/sub-stressors
Livestock, farming, and ranching	• Unsustainable grazing • Changes to drought-adapted grazing species (e.g., from cattle to goats or exotics) • Increased groundwater pumping to attempt to maintain farming • Increased spread of invasive plant species (e.g. planting exotic forage and passive spread) • Increased disease transmission from domestic to native species. • Competition for water resources with native species. • Altered streambank structure and erosion from domestic animal pressure • Increased nutrient loading from animal waste
Mining and quarrying	• Habitat destruction and modification • Disturbance from mining activities (e.g., noise, lights, dust) • Loss of topsoil/increased erosion • Harmful/toxic byproducts (including those in ponds and downstream)
Renewable Energy Infrastructure	• Habitat loss (Footprint of installations) • Increased invasives (due to increased traffic) • Loss of water due to increased water use • Habitat fragmentation (transmission lines, roads) • Direct mortality from wind and solar power to wildlife (e.g. to raptors and other migratory birds) due to transmission lines, facilities/structures, and risk of concentrated solar power
Logging and wood harvest	• Altered vegetation composition and structure • Increased erosion after logging due to rainfall events • Increase in water temperatures (in streams, etc.) due to lack of shading • Increased stream sedimentation (including from logging roads and other infrastructure) • Habitat loss due to forest harvest (e.g., total forest loss or loss of multi-story and/or various age classes needed for some species, degradation of riparian habitat)

[2] CMQ 2: Monitoring Species/Processes Relative to Climate Change and Related Threats/Stressors

Fire and fire suppression	• Increasing fire frequency, size, and/or severity outside of historical range of variability (e.g.,from increased human-caused fire ignition rates, build-up of fuels) • Decreasing fire frequency, size, and/or changes in severity outside of historical range of variability (e.g., from fire suppression). • Change in timing/seasonality of fires • Invasive or exotic species (e.g., fire-adapted, new aggressive invasives that will likely alter fire regimes) • Management treatments/actions that might result in undesirable effects (e.g., soil erosion, watershed/stream erosion, stream sedimentation, water quality, increased invasive or exotic species)
Dams and water management/use	• Altered hydrology (e.g., flow regimes, including changes in peak flows) • Increased groundwater pumping • Decreasing water availability (including timing), affecting aquatic and riparian habitat • Stream channelization • Changes in ground water recharge • Reduced aquatic habitat connectivity (e.g., with salmonids) • Terrestrial habitat loss (e.g. from new dams) • Changes in sediment flow • Altered water quality (e.g., changes in dissolved oxygen, temperature, salinity, pollutants, etc.)
Invasive species	• Spread of invasive non-native and native species (e.g., bark beetle, cresosote, mesquite tamarisk, etc.) • Reduced resilience to disease (due to increase in invasives and drought stress, etc.) • Increased competition with native species due to climate change • Changes in community composition
Agriculture and Forestry effluents and pollution	• Changes to sedimentation (in streams, lakes, etc) • Increased soil erosion • Herbicide runoff • Increased nutrient loading from fertilizer/manure runoff • Changes to chemical/mineral composition and trace elements
Climate Change: Habitat shifting and alteration (*continued from previous page)* Climate Change: Habitat shifting and	• Sea level rise • Shifting of climate zones/envelopes • Changes in forage or cover (e.g., availability, structure, or composition) • Changes in habitat connectivity • Uncoupling of community relationships (e.g., host plant-insect, predator-prey relations, trophic or

alteration	phenological mismatch) • Providing competitive advantage to invasive species
Climate Change: Drought	• Desertification (e.g., dust, loss of top soil and organic matter, dramatic vegetation changes, dune migration, etc.) • Increased length, frequency and intensity of drought • Decrease in water availability to the ecosystem • Increased erosion (e.g., vegetation loss leading to wind erosion) • Conditions exceeding species adaptive capacity
Climate Change: Temperature extremes	• Increased frequency of extreme heat events • Increased frequency of extreme cold events • Changes in oceanic temperature (e.g., Sea of Cortez) • Altered annual average temperature • Changes to soil temperature and soil moisture • Changes in evapotranspiration • Changes in precipitation type (e.g., rain versus snow) • Phenological changes (e.g., earlier onset of spring and other seasonal changes)
Climate Change: Storms and Flooding	• Changes in frequency and intensity of flooding (e.g., altered pulse flows in rivers or flows in dry washes) • Changes in timing of flooding due to changes in precipitation timing • Changes in frequency, timing, and intensity of storms. • Changes in sediment deposition patterns
Ecosystem effects	• Increased habitat fragmentation (e.g., from development, land conversion, etc.) • Loss of ecosystem services • Changes in community composition • Changes in disturbance regime • Changes in carbon storage capacity • Changes in nutrient cycling

Appendix O: Pilot Area Nomination Form

Landscape Conservation Planning & Design
Pilot Area Nomination Form

(Total pages should be 6 or less)

Background information:

The Desert Landscape Conservation Cooperative (LCC) is designing a process that will:

- produce spatially explicit data and information about focal resources chosen by the Desert LCC partners (grasslands/shrublands, streams, and springs, including riparian and aquatic resources);
- seek to understand the effects of climate change and other landscape stressors on natural resources;
- integrate social, cultural and economic information to understand what these resources might look like in the future; and
- look at specific focal areas to develop collaborative adaptation responses that are useful and implementable by our partners.

Landscape design is the integration of societal values with ecological goals, using science based in landscape ecology to provide a variety of scenario plans that describe where conservation can best be achieved and how it relates to measurable goals. In 2014-2016, the Desert LCC is engaging interested parties in determining design priorities, compiling and curating existing information and resources, determining what additional information, tools, or resources are needed, and developing plans for 2-3 pilot Landscape Conservation Designs within the Desert LCC geographic area.

We are currently requesting nominations for pilot areas of interest to our partners.

New Due Date: September 18, 2015

For questions and to submit nomination forms, please contact: Duane Pool at duane.pool@rmbo.org

Additional information:

Desert LCC Website: www.usbr.gov/dlcc

Desert LCC Conservation Planning Atlas: http://dlcc.databasin.org/

Desert LCC Critical Management Questions:

http://www.usbr.gov/dlcc/resources/docs/DLCCCMQs.pdf (English)

http://www.usbr.gov/dlcc/science/2013/docs/DLCCCMQs-handoutSPA.pdf (Spanish)

Pilot area name:

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.** *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)*

2. **Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.** *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)*

3. **Describe the primary management questions or concerns in this pilot area.** *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)*

4. **Describe the major partners or partnerships working in the pilot area.** *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)*

5. **Briefly describe the types of conservation or management activities currently occurring in the pilot area.**

6. **At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.**

7. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

8. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

10. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

11. **Describe resources available for implementing conservation planning and design activities in the future.** *(Include information about partner's willingness or ability to implement conservation activities on the ground.)*

12. **Provide a shapefile (or similar file) of the pilot area boundaries.**

13. **(Optional) Describe any additional conservation opportunities in this pilot area.**

14. **(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.**

15. **(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination.** *(Including established goals and objectives associated with springs, streams, grasslands.)*

16. **(Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.** *(Include photo credits and captions).*

Appendix P: Pilot Area Scoring and Methods

Pilot Area Scoring Methodology

The LCPD working group developed a method for applying the Steering Committee approved pilot area and pilot area portfolio selection criteria. The LCPD core team held calls with the working group and utilized collaborative online tools to arrive at the scoring rubric available below. We then held calls with the LCPD working group to review individual scoring of pilot areas, and discuss potential portfolios. We asked reviewer to provide written comments on the strengths, learning opportunities, weakness and outstanding questions/concerns for each of the nominated areas. The LCPD working group reviewed pilot areas independently, then the team aggregated their scores and comments and lead structured discussions to arrive at the proposed combination of pilot nominations for the LCPD portfolio.

Pilot Area Scoring Criteria

Pre-screening Criteria Already Addressed by LCPD Team

- Are there any significant issues that would preclude the DLCC from pursuing Landscape Conservation Design in this pilot area?
- Does the nomination demonstrate a nexus to the DLCC mission?

Scoring Criteria

Please use the associated scoring sheet in excel to score each of these criteria on a scale of 1-5 where 1 is low or less relevant, 3 is neutral, and 5 is highest or most relevant (see each criteria for more detail). Note that each numbered criteria lists associated questions in the pilot nomination form.

Landscape-scale project with nexus to climate change

1. Does the nomination demonstrate conservation challenges that need a landscape-level approach and connect to the larger Desert LCC geography, in other words are the problems in the area "too large in scope for any one agency, organization, or individual to solve alone"? (Q1, Q2, Q3, Q7, Q10)

   1 = conservation challenges are very localized and/or being addressed by a single entity in a way that does not connect to other resources/entities
   2 = either a high "1" or a low "3"
   3 = not sure; conservation challenges are more wide spread and/or relevant to some entities in the area, may be relevant to more than one resource, and do not appear to be addressable by a single entity
   4 = either a high "3" or a low "5"
   5 = conservation challenges are clearly demonstrated to be wide-spread in the region, affecting multiple different resources and/or relevant to multiple entities in the area and cannot be addressed by a single entity

2. Does the nomination demonstrate a need/opportunity to address climate change and related stressors? (Q2, Q3, Q10)

   1 = nomination fails to mention link to climate change and/or does not articulate related stressors needing to be addressed
   2 = either a high "1" or a low "3"
   3 = not sure; nomination makes some reference to climate change and/or related stressors in the area, but may not be clear or seem significant
   4 = either a high "3" or a low "5"
   5 = nomination demonstrates a clear connection to climate change and/or other related stressors

Potential to implement design

3. Does the nomination present evidence of sufficient partnerships, collaboration and partnership resources to develop and implement a conservation design at the scale/scope of the issues in the nomination? (Q4, Q5, Q11, Q13)

   1 = key partners, collaboration and/or resources appear missing or partnerships do not appear strong enough to successfully create and implement design
   2 = either a high "1" or a low "3"
   3 = not sure; partnerships, collaboration and resources may be adequate to create and implement design
   4 = either a high "3" or a low "5"
   5 = partnership clearly has strong capacity, proven record of collaboration and should be able to successfully create and implement design

4. Does the partnership/collaboration appear to have or to be able to get the necessary resources to conduct conservation design activities and implement the design in the future? (Q4, Q5, Q11)

   1 = partnership resources appear missing or partnerships do on appear strong enough to successfully create and implement design
   2= either a high "1" or a low "3"
   3 = not sure; partnership resources may be adequate to create and implement design
   4= either a high "3" or a low "5"
   5= partnership resources are clearly present to be able to successfully create and implement design

5. Does the nomination demonstrate the connection between current partner conservation/management activities, and goals/objectives and how the LCPD would contribute to achievement of those activities and objectives (the probability of the partners to implement the design) (Q5, Q6, Q9)

   1 = little or no evidence that the partners activities and goals/objectives can be connected to design creation and implementation, unclear that LCPD would be integrated into future work
   2 = either a high "1" or a low "3"
   3 = not sure; the connection between partner's activities and goals/objectives and design creation and implementation is not clear, the partners may be able to integrate adaptation strategies into their future work
   4 = either a high "3" or a low "5"

5 = there is a strong connection between partner's activities and goals/objectives and how they indicate LCPD will contribute to meeting their objectives which indicates strong likelihood of LCPD integration into future work

Nomination includes species and habitats of management interest

6. Species: Does the nominated area support species identified as species of management interest or concern by relevant federal, state, Tribal, or local government, NGO, or private landowner conservation goals? (Q1, Q3, Q6)

   1 = little evidence of presence of species identified as species of management interest by multiple entities in the area, may be very few species identified, limited evidence of what management issues are, or species appear to be relevant to minimal number of partners
   2 = either a high "1" or a low "3" in your opinion
   3 = not sure; some evidence of presence of species identified as species of management interest by multiple entities in the area, may be species relevant to select partners
   4= either a high "3" or a low "5" in your opinion
   5 = clear evidence of presence of species identified as species of management interest by multiple entities in the area

7. Habitats: Does the nominated area support habitats identified as habitats of management interest by relevant federal, state, Tribal, or local government, NGO or private landowner conservation goals? (Q1, Q2, Q3, Q6)

   1 = little evidence of presence of habitats identified as habitats of management interest by multiple entities in the area, may be very few habitats identified, limited evidence of what management issues are or habitats appear to be relevant to minimal number of partners
   2 = either a high "1" or a low "3" in your opinion
   3 = not sure; some evidence of presence of habitats identified as habitats of management interest by multiple entities in the area, may be habitats relevant to select partners
   4= either a high "3" or a low "5" in your opinion
   5 = clear evidence of presence of habitats identified as habitats of management interest by multiple entities in the area

8. Vulnerability Does the nomination demonstrate that there are species, habitats and/or resources in this area shown or predicted to be vulnerable to climate change? (Q3,)

   1 = little evidence of presence of species, habitats and/or resources identified as being vulnerable to climate change, may not be clearly articulated or may be limited set of entities that are identified as being vulnerable
   2 = either a high "1" or a low "3" in your opinion
   3 = not sure; some evidence of presence of species, habitats, and/or resources identified as being vulnerable to climate change, may be moderately articulated or moderate amount of entities
   4= either a high "3" or a low "5" in your opinion
   5 = clear evidence of presence of species, habitats and/or resources identified as being vulnerable to climate change

Nexus to human social, cultural, and economic communities of interest in the area

9. Does the nomination demonstrate that the partners have identified and are accounting for the perspectives of concerned communities of interest with regard to the focal resources? (Q6, Q7, Q10)

1 = little evidence of how communities of interest interact with and value focal resources, may be unclear or not addressed
2 = either a high "1" or a low "3" in your opinion
3 = not sure; moderate evidence of how communities of interest interact with and value focal resources
4= either a high "3" or a low "5" in your opinion
5 = clear evidence of how communities of interest in area interact with and value focal resources

Scalability and adaptability to other areas within the DLCC

10. Does the nomination address issues, landscapes, and/or resources that may be relevant to the larger Desert LCC community (in other words does the design context seem potentially relevant to other locations and/or projects)? (Q2, and all questions)

    1 = few or none of issues, landscapes, and/or resources addressed seem relevant to other locations/projects within the Desert LCC, may very localized, specialized or address issues/landscapes and resources in a context that may not be relevant to other locations/projects
    2 = either a high "1" or a low "3" in your opinion
    3 = not sure; a few or more of the issues, landscapes, and/or resources addressed in the nomination may be relevant to other locations/projects within the Desert LCC
    4= either a high "3" or a low "5" in your opinion
    5 = Issues, landscapes, and/or resources address in the nomination seem highly relevant to other locations/projects within the Desert LCC

Portfolio - Represents the breadth of DLCC Priorities

We will apply these filters through group discussion in order to come up with several proposed portfolios of projects to recommend to the Steering Committee that addresses these

- Number of DLCC priority resources addressed, rivers/streams and riparian, springs and riparian, grasslands and shrub lands.
- Addresses bi-national conservation.

Appendix Q: Full Pilot Area Nominations

- Big Bend – Rio Bravo
- Coconino Plauteau Watershed Partnership
- Gila River Watershed New Mexico
- Lower Rio Conchos
- Northern Chihuhuan Desert
- Reserva de la Biósfera Pinacate y Gran Desierto del Altar y su área de influencia
- San Pedro River Watershed
- Transboundary Madrean Watershed
- Upper Verde River Watershed
- Western Arizona Riparian

Landscape Conservation Planning & Design
Pilot Area Nomination Form
(Total pages should be 6 or less)

Pilot area name: Big Bend – Rio Bravo

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*
Russell Martin
Texas Parks & Wildlife Department
Wildlife Diversity Biologist
(432) 837-2051 ext 228
Russell.Martin@tpwd.texas.gov

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.** *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)*

The Big Bend – Rio Bravo area (see attached map) is the heart of the Chihuahuan Desert and the core area for decades of bi-national conservation efforts. The nominated area covers 8.86 million acres (US = 4.88 & MX = 3.98) and contains eleven protected areas (see Appendix A for full list) all within the Rio Grande/Rio Bravo watershed. The proposed boundaries were chosen by selecting the HUC 8 & HUC 10 watersheds intersecting the six US protected areas and the boundaries of the five protected areas on the Mexico side. Watersheds were chosen because they represent natural, ecologically-significant boundaries relative for conservation efforts.

There are numerous partnerships cooperating within the region including the Sister Park Partnership, the Big Bend – Rio Bravo Partnership, the Big Bend Conservation Cooperative, the Desert Fish Habitat Partnership, and the National Fish Habitat Partnership.

All three of the DLCC priority resources are located within the proposed pilot area at various levels of ecological integrity, from pristine to highly degraded, which provides opportunities for conservation of highly functional resources to restoration of highly degraded areas.

2. **Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.** *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)*

The Chihuahuan Desert is one of the four major ecoregions within the DLCC geography and the largest desert in North America. The Chihuahuan's highly diverse landscape, composed of desert grasslands and sky islands, streams & riparian corridors, and seeps & springs, is noted as having one of the highest levels of biodiversity and endemic species among the world's arid and semiarid ecosystems.

Seeps & Springs – If water is life, then seeps and springs are the heart of Chihuahuan Desert ecosystem. The proposed pilot area contains countless springs which sustain a significant component of the baseflow of the major rivers and tributaries as well as springs which are remote and discontinuous from the perennial rivers.

These two types of springs allow for the ability to assess the response of large, perennial rivers to changes in hydrological processes from climate and landscape change, and of small headwater catchments to similar changes. These two different scales will allow for an assessment of species response from both isolated and connected groundwater dependent sources. The proposed pilot area includes the San Carlos, Boquillas, and Gambusia springs, which were all identified as priority conservation areas and support multiple conservation targets (ie species) in the 2014 binational conservation assessment.

Streams & Riparian – If the seeps and springs are the Chihuahuan's heart, then the streams & riparian corridors are the veins and arteries that transport life through the Chihuahuan. The proposed pilot area includes over 200 miles of the Rio Grande/Bravo river corridor as well as San Antonio, San Carlos, Terlingua, and Alamito Creeks, which were all identified as priority conservation areas and support multiple conservation targets (ie species) in the 2014 binational conservation assessment. Additionally, the Big Bend reach of the Rio Grande was identified as 2012 "Water to Watch" by the National Fish Habitat Partnership and is a priority area for the Desert Fish Habitat Partnership.

Grasslands & Sky Islands – The Chihuahuan's uplands (grasslands & sky islands) act as the lungs by capturing and filtering the winter and monsoonal precipitation patterns it receives each year. The proposed pilot area includes parts or all of the Sierra de Hechiceros y Lagunas de Sanchez y de Montoya, Marfa, Alpine, Marathon, Morelos – Los Lirios, Valle de Colombia, and Seranias del Burro grasslands as well as the Chinati, Chisos, Dead Horse, Sierra Rica, Sierra del Carmen, Mountains of the Serranias del Burro, Sierra la Encantada, and Sierra de Santa Rosa, which were all identified as priority conservation areas and support multiple conservation targets (ie species) in the 2014 binational conservation assessment. Additionally, TPWD, NRCS, and the Borderlands Research Institute have identified the Marfa, Alpine, and Marathon grasslands as a State Priority Special Emphasis Area under NRCS's EQIP program, which prioritizes NRCS funding towards restoration and management of those private grasslands.

3. **Describe the primary management questions or concerns in this pilot area.** *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)*

Within the BBRB pilot area, the primary management questions/concerns are 1) what did the landscape and Rio Grande look like historically, 2) where are priority resources in relatively healthy condition and require minimal conservation effort , 3) where are priority resources most vulnerable to stressors (ie agriculture, energy, transportation, etc) requiring higher levels of conservation, 4) where are priority resource concerns most vulnerable to climate change, 5) where would restoration of priority resources provide the greatest ecological and social benefits, and 6) to develop a conservation delivery mechanism that will facilitate the implementation of our management questions/concerns on public and private lands within the BBRB region.

		Salafsky et. al 2008 Threat Categories										
		1	2	3	4	5	6	7	8	9	10	11
Communities Affecte	Seeps & Springs		X	X		X		X	X			X

	Streams & Riparian		X	X	X		X	X	X	X		X
	Grasslands & Sky Islands	X	X	X	X			X	X			X
	Human Communities			X			X	X		X		X

Salafsky et al. 2008 Unified Classifications of Threats: 1) residential and commercial development, 2) agriculture and aquaculture, 3) energy production and mining, 4), transportation and service corridors, 5) biological resource use, 6) human intrusions and disturbance, 7) natural system modification, 8) invasive and other problematic species and genes, 9) pollution, 10) geological events, and 11) climate change and severe weather

4. **Describe the major partners or partnerships working in the pilot area.** *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)*

The US Department of the Interior (DOI) and the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP) established a Letter of Intent for "Joint Work in Natural Protected Areas on the United States – Mexico Border" in 1997. In 2006, a "Joint Declaration of Sister Park Partnerships" was established, recognizing BBNP, APFFMC and APFFCSE as sister parks. In April 2013, the Boquillas Port of Entry was opened in BBNP, providing improved working partnerships between BBNP and the APFFMC and the gateway community of Boquillas, Mexico. Since 2013, annual work plans have been established among the three sister parks.

In 2009, the Big Bend – Rio Bravo Partnership was established when the US Department of Interior and the MX Secretary of Environment and Natural Resources signed a Memorandum of Understanding intended to increase cooperation in this area to protect the region's extraordinary biological diversity, and support the conservation of this shared desert ecosystem for current and future generations. In 2014, the partnership published Big Bend – Rio Bravo Conservation Assessment, which established a framework for future conservation actions by identifying priority conservation areas and targets across the region (2009 BBRB MOU).

In 2010, the Big Bend Conservation Cooperative was established when three agencies within the Department of the Interior - the U.S. Fish and Wildlife Service (FWS), the U.S. Geological Survey (USGS), and the National Park Service (NPS) - along with the Texas Parks and Wildlife Department (TPWD) signed a Memorandum of Understanding (MOU). This initiative established a binational partnership composed of government, public, and & private stakeholders that created and published a conservation assessment for the region in 2014.The 2014 Big Bend – Rio Bravo (BBRB) conservation assessment identified resources of management concern, called conservation targets, by convening 60 experts that were involved with the partnership. The conservation targets identified in the assessment included terrestrial & aquatic species, hydrologic features, and vegetation.

The Desert Fish Habitat Partnership and National Fish Habitat Partnership are coalitions of federal, state, tribal, NGO, and local partners working to protect, maintain, and restore important desert aquatic habitats. The Desert Fish Habitat Partnership has supported several restoration projects in the Big Bend region.

A full list of participating partners is included in Appendix B

5. **Briefly describe the types of conservation or management activities currently occurring in the pilot area.**

The previously identified partners are directly or indirectly conducting conservation activities within the pilot area including management, research, and monitoring on public and private lands across a wide range of systems and species. A few examples of the partners and their activities are included in this table.

	Land Management	Habitat Restoration	Research	Monitoring	Technical Guidance	Financial Assistance	Tourism and Community Development
NPS	X	X	X	X	X		X
USGS			X	X			
USFWS	X	X	X	X	X	X	
CONANP	X	X		X	X	X	X
RGJV				X		X	
TPWD	X	X	X	X	X	X	
DFHP		X		X		X	

6. **At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.**

Recommendation #3 of the binational conservation assessment was to define conservation goals and objectives for each conservation target starting with the highest priority targets. While these goals and objectives were not established, the framework by which to define them has largely been identified so this should be one of the first steps in the LCDP process if this region is selected as a pilot area (2014 BBRB CA). Additionally, the Chihuahuan Desert Rapid Ecological Assessment is also scheduled to finalize their management questions in mid-2015, which the BBRB partnership will reference when creating management questions for the BBRB pilot area (CD REA).

At the scale of the pilot area, examples of possible goals for streams and riparian corridors could include looking at conservation efforts focused on the main channel of the Rio Grande, improved water quantity and quality monitoring, protection from pollution, and increased invasive species control, seeps and springs require additional protection and research in the lower canyons of the Rio Grande Wild and Scenic River and Monumento Natural Rio Bravo del Norte, and the uplands (grasslands & sky islands) require would benefit from research and management in the face of climate change as well as the establishment of long-term desired conditions (erosion control, sustainable grazing, rangeland reseeding) for grassland communities.

7. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

The social, cultural, and economic fabric of the local communities are intrinsically intertwined with the regions ecological health and all of the human communities within the pilot area are vulnerable to social, cultural, and economic changes that may result from climate change especially those along the Rio Grande/Rio Bravo. The BBRB region is projected to be warmer and drier under various climate change scenarios, which will adversely impact most, if not all, of the local communities as they were originally founded near and are still intimately connected with the few, scattered water sources within the region.

We can look at the 2011 drought as an example of how projected climate scenarios expose the vulnerabilities of the human communities within the pilot area. According to the 2014 Rio Grande-Bravo Climate Outlook, "the Rio Grande/Bravo Basin (RGB) is subject to perhaps the widest variety of extremes in weather and climate in the continental United States; the region is exposed to tornadoes, severe storms, hurricanes, winter storms, wildfire, and drought. The drought in the RGB… began in Fall 2010 and reached exceptional proportions in 2011... Cumulative drought impacts on the U.S. side of the border include wildfire damage, agricultural losses, urban and residential infrastructure damage, losses in energy production and interstate transmission, interstate lawsuits, and reductions in surface water supplies, with an estimated cost of more than $13 billion in 2011 alone. The ongoing drought has impacted the Mexican states of Chihuahua, Coahuila, Nuevo Leon and Tamaulipas, known for agriculture, industry, manufacturing, mining, international trade, technology development, in the following ways: agricultural losses, rangeland impacts, extensive wildfires, and reductions in surface water supplies; Mexican agricultural losses from drought in 2011 exceeded $1.3 billion."At a local level, residents in communities along both sides of the Rio Grande depend on water flows for economic revenue and subsistence. The Mexican communities are particularly vulnerable to the increased frequency and intensity of drought, changes to rain patterns, increasing temperatures, increased frequency and intensity of catastrophic fires, and increases in the frequency and intensity of diseases that are predicted to result from climate change. Business outfitters running the Rio Grande, livestock managers, and municipal water systems have all been impacted significantly from low flows.

8. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

In arid regions, areas with surface water support disproportionally more species than the surrounding landscapes. They also support high rates of endemic species. Assessment of the response of the aquatic-resources to landscape and climate change are critical to the management of these water-dependent species. Future management decisions (such as restoration actions) might include a determination of which genotypes (such as cottonwood) species, might be more appropriate for future climatic conditions.

"It is believed that these altered hydrologic and channel morphologic conditions have negatively impacted native fauna, through – via loss of high quality habitat, - and riverside towns, - through the decrease in channel capacity and accompanying increase in the frequency that these towns are flooded. In American Rivers' 15th annual report, America's Most Endangered Rivers, the Rio Grande was highlighted in the top seven as a river that "faces potential ecological collapse due to excessive consumption of its limited water supply and over-engineering of its fragile riverbed and riverside habitat (2012 CC Action Plan – Big Bend)."The 2012 Big Bend Climate Change Action Plan stated we must "identify areas of high grassland conversion and work to maintain

and/or to restore their capacity to provide the environmental services vital to the Chihuahuan society (e.g., aquifer recharge, carbon sequestration and biodiversity) has to be a priority in the Big Bend region. Nearly 1 million acres in Chihuahua have been converted to irrigated agriculture (Shackelford 2010). Stemming the rate of conversion is critical to grassland conservation itself, but carries significant implications for reducing soil erosion as well, both of which carry important climate change response implications (Fig. 2). Emphasis needs to be placed on taking advantage of work already implemented, groups already involved, and initiatives outlined as priorities in the Action Plan for Grassland Conservation and Sustainable Use of the State of Chihuahua 2011-2016 (Guzman-Aranda et al. 2011)." (2012 CC Action Plan – Big Bend).

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

10. If the BBRB pilot area is selected, the DLCC Climate-Smart LCPD project will contribute to the achievement of our objectives by coordinating with the existing binational partners to develop and review goals and objectives that will address our management questions and concerns. Additionally, working in this framework will provide the opportunity to establish long-term desired conditions for shared resources across the region. From a binational standpoint, this planning and design project will further assist managers of private and public lands on both side of the international border to work collaboratively on identifying resource targets and conditions. To date, there has been many resource management efforts accomplished in the region, but additional planning and design is needed to establish long-term objectives within this region. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

The binational nature of the region makes a collaborative approach critical for success. The majority of the people in the region make their living off the land through grazing animals or agriculture, or from ecotourism. The recommendation from the conservation assessment (CEC, 2014) is to use tools like vulnerability assessments and scenario planning in conjunction with climate change projections to help managers and landowners plan for uncertainty. This would be accomplished by choosing conservation actions which promote adaptation and build resilience to climatic changes that would favor increased drought, extreme weather, changes in wildfire and hydrologic regimes, and the spread of exotic species and diseases (2014 BBRB CA).

The area has been impacted by drought which would be exacerbated by inappropriate grazing and changes in water availability in the Rio Grande and Rio Conchos, streams, and in springs, seeps, and ground water. With the forecast increase in temperatures and decrease in water availability the competition for limited water resources will increase. Invasive species are a serious threat throughout the region, with feral hogs impacting water quality and the integrity of springs and seeps, buffelgrass and natal grass encroaching on native grasslands, and salt cedar and giant cane along the riparian corridors. A more serious threat is the loss of grasslands from woody vegetation encroachment as a result of unsustainable grazing. Human communities can adapt to these changes through better grazing management, eliminating water loss from the system, and improving the quality of the water by decreasing sediment loads, flood hazards to humans and structures, and enhancing recreational opportunities on the shared resource of the Rio Grande (2014 BBRB CA).

11. **Describe resources available for implementing conservation planning and design activities in the future.** *(Include information about partner's willingness or ability to implement conservation activities on the ground.)*

12. A large and diverse group of partners created the conservation assessment for the area (CEC, 2014) as well as earlier planning efforts within the region at the local level. Due to the unique binational and ecologically significant resources funding has been available from a broad spectrum of funders, but consistent funding has proved difficult to obtain. The collective resources of the partners participating in the Big Bend Conservation Cooperative and the conservation assessment is massive, and the time people have donated to past planning efforts bode well for the future. The hope was for the conservation assessment to be used as an instrument to support and justify funding at all scales from international and national to regional and local. **Provide a shapefile (or similar file) of the pilot area boundaries.**

13. **(Optional) Describe any additional conservation opportunities in this pilot area.**

In May 2002, seven months after the 9/11 attacks, the four river crossings (not bridges) between Mexico and Texas, in and adjacent to BBNP were closed, preventing international access to scientists, resource managers, and tourists. In April 2013, the Boquillas Port of Entry was opened, creating an effective means for both U.S. and Mexico counterparts to cross the border.

In the last decade, the Government of Mexico has substantially expanded their protected areas program within this region. The Flora and Fauna Protected Area Ocampo was established in 2009, achieving the geographic unification of the biological corridor between Maderas del Carmen and Santa Elena Canyon protected areas. Ocampo represents a special portion of the corridor, managing a long stretch of the Rio Grande riparian zone, excellent habitat for bighorn sheep, and recuperation of upland vegetation (Binational Strategic Planning Event with Sister Parks, 2013).

Also in 2009, the Government of Mexico established the Monumento Natural Rio Bravo del Norte, which placed over 530 kilometers of Rio Grande riparian habitat under the management of CONANP. This protected area starts 30 kilometers east of the city of Ojinaga and ends near the Amistad reservoir.

Integrating research from the pilot project into decision frameworks for organizations, like the Desert Fish Habitat Partnership, will allow these groups and partnerships to more effectively direct funds to support on the ground habitat restoration projects.

14. **(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.**

At the binational level, the resource managers in this region have shown many successes in working collaboratively on projects. Recent examples include the removal of salt cedar and river cane along 25 miles of the Rio Grande and restoration of springs and tributaries in APFFCSE and BBNP. These collaborative efforts show the close working relationships that have developed between managers and have proven to be effective at accomplishing goals.

15. **(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination.** *(Including established goals and objectives associated with springs, streams, grasslands.)*

Big Bend – Rio Bravo Conservation Assessment

America's Great Outdoors Initiative

National Fish Habitat Partnership's Water to Watch (Big Bend Reach of the Rio Grande and tributaries)

Desert Fish Habitat Partnership Priority Area

Big Bend Conservation Cooperative MOU

16. **(Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.** *(Include photo credits and captions).*

See attached photos

Appendix A – Participating Protected Areas

Comisión Nacional de Áreas Naturales Protegidas

Cason de Santa Elena

Cuenca Alimentadora del Distrito Nacional

Maderas del Carmen

Ocampo

Rancho Media Luna

Sierra San Vicente

National Park Service

Big Bend National Park

Rio Grande Wild & Scenic River

Texas Parks and Wildlife Department

Big Bend Ranch State Park

Chinati Mountains State Natural Area

Black Gap Wildlife Management Area

Elephant Mountain Wildlife Management Area

Appendix B– Big Bend – Rio Bravo Currently Participating Partners

Mexico's Protected Areas Partners:

Federal Government:

- CONAFOR (Comisión Nacional Forestal). Fire issues
- CONABIO . Guidance on Monitoring and data inventory
- INECC. (Instituto Nacional de Ecología y Cambio Climático).

State Government:

- SEMA (Secretaria de Medioambiente de Coahuila
- Desarrollo Urbano y Ecología del Estado de Chihuahua

ACADEMIC INSTITUTIONS:

- UAAAN- Universidad Autónoma Agraria Antonio Narro
- UANL – Universidad Autónoma de Nuevo León
- AUCJ – Universidad Autónoma de Ciudad Juarez
- AUCH – Universidad Autónoma de Chihuahua

NGO's:

- PROFAUNA A.C. (Protección de la Fauna Mexicana A.C.)
- PRONATURA NE

PRIVATE LANDOWNERS:

- CEMEX

US Partners:

Federal Government:

- NPS (National Park Service)
- USGS (US Geological Service)
- USFWS (US Fish & Wildlife Service)
- NRCS (Natural Resources Conservation Service)

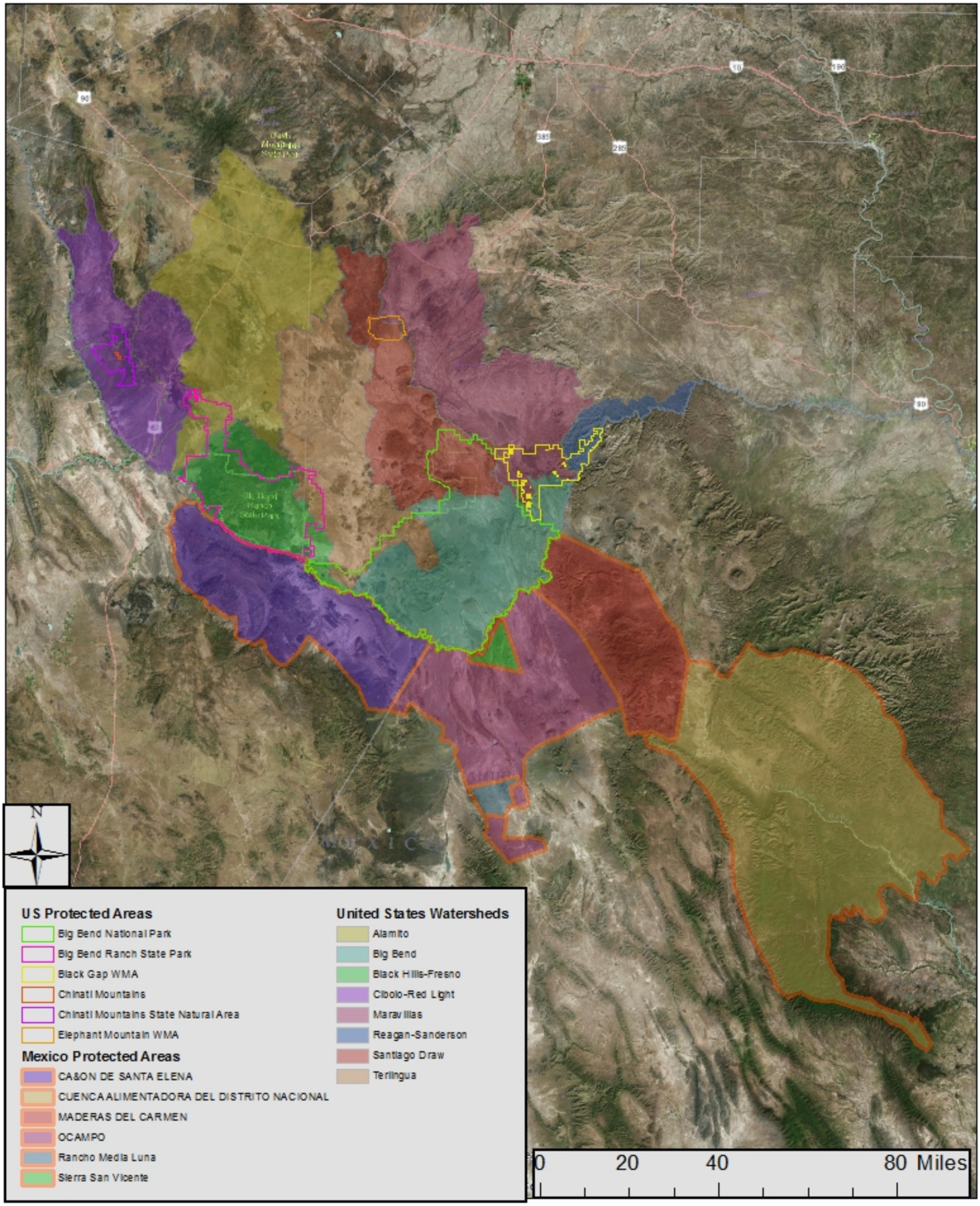
State Government:

- TPWD (Texas Parks & Wildlife Department)

NGO's:

- RGJV (Rio Grande Joint Venture)

Big Bend - Rio Bravo Pilot Area



Landscape Conservation Planning & Design
Pilot Area Nomination Form

(Total pages should be 6 or less)

Background information:

The Desert Landscape Conservation Cooperative (LCC) is designing a process that will:

- produce spatially explicit data and information about focal resources chosen by the Desert LCC partners (grasslands/shrub lands, streams, and springs, including riparian and aquatic resources);
- seek to understand the effects of climate change and other landscape stressors on natural resources;
- integrate social, cultural and economic information to understand what these resources might look like in the future; and
- look at specific focal areas to develop collaborative adaptation responses that are useful and implementable by our partners.

Landscape design is the integration of societal values with ecological goals, using science based in landscape ecology to provide a variety of scenario plans that describe where conservation can best be achieved and how it relates to measurable goals. In 2014-2016, the Desert LCC is engaging interested parties in determining design priorities, compiling and curating existing information and resources, determining what additional information, tools, or resources are needed, and developing plans for 2-3 pilot landscape conservation designs within the Desert LCC geographic area.

We are currently requesting nominations for pilot areas of interest to our partners.

Due Date: July 10, 2015

For questions and to submit nomination forms, please contact: Duane Pool at duane.pool@rmbo.org

Additional information:

Desert LCC Website: www.usbr.gov/dlcc

Desert LCC Conservation Planning Atlas: http://dlcc.databasin.org/

Desert LCC Critical Management Questions:

http://www.usbr.gov/dlcc/resources/docs/DLCCCMQs.pdf (English)

http://www.usbr.gov/dlcc/science/2013/docs/DLCCCMQs-handoutSPA.pdf (Spanish)

Pilot area name: Coconino Plateau Watershed Partnership

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

Ron Doba, Coconino Plateau Watershed Partnership (CPWP), Coordinator, 480-299-5764, rdoba@cox.net

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.** *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)*

The Coconino Plateau Watershed Partnership (CPWP) study area is located in north central Arizona, partially within the northern extent of the DLCC boundary in Arizona. The geographic boundary of the CPWP study area includes portions of the Little Colorado River Watershed, Verde River Watershed, Upper Colorado River Watershed, Grand Canyon National Park (GCNP), Coconino and Kaibab National Forests, Wupatki National Monument, municipal and Tribal lands. The boundary was originally based on a planning area established by the Arizona Department of Water Resources (ADWR) under their Rural Programs/Rural Water Studies for the North Central Arizona Water Supply Study. The appraisal study was completed in 2006 by Reclamation and the Coconino Plateau Technical Advisory Group (CPTAC). The boundary is based on participant water needs, is flexible, and includes areas that would potentially receive water deliveries via a regional infrastructure project to increase use of renewable water supplies.

CPWP participants include cross-jurisdictional representatives from four cities, five Tribes, five State departments, six federal agencies, local governments, and non-profit and private water companies (cpwac.org). The CPWP was established to facilitate water resource planning, promote conservation strategies, and to compile and evaluate information for sound water resource management on the Coconino Plateau.

The primary water source for the Coconino Plateau is non-renewable groundwater. Depth to groundwater in the primary aquifer is about 2,000 feet below land surface. Groundwater is discharged via pumping for municipal and industrial supplies and regionally via springs that comprise sacred Tribal sites and ecological habitats that support ecotourism in the GCNP and National Forests. The GCNP is the second largest karst system in the National Park system and further research is required to understand the hydrology of the area. Karst sinkholes provide a direct connection between surface water runoff and groundwater and springs. More information is required to develop management practices to protect water quality.

The boundary includes a variety of ecological environments including desert scrub, forest woodland, grassland biomes and the only alpine biome in Arizona. Continued groundwater pumping to meet growth and demands and potentially less water available under climate change will impact sensitive ecosystem biomes that provide habitat for threatened species such as the Little Colorado spinedace, candidate roundtail chub, and northern leopard frog. Despite on-going resource evaluations, information for ecosystems in the region is sparse.

2. **Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.** *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)*

Landscape level resource management including compilation of available research and identification of data gaps will guide future data collection to evaluate impacts of declining water resources and to develop management

strategies to assess climate change impacts on anthropogenic and ecologic water demands. Additional concerns of water resource availability include impacts on forest health and on social and economic well-being. The resources of the forests, canyons, and high desert provide recreation and eco-tourism for Arizona residents and visitors and generate sustainable economic development. It is vital to assess resource data gaps to guide future studies that support integrative management of water to meet social, cultural, ecosystem and economic needs.

The complexity and diversity of the Coconino Plateau region is exemplified by its geographic location within the areas of both the DLCC and SRLCC. Although the CPWP straddles the two LCCs, the greater area of the CPWP has an inextricable connection to the environmental and cultural elements within the DLCC. The eight thematic areas of focus developed by the DLCC Steering Committee closely correspond to the strategic objective of the CPWP to develop a Sustainable Water Management (SWM) framework for the region. The SWM framework would address the Water, Ecosystems, Wildlife and Plant Populations, Habitat, Soils, Human Environment, Cultural Resources and Threats themes from the water supply and demand perspective including factors such as climate change and drought.

3. **Describe the primary management questions or concerns in this pilot area.** *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)*

The CPWP is concerned with impacts of population growth and climate change on water resources and with securing water supplies to meet future demands and ecosystem requirements including:

- Limited water availability on Tribal lands, ongoing water rights adjudications and water settlements
- Current water hauling practices by the Navajo Nation, the Hopi Tribe and residents in un-incorporated areas to meet daily water needs
- Future municipal and industrial water demands and economic development
- Impacts of water availability on ecosystems, reduced ecotourism and economic development
- Groundwater declines and economic and ecologic impacts
- Impact of reduced surface water supplies on aquatic habitat
- Impacts of drought and climate change on water supplies
- Water requirements of springs and streams on federal lands including the GCNP, Wupatki National Monument, and Kaibab and Coconino National Forests.

Primary management questions include:

- What renewable water resources are available to meet future demands based on population growth, and recreational and environmental needs?
- How would decreased water supplies impact social and economic well-being?
- What are the future projected water demands under various climate change scenarios?
- What baseline surface water flows are required to maintain springs and streams to protect critical habitat?
- What best management practices can be developed to support sustainable water use practices?

4. **Describe the major partners or partnerships working in the pilot area.** *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)*

The CPWP has approximately 30 participants that include cities, towns, state agencies, Coconino County, federal agencies, Tribal nations, environmental groups and special districts. A complete listing of the participants can be found at cpwac.org. Funding for the CPWP is provided by voluntary contributions from participants. Current funding agencies include Coconino County, City of Flagstaff, City of Page, Town of Tusayan, City of Sedona,

Tusayan Sanitary District, and Havasupai Tribe. The CPWP and its affiliated Coconino Plateau Water Advisory Council (CPWAC) share an annual budget of approximately $45,000. In-kind services are provided by cities, towns, state and federal agencies for specific projects.

5. Briefly describe the types of conservation or management activities currently occurring in the pilot area.

Current, on-going conservation management strategies are primarily initiated and administered by individual entities. Cities such as Flagstaff replaced potable water use with reuse of effluent for turf, implemented an inverted block rate water fee structure, and established watering restrictions to encourage water conservation. The Town of Tusayan implemented an innovative system to reuse effluent for toilet flushing.

Throughout its history of fifteen years, the CPWP has strived to identify potential regional conservation activities among its diverse representation. The CPWP adopted the following vision:

The Vision of the Council and Partnership is to be a leader in ensuring an adequate, long-term, sustainable supply of water is available to meet the current and future reasonable needs while preserving the health of the environment on the Coconino Plateau.

The CPWP tasks the CPTAC to research, compile and evaluate water resource information and provide guidance regarding water resources to the CPWP. The CPTAC is developing the SWM framework that involves identification of water use thresholds for municipal and industrial, ecosystem, and social and economic wellbeing demands. Information for ecosystem flow requirements and social and economic well-being are lacking. The CPTAC requires further expertise to complete the SWM framework which aligns with information that the DLCC is compiling for landscape regions. Once completed, the SWM framework will be made available to water and land managers for use in their decision making process and provide information to promote water education and conservation. The CPTAC recently prepared and published the only region wide water resource maps available. The water source maps summarize surface water and springs, groundwater resources and municipal and industrial water demand volumes and associated supplies.

The CPWP Public Outreach Committee (POC) conducts activities to increase water awareness and promote conservation among water managers, land managers, teachers and students across the Coconino Plateau. The POC is developing a water awareness video, conducts annual water awareness contests at schools, and shares water conservation and awareness information at schools and community outreach events.

6. At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.

A goal of the CPWP is to evaluate available water resources and promote sustainable groundwater pumping to reduce the impact on regional springs that provide water for wildlife and for regional surface water flows such as the Verde River tributaries (e.g. Oak Creek and Sycamore Creek) that provide habitat for threatened aquatic life. Clear Creek, Chevelon Creek, and Blue Springs are surface water features within the Little Colorado River watershed (within the DLCC and adjacent to the CPWP) that require further data collection to better understand the minimum water thresholds required to protect threatened species. CPWP participants are interested identifying the impacts of future growth on sensitive environmental areas such as the Grand Canyon.

Further research is required to document and characterize springs and streams and their associated ecosystems to inform water management policies.

Additional data is required to better understand how forest management impacts water supplies, especially in the area of the Upper Lake Mary watershed where increased runoff to the Lake would result in decreased dependency on groundwater supplies.

7. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

All communities within the CPWP are impacted by climate change and the potential for scarce water supplies to become scarcer. Ecotourism currently supports economic development throughout the area and reductions in available water resources would degrade ecologic habitat and reduce ecotourism in the region that includes hiking, fishing, birding, white water rafting, and other recreation opportunities in Oak Creek and the National Monuments and Parks. Degradation of existing ecosystems would reduce visitation and revenues resulting from tourism, not to mention the impact to jobs in associated population centers. Reduced water supplies would result in reduced quality of life from a social and cultural standpoint.

A current example of the impact of reduced water supplies is evidenced by the City of Williams. Williams has a tourism based economy, they rely on unpredictable surface water supplies that will be further impacted by climate change. Williams also relies on deep groundwater supplies that are expensive to access and develop. The City of Williams is an active participant in the CPWP with strong interests in sustainably managing its water resources.

8. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

The area consists of four ecosystem biomes that define its unique nature. To understand and manage the vast landscape, pro-active innovative investigations are required. Integrative management of water, land, and environmental resources is necessary to ensure that the existing grasslands, streams, springs/seeps and riparian areas remain healthy into the future. People who live in the region enjoy the quality of life that is currently provided by existing habitats . The springs/seeps and streams support riparian environments and eco-tourism and sacred Tribal sites. The environment as a whole integrates and processes precipitation, water infiltration, and groundwater recharge and discharge in the hydrologic system. While loss of habitat would certainly impact endangered and threatened species, it is uncertain how this would impact municipal and industrial water supplies. Although participants have diverse interests for maintaining current water supplies and ecosystems, they stand united in their vision to protect the beauty and function of existing ecosystems and to ensure that they remain healthy to support economic opportunities and are protected from deterioration due to climate change, drought and mismanaged water use.

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

The DLCC would contribute landscape resource management expertise and Geographic Information System support for the water source menu maps recently prepared by the CPTAC. Further, the DLCC would greatly contribute to completion of the SWM framework, in particular with development of thresholds for ecosystem water needs and for social and economic well-being.

10. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

Development of the SWM framework will provide valuable information for water and land managers regarding water resource thresholds required to support ecosystems and social and economic well-being. These thresholds would be used to develop integrative water management plans to provide water for municipal and industrial demands and identify the "tipping point" impact on natural resources. The framework includes identification of critical habitats, minimum base flow requirements, projected municipal and industrial water use, current and future conservation practices, projected impact on natural resources under different scenarios, support conservation resolutions/ordinances and identify potential sources of future water supplies available for development.

11. **Describe resources available for implementing conservation planning and design activities in the future.** *(Include information about partner's willingness or ability to implement conservation activities on the ground.)*

The CPWP includes a diverse group of representatives with advanced skills in hydrology, geology, water resource planning, biology and federal, state and local regulations. Work task are mostly done on an in-kind basis although the CPWP does have annual funding from partners that can be used towards special projects. As previously indicated, approximately $45,000 per year is provided by funding partners for the operation of the 501 (c)(3) non-profit and its affiliate 501 (c)(4) non-profit, the Coconino Plateau Water Advisory Council. Currently the two organizations have liquid assets of approximately $180,000. The CPWP contracts with an independent contractor (Ron Doba) for business management services.

Predictive groundwater flow models have been developed to assess groundwater pumping at Red Gap Ranch/Leupp area, to support an adequate water supply designation for the City of Flagstaff and to evaluate widespread groundwater conditions in the Northern Arizona Regional Groundwater Flow Model. These models are up to date and available for use in future analyses, with further monetary commitments.

Authorization to submit this application to the DLCC for this project was approved by the board of directors on August 28, 2015.

12. **Provide a shapefile (or similar file) of the pilot area boundaries.**

13. **(Optional) Describe any additional conservation opportunities in this pilot area.**

Additional renewable water resources will be available via the ADWR reallocation of 17, 333 acre-feet per year of Non-Indian Agricultural priority CAP water. The water could be available for use in the proposed North Central Arizona Pipeline. The water could become available in 2021 to rural areas if infrastructure is available to convey the water. This water could provide renewable water supplies to replace groundwater pumping. Other opportunities that would provide renewable resources in the region include settlement of the Little Colorado River adjudication; enhanced wastewater treatment resulting in increased indirect reuse of treated effluent and potential direct reuse.

14. **(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.**

Nomination of the CPWP as a pilot area may provide an opportunity for the DLCC and CPWP to leverage resources to benefit data compilation in the region. DLCC support of CPWP completion of the SWM framework and hosting of the water source menu maps could be used as examples in other LCC's of strategies to develop guidance for sustainable water management.

15. **(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination.** *(Including established goals and objectives associated with springs, streams, grasslands.)*

The appraisal level study for the NCAWSS can be downloaded from the following website: http://www.usbr.gov/lc/phoenix/reports/ncawss/ncawss.html. This study identifies the projected unmet water demands for the region.

16. **(Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.** *(Include photo credits and captions)* The following images may be subject to copyrights:

Chevelon Creek

Chevelon Reservoir

Clear Creek

Blue Springs

Upper Lake Mary

Little Colorado River Forest Pond

Pilot area name: Gila River watershed in New Mexico

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

Martha S Cooper, The Nature Conservancy (TNC), SW NM Field Rep., 575-535-4417, mschumann@tnc.org

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.**

The proposed pilot area encompasses the Gila watershed in New Mexico, with a focus on its headwaters and riparian corridor. The headwaters primarily overlap with the Gila National Forest, reflecting Aldo Leopold's intent to protect an entire watershed. The riparian corridor, mapped as a mile wide, is a distinct ecosystem defined by proximity to water. The entire length of the Gila River in New Mexico is currently free of permanent large-scale dams or diversions enabling the relatively natural flow regime along this reach of the Gila River in NM to persist. Consequently, the ecological integrity of riparian and aquatic communities is extraordinarily high and resilient to disturbance. While this is the focus area, the entire watershed and tributaries affect the condition of the river corridor and need to be considered within a planning context.

Eco-regions of the Gila watershed in NM include Arizona-New Mexico Mountains in the headwaters and downstream Chihuahuan Desert and Apache Highlands ecoregions. The convergence of three eco-regions is a contributing factor to the species diversity of the Gila watershed, as each eco-region is associated with a different species assemblage.

Aquatic and riparian communities are the primary resources of management concern within this pilot area. The Gila River in NM supports one of the two most intact native fish communities in the Lower Colorado River Basin, including important populations of Spikedace and Loach Minnow, federally listed endangered species. The high diversity and abundance of plants and animals found in riparian zones is due to high productivity, complex food webs, and complex habitats. The riparian corridor provides habitat for numerous wintering bird species and for migrants seeking rest and food. The Cliff-Gila Valley supports the highest density of breeding non colonial birds recorded in North America, including large populations of Southwestern willow flycatcher, Western yellow-billed cuckoo (both federally protected species) and 51 other species of conservation concern (i.e., 15 state-listed species, 49 Species of Greatest Conservation Need (NMDGF), 16 U.S. Forest Service Region 3 Sensitive Species, and 6 U.S. Bureau of Land Management NM Sensitive Species (Appendix 9, Gori et al. 2014). The upper Gila watershed is also one of two hotspots of mammal diversity outside of the tropics in North America.

Riparian and aquatic species in the Gila watershed in NM face numerous challenges including diversion and water management, nonnative aquatic species, drought, temperature extremes, poorly-managed livestock grazing and the downstream effects from large, high-severity wildfires in the upper watershed. Climate change is imposing additional stresses. The Critical Management Questions this geography would address relates to CMQ1: water management and climate change, CMQ2: Monitoring species/processes relative to climate change and related threats/stressor and CMQ5: Changing wildfire regimes + riparian habitat management.

Numerous strategies and partnerships exist within the Gila watershed. However, a landscape conservation planning and design effort in the Gila watershed in NM, focused on the Gila River, would bring numerous agencies, organizations, scientists and stakeholders together to identify priority conservation objectives in a way that has not successfully occurred before.

2. **Explain why this area is important & how it connects to the larger DLCC geography, mission and vision.**

The Gila watershed and river has incredibly high biodiversity; these are the priority resources. The upper watershed has a long history active fire and fuels management including wildland fire use. The river corridor has shown remarkable resilience to recent large wildfires, floods, and long-term drought although these factors will increasingly impact riparian and aquatic species in the future. In contrast to many SW stream systems, native fishes persist and the riparian community is composed almost entirely of native cottonwoods and willows. The Gila River can inform restoration projects in more degraded systems, offering an example of an ecosystem maintained by a relatively natural flow regime. The Desert LCC vision is resilient landscapes capable of responding to environmental challenges and supporting natural and cultural values for current and future generations. The Gila is special in that it is a relatively protected and intact watershed in high functioning condition. The conservation issue pertinent to the Gila is how to support and perpetuate biodiversity and resilience of the Gila in the face of ongoing climate change while balancing the needs of current and future generations.

The Desert LCC mission is to use collaborative partnerships to provide scientific and technical support, coordination, and communication to resource managers and others to address climate change and other landscape-scale ecosystem stressors. The Desert LCC is well poised to bring examples of high-functioning collaborative partnerships to this region and amplify the conservation work being led by individual agencies and small collaborative efforts.

Describe the primary management questions or concerns in this pilot area.

Primary management questions within the Gila watershed and focused on the Gila River relate to: (1) how climate change and potential diversion of an additional 14,000 ac/ft per year authorized by the Arizona Water Settlement Act (AWSA) of 2004, would affect the riparian and aquatic communities; and (2) and how fire management, large high severity wildfires, and climate change in the upper watershed affect downstream riparian and aquatic communities; and (3) how resource managers and stakeholders can adjust their management strategies to build resilience of natural and human communities to climate change. The most important stressors include water withdrawal, drought, climate change and wildfires. Ranchers and farmers rely on Gila River water for crops and livestock. The mining industry also uses water, although a relatively small amount compared to historical use. Cities and communities in Southwest NM are looking to the Gila River as a potential source of water for people.

Since the USGS gage began recording flows in 1928, the Gila River has always registered flow even during June, the month with lowest flows. The two driest decades on record are the 1950s and 2000s. A marked increase in the number of very low flow (mean daily discharge< 20 cfs) conditions began in 2002; 2013 had the greatest number of very low flow days in the period of record. These trends reflect warming basin temperatures and drought, both of which affect the volume and duration of snowpack that typically supports June flows. Climate change will continue to influence water availability for the ecosystem and people. The overarching management issue is how to maintain continuous flow in the river while accommodating human needs.

Describe the major partners or partnerships working in the pilot area.

While a cohesive partnership does not currently exist, numerous partners and stakeholders have spent a significant amount of time working together in a variety of capacities.

AWSA: Southwest NM Stakeholder Group (est. 2007) for the AWSA. Governor Richardson tasked he group with collaborative designing, overseeing, and implementing a process to provide planning and decision-making related to utilization of AWSA funding. Membership included interested citizens, interest groups and agencies, agricultural groups, and conservation organizations.

Resources developed through the AWSA process and coordinated by the NM Interstate Stream Commission (ISC) include:

- A decision-support model developed by Sandia National Lab. The model focuses on hydrology: runoff, rainfall, tributary flows, irrigation and other factors. The model can be run to test various scenarios, such as increased irrigation demands and increased diversion.
- A groundwater model was developed by SSPA, the report is entitled, "Analysis of flow and water use alternatives on hydrologic condition in the riparian corridor of the Gila-Cliff Basin" (SSPA 2014). Numerous other technical reports have been produced by consultants for the ISC in support of understanding the geomorphic, hydrologic, and ecological conditions of the Gila River in the Cliff-Gila Valley of NM.

Wildlife: Annual monitoring of Gila-San Francisco Basin fish assemblages began in 1988 and continues to the present. NM Department of Game and Fish (NMDGF) staff coordinates this effort which is supported by US Fish and Wildlife Service funding and staff. Other agencies and organizations that assist with sampling include BLM, Gila NF (USFS), TNC, and UNM. In addition, Dr. Keith Gido and Dr. Tom Turner, professors of biology at Kansas State University and University of New Mexico, respectively, and their graduate students conduct research projects related to the fishes of the Gila River in NM.

Long-term monitoring and research of Southwestern willow flycatcher has occurred within the Cliff-Gila Valley, supported by Freeport McMoRan, the largest landowner of riparian habitat. The Gila NF and TNC are two other landowners who help support this effort that results in a robust Valley-wide population estimate. Western yellow-billed cuckoos are now being monitored as well, revealing perhaps the largest extant population of the species.

Climate change: Dr. David Gutzler at UNM has developed and summarized climate and flow projections for the Gila (Gutzler 2013). In addition, Dr. Gregg Garfin at University of Arizona led an effort that examined historical and projected records of climate focused on the upperGila watershed in New Mexico. As part of this work, they used projections from five dynamically-downscaled climate models to drive a Variable Infiltration Capacity (VIC) model that generated daily flows at three Gila R. gages for two time periods, 1971-2000 and 2041-2070. These projections are available for use in the conservation planning process.

Gila River Flow Needs Assessment – TNC convened a team of 12 academic partners to produce a report describing existing condition of the Gila River in the Cliff-Gila Valley. The report also examined the potential impacts of the AWSA diversion and climate change on the riparian and aquatic ecosystem in the 22-mile Cliff-Gila Valley. Two workshops brought together 35 scientists from 24 agencies, universities, and organizations to review and contribute to the report.

The **New Mexico Environment Department** (NMED) has facilitated two efforts:
1) Gila River Watershed Improvement Plan & Strategies (WIPS) (2009) is an inventory and data resource in support of a science-based approach to watershed resource planning. The document represents several years of collaboration between public and private organizations, groups and individuals.

2) NMED's Wetland Program initiated the development and use of a rapid assessment framework to evaluate the ecological condition of riverine wetlands and their associated riparian areas throughout New Mexico. The. Numerous partners participated in workshops that reviewed and tested the methodology. Core partners include UNM, NM Natural Heritage, Museum of Southwestern Biology and SWCA. The methodology was tested on the Gila and extensive data was collected.

Agricultural Producers– Grant, Catron, Hidalgo, and Luna County Soil and Water Conservation Districts (SWCD) are the primary liaison to agricultural producers within the watershed. Natural Resource Conservation Service staff support the Districts with technical information and funding offered through the Farm Bill.

Gila National Forest – The Gila has recently initiated their Forest Plan Revision process. This multi-year effort is committed to involving the public and incorporating perspectives and values of all stakeholders through collaborative workshops and other means of soliciting input.

The **Gila Conservation Coalition** (GCC) is comprised of the Gila Resources Information Project, the Upper Gila Watershed Alliance, and the Center for Biological Diversity and is focused on protecting the free-flowing nature of the Gila River in New Mexico. Other local conservation organizations that coordinate with GCC include NM Audubon and the NM Wilderness Alliance.

Grant County Eco-Watershed Group is an advisory group with representation from Grant County staff, NM State Forestry, BLM, Gila NF, Grant County SWCD, conservation organizations, and local businesses.

3. **Briefly describe the types of conservation or management activities currently occurring in the pilot area.**

Pilot area includes public land managed by the U.S. Forest Service (Gila National Forest), Bureau of Land Management and NM State Land Office. Public land ownership primarily occurs in the headwaters and canyon-bound reaches of the river. In the headwaters forest restoration activities include fire and thinning. Grazing occurs primarily on non-Wilderness land. In the river corridor on public land, motorized recreation and cattle grazing are excluded for protection of the resource. Private land ownership primarily occurs in the valley-reaches (Cliff-Gila, Redrock, and Virden) of the river. Land use includes ranching and farming on the uplands, irrigated agriculture in the historical floodplain, management for conservation values, and recreation. TNC manages the 1200 acre Gila Riparian Preserve in the Cliff-Gila Valley, undertakes habitat restoration projects, and conducts vegetation and hydrologic monitoring.

At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.

Goals and objectives of some partners related to river and riparian resources are to maintain the relatively natural flow regime of the Gila River that supports the diversity of riparian and aquatic species. Some partners are more focused on the water supply of the Gila River to human communities. A shared goal is to balance ecosystem and human needs while developing viable management option to maintain and increase the resiliency of the ecosystem and species and help them to adapt to climate change. Investing in natural infrastructure benefits the ecosystem and people. Wetlands and a vegetation riparian corridor provide a natural defense against floods and protect communities and the ecosystem in an era of extreme weather.

4. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

The social, cultural, and economic activities of human communities within the Gila watershed include ranching, farming, mining, recreation and tourism. Climate change will reduce, on average, water supply from the Gila River at the Gila by Gila gage by 6% and median flows will be reduced by 15%. This will negatively impact ranchers and farmers who do not have the infrastructure needed (i.e. wells/pumps or storage or highly efficient irrigation systems) to continue production during drought. Grazing in the watershed is impacted by climate change, as water availability for livestock and forage production (quantity and quality) is a limiting factor. The mining industry, because Freeport McMoran owns 45,000 ac/ft of water and uses only a fraction of it, is not likely to be impacted. The recreation and tourism industry, as it relates to fishing and birding, could be impacted by climate change if the aquatic and riparian communities diminish over time.

The Gila River and watershed defines this region and contributes to the social and cultural fabric of the community. One only need visit the river or a Gila NF campground on the weekend to witness this. Hunting and fishing are recreational activities that bring families and friends together.

Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.

The Gila watershed, and in particular the Gila River, is valued for its biodiversity. Numerous agencies are tasked with protecting threatened and endangered species, some of which have robust and relatively stable populations, like Southwestern willow flycatcher. The Gila Rivers offers a living laboratory for studying how Southwestern rivers function when the natural flow regime persists. The ecosystem also supports tourism in the region, particularly birders.

People are concerned about how by climate change is affecting the Gila River (less snowpack, more inconsistent river flows) and a reduction in the amount of water available to people. In addition irrigation needs, at least in the Cliff-Gila Valley, are at a historical high causing portions of the river to be dewatered in late spring during low flow years. Many people are concerned about the impact to the river and riparian resources resulting from additional diversion authorized by AWSA. Climate change creates stresses on the system and could facilitate an increase in non-native aquatic species and salt cedar. In addition, NM's largest wildfire, the Whitewater Baldy Fire in 2012, caught everyone's attention and negatively impacted water quality and native fishes and, for a short-period of time, affected the shallow alluvial aquifer resulting in localized riparian tree mortality.

5. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

The primary objectives in this region are that the Gila River and watershed continues to support biodiversity and the social/cultural/economic fabric of the area. To date, land and water management agencies have not directly incorporated climate scenarios into their planning efforts. In addition, discussions around the AWSA planning process have at times created conflict, rather than presenting an opportunity to develop shared desired future conditions and a map to get there. A Planning and Design project would facilitate bringing together resources and information that exist for the area with land managers, scientists, and stakeholders to explore how these objectives could be met.

6. **Describe how developing collaborative adaptive management <u>actions</u> for Desert LCC focal resources help human communities in the pilot area adapt to projected climate changes.**

Currently human communities within the Gila watershed and along the river are not preparing for climate change. However, developing numerous collaborative adaptive management actions could benefit people. For example, increasing wetland habitat could be a means to store water underground for slow release during periods of low flow. Healthy riparian areas provide clean water, habitat for fish and wildlife, maintain opportunities for recreation and tourism and help save taxpayers money. As climate change will reduce water availability, improved irrigation management and infrastructure could support the needs of farmers and ranchers and sustain flows in the river.

7. **Describe resources available for implementing conservation planning and design activities in the future.**

Numerous entities are committed to some version of conservation planning. The Gila NF has undertaken Forest Plan Revision. The Nature Conservancy periodically undertakes collaborative planning efforts within the Gila watershed. NMED, with the NM Watershed Improvement Plan & Strategies, and NMDGF with the Comprehensive Wildlife Conservation Strategy for New Mexico, both completed in 2006, are committed to conservation efforts within the Gila. The US Fish and Wildlife Service ensure compliance with the Endangered Species Act. USGS maintains stream gages on the Gila.

Federal and state agencies have historically implemented small-scale activities on the ground, with the exception of larger forest restoration activities completed by the Gila NF. Competitive funding opportunities and cost-share programs can support activities on public and private land. The conservation benefit of these activities could be leveraged by increased coordination supporting shared objectives around adaptation planning

8. **Provide a shapefile (or similar file) of the pilot area boundaries.**

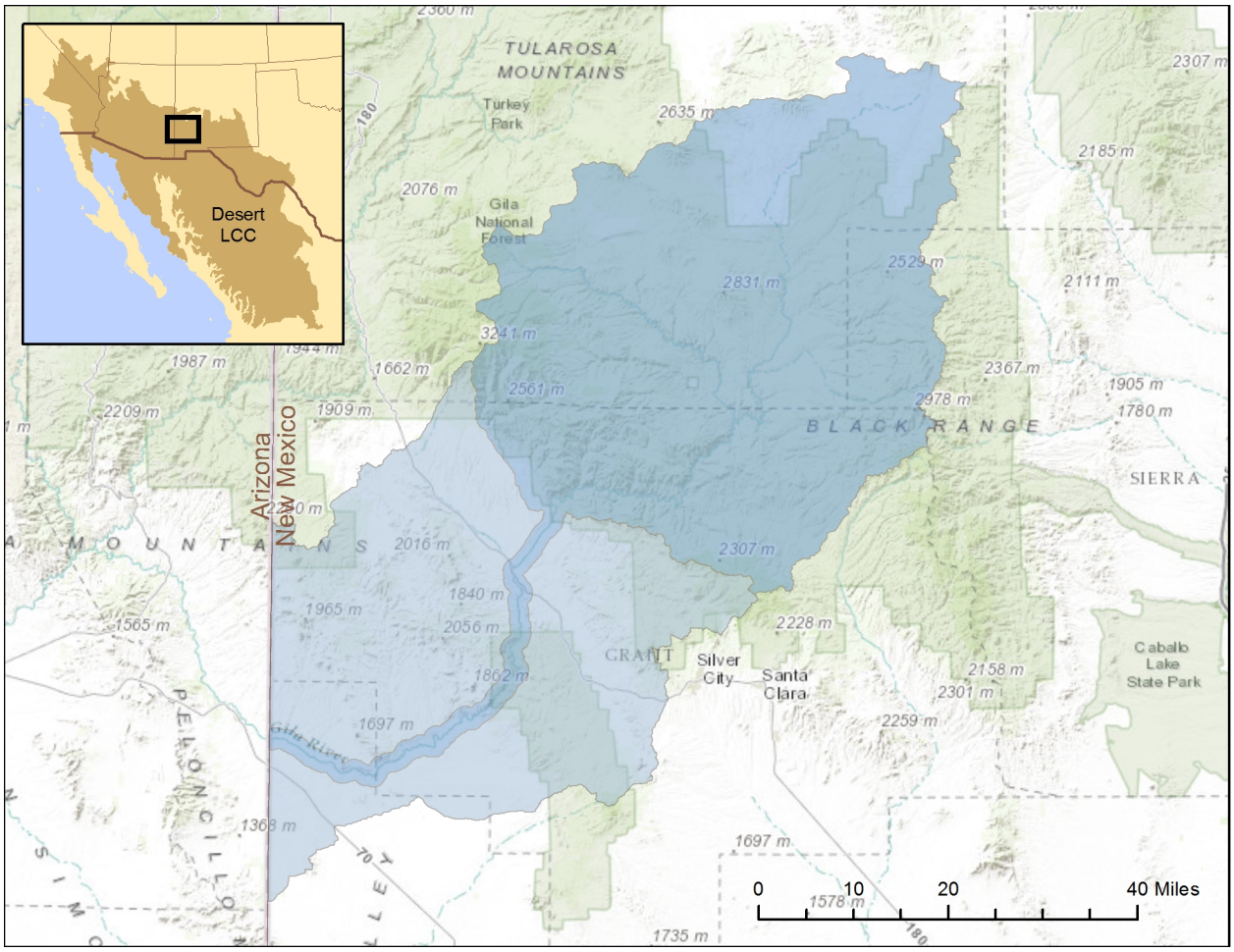
A pdf and shapefile are attached.

9. **(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.**

The AWSA planning process has involved nearly every partner and stakeholder within the Gila watershed. A landscape conservation design effort could contribute towards the AWSA NEPA process and could potentially inform mitigation activities.

In addition, in 2009, Conservancy science staff in New Mexico launched the Southwest Climate Change Initiative (SWCCI), a 4-state collaborative effort involving a team of scientists from the Wildlife Conservation Society, Rocky Mountain Research Station, University of Arizona, University of Colorado, and the National Center for Atmospheric Research. As part of this work, climate change adaptation workshops were conducted in four pilot landscapes (AZ, NM, UT, CO), applying a planning tool, the ACT framework, with local scientists and resource managers to identify practical adaptation actions for that landscape (Cross et al. 2012). Follow-up work has led to the development and implementation of adaptation plans in each landscape. The SWCCI team can assist, as needed, with conservation planning and design in the Gila landscape.

10. **(Optional) Provide links to any additional documents** Gila River Flow Needs Assessment: http://nmconservation.org/Gila/GilaFlowNeedsAssessment.pdf


Desert LCC
TULAROSA MOUNTAINS
Turkey Park
Gila National Forest
BLACK RANGE
SIERRA
GRANT
Silver City
Santa Clara
Caballo Lake State Park
Arizona
New Mexico
Gila River
0 10 20 40 Miles

Pilot area name: Lower Río Conchos, México

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

Alfredo Rodríguez, WWF-México, Water Program Coordinator, 52 (614) 413 3967, alrodriguez@wwfmex.org

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.**

The geographic focus of the proposed pilot area is the lower portion of the Rio Conchos basin - about 120 miles of river extending from the town of Julimes to the town of Ojinaga - in the northern Mexican state of Chihuahua. As the largest Mexican tributary to the Rio Grande/Bravo, which forms the border between the United States and Mexico, interests in both countries rely on the waters of the Rio Conchos. The Rio Conchos rejuvenates flow to the almost dry Rio Grande/Bravo and; thus, supplies flow to Big Bend National Park of the United States and for a number of Natural Protected Areas of Mexico. The Rio Grande/Bravo forms the heart of the Chihuahuan Desert, a priority geography for both the World Wildlife Fund (WWF) and the Desert Landscape Conservation Cooperative (Desert LCC).

Geographic Boundary The Rio Grande/Bravo's most important tributary – the Rio Conchos of northern Chihuahua, Mexico – is born in the mountains of the Sierra Madres and travels to its confluence with the Rio Grande/Bravo. In the headwaters live the indigenous Tarahumara people. Further downstream Irrigation Districts (large-scale farmers) and Irrigation Units (smaller farms) dominate water use. In this area, the river is highly modified and is impacted by impoundments and channelization and is over-allocated with people using eight times more water than their water rights. After this agricultural zone, however, the river travels 120 miles of the amazing, arid environment of northern México to the confluence of the Rio Grande/Bravo.

Focal Species Noted fauna include Mule Deer (*Odocoileus hemionus*), Grey Fox (*Unocyon cineroargentinus),* Jaguar (*Panthera onca)* and Javelina (*Pecari tajacu).* This area is also characterized by a wide variety of cacti species such as the abundant Ocotillo (*Fouquieria splendens),* Candelilla Wax (*Euphorbia antisyphilitica)* and the eagle claws cactus (*Echinocactus horizonthalonius*). Grasslands comprise about twenty percent of the desert vegetative cover and include Side-oats Grama (*Bouteloua curtipendula*), Black Grama (*Chondrosum eriopodum),* and Purple Three-awn Grass (*Aristida purpurea).* The Rio Conchos basin is also home to 48 species of fish of which 10 are considered endemic. Unfortunately, it has been estimated that one-half of the native fish of the Chihuahuan Desert portion of the river basin are already extinct or threatened with extinction. Extinction rates are likely to increase with the hotter and drier conditions climate change will bring.

Hydrologic Conditions The Rio Conchos basin is one of the most important river basins in northern Mexico, draining area of 67,000 km2. It comprises 14 percent of and provides one-third of the water volume (2,553 million m3/year) to the Rio Grande/Rio Bravo basin. The Rio Conchos originates in the Sierra Madre Occidental, locally known as Sierra Tarahumara, at a mean altitude of 2,300 meters above sea level, and flows through Mexico to the Rio Grande/Bravo at the US–Mexican border. The river and its tributaries are regulated by seven main reservoirs with a total capacity of 3,654 cubic meters. Annual precipitation in the basin ranges from 700 millimeters in the upper portion of the basin to 250 millimeters in the lower portion. On average, 90 percent of the annual rainfall occurs during the wet season months, with the peak rainfall months of July and August - a

consequence of the North American monsoons. In addition to the low precipitation values, the basin is prone to long periods of drought, such as the most recent, which extended from 1993 to 2005.

2. Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.

In both the U.S. and Mexico, agriculture consumes about 90 percent of the available water in the Rio Grande/Bravo basin.. As water use has increased over the years, even minor droughts are acutely impacting local people and businesses. Demands for these diminishing freshwater supplies are expected to escalate in coming years with continuing rapid growth of human populations and climate change forecasts predicting drier and warmer conditions. In addition to these water quantity issues, water quality issues related to bad agricultural practices (e.g. pesticides), the depletion of aquifers (resulting in increased arsenic and fluorine loads), and lack of appropriate sewage treatment prevail. Dispute over water in this priority river has been the source of conflict among neighbors, farmers, ranchers, pueblos, cities, states, cultures, and the countries of the United States and Mexico, eroding the health of the river, its people, and native wildlife.

As stated above, people of two counties rely on the waters of the Rio Conchos. The indigenous Tarahumara people, inhabitants of the Rio Conchos headwaters, rely on heavy rainfall for life itself. Further downstream, agriculture and municipal interests are increasing their use. Irrigation Districts (large-scale farmers) and Irrigation Units (smaller farms) dominate water use in the middle and lower sections of the Rio Conchos and as the river flows into the Rio Grande. Though both the Irrigation Districts and Irrigation Units manage water based on allocations given by The National Water Commission (CONAGUA using the Spanish Acronym), the water regulatory agency in Mexico the federal entity that regulates, controls and administers water, they differ in how the water is “managed”. The richer Districts highly control this water while the poorer Irrigation Units are mostly uncontrolled. Though Mexico’s 1992 federal water law allows for the issuance of permits only when water is available, data gaps and historical conflicts make compliance difficult, leading to over-allocation. Despite the problems with sharing the water resource, there is a growing appetite to increase the understanding of and manage the challenges facing the Rio Conchos creating an opportunity for the Desert LCC to encourage a science-based decision-making process throughout the 120-mile section of the Rio Conchos.

3. Describe the primary management questions or concerns in this pilot area.

In the arid climate of the Chihuahuan Desert, water scarcity, compounded by climate change and increasing demand, highlights the importance of understanding existing freshwater management problems. Since the 19th century, the construction of irrigation projects and dams for agriculture reduced the hydrological variability of the Rio Conchos and; thus, the Rio Grande/Bravo. The 1993–2005 drought reduced river flows to 25 percent of the historical mean over the previous 60 years. As a result, in 1999, the Rio Grande/Bravo did not reach the Gulf of Mexico for the first time in recorded history. Moreover, government authorities have classified almost a fifth of the country’s aquifers “over exploited,” meaning they are draining away at a much faster rate than they are being replenished. The worst hit area is in northern Mexico’s Chihuahuan Desert region, which accounts for 84 percent of the country’s economic activity. It is worth noting that most of the country’s water is supplied by aquifers.

Compounding these problems, are water releases from the Luis L. León dam which are based on the obligations of the 1944 Water Treaty from the irrigation districts from southern Texas and northern Tamaulipas. These unnatural flow regimes have helped provide the necessary conditions for sediment to accumulate in the

mainstem of the Rio Grande/Bravo and for invasive species such as the *Arundo donax,* (Giant Cane) and the *Tamarix ramosissima* to flourish.

Healthy and resilient freshwater ecosystems underpin functioning economies. Agriculture accounts for 90 percent of water use in the Rio Conchos basin. Unless the river basin is managed sustainably, one stakeholder's improved efficiency will likely be overshadowed by increased usage or impacts by other users. Reducing the Rio Conchos water deficit is a difficult task given the social and economic importance of agriculture to the region. Our aim, and one shared by the the Desert LCC, is to manage shared water resources in a manner that allows people to make better informed decisions while protecting and restoring the freshwater ecosystem on which they depend. The keys to better water resource management are the private sector, primarily large-scale agriculture, and improved governance from the local to international levels and the 120-miles section of the lower Rio Conchos affords us that opportunity. With the leadership of the Desert LCC, WWF and its partners can help water managers from both countries understand the science and define better water management policies all for the river benefit and its native riparian ecosystems. An example of such a policy might be altering flow releases from the Luis L. León Dam with a goal to mimic the natural hydrological flow regime. The three major management questions for this pilot area are as follows:

- What management strategies can we implement along the Rio Conchos to help improve the river itself and its ecosystems after the river passes through the major irrigation districts the State of Chihuahua, taking into consideration the changing climate?
- To what extent does the operation of the Luis L. León Dam by storing water and releasing it (either through controlled generation or spill) usually in a controlled manner alter the flow of the Rio Conchos river? How can the flow regime be changed to maximize benefit and avoid or minimize impact of the project on the resources and people of the Rio Conchos and RIo Grande/Bravo?
- How can we help to define strategies for a better water management in the area where the major stressor includes water scarcity, drought events, aquifer depletion, groundwater contamination with arsenic and fluorine and surface water pollution by untreated discharges?

4. Describe the major partners or partnerships working in the pilot area.

WWF has worked in the proposed area – the 120 miles stretch of the Rio Conchos from the town of Julimes to the town of Ojinaga – for ten years implementing an Integrated River Basin Management Program for the Rio Conchos Basin. Currently, WWF maintains an 8-person office in Chihuahua City and is joined by one full-time staff in the United States. The Chihuahuan Desert is one of 18 priority places for the WWF-US office. To accomplish its goals, the binational WWF-Chihuahuan Desert Program works across the border with governmental agencies, the social sector and water users. The major partners working together with WWF include governmental agencies, universities and social groups include:

- CONAGUA provides technical guidance and hydrological and chemical data. Their interest in conserving the Rio Conchos is related to meeting Mexico's obligations under the 1944 water treaty with the US.
- The Junta Central de Aguas of the Chihuahua State works with WWF by providing climate data from their climatological stations distributed across the Mexican state of Chihuahua. They are interested in the Rio Conchos as it is the water source, which will provide future socioeconomic growth.

- Autonomous University of Chihuahua has a professional, academic group of hydrologists that works with WWF and have access to the best geological, geophysical and hydrochemical equipment in the region. Currently, WWF is working together with this group to study aquifer recharge in the middle Rio Conchos.
- Irrigation Units. In the Rio Conchos alone, WWF works with leaders of 12 Irrigation Units representing 800 farmers along the San Pedro and Conchos rivers. These agricultural units are just upstream of the pilot area so their actions will impact the water quality and quantity of the area. The member farmers also have personal connections to people downstream and can open doors otherwise unavailable to conservation groups or those associated with government entities.
- In the Chihuahua area there are other important actors that will work with WWF in the proposed pilot area including CONANP, Profauna, the NGO Rio Conchos and The Coca-Cola Company.

5. Briefly describe the types of conservation or management activities currently occurring in the pilot area.

The proposed pilot area falls within the Rio Conchos integrated river basin management (IRBM) geography WWF and partners began implementing in 2004. Though WWF and partners have been implementing this plan, at the time the subject of climate change, much less how the impacts of climate change might affect ecosystem conditions and the effectiveness of restoration was simply not part of the conservation discussion. However, now the people are ready to address those impacts and the Desert LCC is well-positioned to help guide in this endeavor with a very willing group of active stakeholders.

6. At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.

WWF and our principal partners mentioned above are defining and implementing better management strategies for the recovery of the pilot area as part of the IRBM for the Rio Conchos basin. A goal is the conservation of the river, its ecosystems and biodiversity and to demonstrate an effective model for climate adaptation in river basin management by combining an ecosystem-based approach and public participation to improve livelihoods. A second goal is the conservation of the water flows that pass through the best preserved arid environment of the Chihuahuan Desert, the Big Bend National Park and its counterpart, the Santa Elena Canyon.

7. Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.

The increased warming that is forecast for the region will likely have a variety of impacts on the region's freshwater ecosystems, including increased evapotranspiration rates and water temperatures, deterioration in water quality, and increased frequency and duration of periods of low-flow and water stress. It is the overlay of these expected impacts of climate change that is particularly worrisome. Although the pilot area has one of lowest population densities in México, it is very vulnerable to impacts from climate change. Most of the communities in the pilot area are located along the banks of the Rio Conchos and are; therefore, directly impacted by extreme events such as flooding and drought. Crop production and cattle farming are two main economic activities - both of which depend on river flows - which will likely be negatively impacted by climate change. Another major community dependency from the river can be seen in their water supply. The communities secure water from shallow wells located close to the river or rely on springs which are hydrologically connected to the river. Water flows reduction or major flooding will affect those communities

Drying and warming trends predicted by climate change may accelerate processes that could further reduce water retention and resilience. For example, more intense drought periods of longer duration will likely reduce bottomland and upland vegetation cover and lead to increased rates of soil erosion and evacuation when drought sequences are punctuated by severe storm events. Reversing these trends and increasing local water retention to compensate for increased water loss inferred by a drier and warmer climate has to be central to the freshwater climate adaptation response in the region.

8. Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.

The annual precipitation in the pilot area is around 230 millimeters (9 inches) per year and in severe drought conditions, that number can decrease to 6 inches per year. During the most extreme drought event - the 11 from 1993 to 2005 - many desert springs dried out for the first time in decades. Moreover, ranchers and people from small communities reported the presence of deer and their fawns close to their houses in search of water. These not-too-distant memories of the drought combined with the already existing arid conditions give the region's people a keen understanding of, and willingness to, stream conservation.

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

Although many forces imperil the freshwater ecosystems of this region, the people of the Rio Conchos truly care about their rivers and streams. However, there is not a recognition of the value of water other than the water itself. This knowledge gap is a result of few researchers working in the Chihuahuan Desert and even fewer are working in the lower portion of Rio Conchos basin. As a result, there are many unknowns about the value of ecosystem services of this part of the Chihuahuan Desert. The development of practical and implementable climate change adaptation recommendations is key for the preservation of the Rio Conchos and Rio Grande/Bravo. The Desert LCC Climate-Smart Planning and Design project has the capacity to develop the necessary research and help define specific recommendations for the Rio Conchos that might include a new operating model for the Luis L. León dam.

10. Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.

Average temperatures in Chihuahuan Desert are expected to rise 3°F to 5°F by the middle of the 21st century the middle part of the Rio Conchos basin. As a consequence, the current and limited river flows will further decline as result of higher evapotranspiration values and from a larger water use from farming activities. The Desert LCC could help focus the region on proactive and practical measures that have the dual objective of restoring the natural capacity of freshwater systems to buffer climate-change impacts and, at the same time, provide other environmental benefits such as improving water quality and habitat for native riparian and aquatic species. Given the hotter and drier conditions that are projected to affect the region, enhancing freshwater ecosystem resilience means enhancing water retention and availability.

11. Describe resources available for implementing conservation planning and design activities in the future.

In addition to WWF and the partners previously listed, there are additional human and and financial resources who can implement conservation planning and design activities. The two major state academic institutions are the autonomous universities of Chihuahua (UACH) and Ciudad Juárez (UACJ). Both academic institutions have programs related to water conservation. UACH awards Master's Degrees in Groundwater Management and UACJ awards Master's Degrees in Environmental Sciences.

12. Provide a shapefile (or similar file) of the pilot area boundaries.

13. (Optional) Describe any additional conservation opportunities in this pilot area.

The Mexico–USA water treaty has not been significantly revised since 1944, during which time climate change and shifting human demands have changed. Therefore, changing the agreement is a long term, yet critical, vision for the region's ability to adapt to climate change. It could be a great opportunity to change the way the water flow are delivered. In order to do that, the Mexican and USA water management authorities require a solid scientific proof of the benefits of a natural regime implementation in accordance with the volumes established by the treaty. These proofs could be part of a water management proposal for the IBWC/CILA authorities and the Rio Grande/Bravo Council at both nations.

14. (Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.

15. **(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination.**

https://www.worldwildlife.org/places/chihuahuan-desert

https://www.worldwildlife.org/stories/ushering-in-a-future-of-cooperation-and-water-security

16. (Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.

Left Photo: Rio Conchos at the Cuchillo Parado bridge, the first site of the e-flow determination (Photo: Alfredo Rodriguez) Right Photo: The El Peguis Canyon, 35 kilometers south of the confluence point between the Rio Grande and the Conchos (Photo: Alfredo Rodríguez)

Landscape Conservation Planning & Design
Pilot Area Nomination Form
For the Northern Chihuahuan Desert Pilot Area

Pilot area name: Northern Chihuahuan Desert Pilot Area

Point of contact (nominator) for pilot area: *Mara Weisenberger, USFWS, Wildlife Biologist, 575-382-5047, x101, mara_weisenberger@fws.gov*

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.**

The Northern Chihuahuan Desert Pilot Area (NCDPA) is located in south-central New Mexico in the Chihuahuan desert. The entire San Andres and Oscura Mountain Ranges, the Tularosa Basin, much of the Jornada del Muerto, a portion of the Rio Grande Basin, and Otero Mesa grassland are within the NCDPA. The Tularosa Basin, east of the San Andres Mountain Range, rises approximately 4,000 feet above sea level where as the Jornada del Muerto and Rio Grande Basin are to the west of the San Andres Mountain Range. Otero Mesa, located in the southeast portion of the NCDPA, contains more than 1.2 million acres offering the largest pristine Chihuahuan Desert grasslands in the United States. The NCDPA encompasses more than 8.4 million acres of relatively undisturbed contiguous Chihuahuan desert. Arid and semi-arid areas of the U.S. may be highly susceptible to the potential effects of climate change, and the NCDPA was chosen because of the high-functioning ecosystems and collaborative efforts between multiple agencies and organizations with jurisdiction in the Pilot Area.

The NCDPA includes lands managed by the Agricultural Research Service – Jornada Experimental Range (JER), Turner Enterprises - Armendaris Ranch, Bureau of Land Management (BLM)– Las Cruces District Office, National Park Service (NPS) – White Sands National Monument (WSNM), Department of Defense, United States Army – White Sands Missile Range (WSMR), National Aeronautics and Space Administration (NASA)– White Sands Test Facility (WSTF), Department of Defense, United States Army – Fort Bliss, New Mexico State Parks, New Mexico Office of the State Engineer/Interstate Stream Commission, United States International Boundary and Water Commission, and the Fish and Wildlife Service (USFWS)- San Andres National Wildlife Refuge (SANWR). There has been considerable collaboration among these partners for several decades.

The NCDPA contains a mix of grasslands, shrublands, the world's largest gypsum dunefield, and riparian-related habitat resources. Within the NCDPA there are at least 150 springs, many with perennial above-ground water and significant riparian habitat which support greater vegetative and wildlife diversity than adjacent terrestrial uplands. Riparian habitats are among the most important vegetative communities for western wildlife species. Additionally, one of the springs on SANWR is the largest between the Sacramento Mountains and the Rio Grande River and features a half mile of Fremont cottonwood (*Populus deltoides*) canopy with a diverse mixture of other trees including Goodding willow (*Salix gooddingii*) and netleaf hackberry (*Celtis reticulata*); this spring is important habitat for migrating and breeding Neotropical migratory birds, as well as resident avifauna and other wildlife. White Sands pupfish (*Cyprinodon tularosa*), a threatened species endemic to the Tularosa Basin is restricted to four populations, all within the NCDPA, including Salt Creek, Lost River and three additional springs on WSMR and WSNM lands. This species is particularly sensitive to climate change effects where water sources are reduced. Extensive black grama grass occurs within the grasslands found on the Otero Mesa, Jornada del Muerto, and bordering the northern San Andres Mountains. Northern Aplomado falcon (*Falco femoralis septentrionalis*) habitat is also scattered throughout the NCDPA with 36,000 acres of Aplomado habitat on the Otero Mesa alone.

2. **Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.**

The NCDPA represents one of the largest blocks of Chihuahuan desert habitat in the United States that retains highly functional ecological system with watersheds that feed into the Rio Grande River and the Tularosa Basin, including a section of the Lower Rio Grande River extending from below Caballo Reservoir downstream to Mesilla Valley Bosque State Park. The NCDPA will focus on 1) riparian and spring systems; 2) grasslands of the Region and 3) seek to analyze the potential climate change effects on these systems, functionality of ecological processes and potential impacts to associated priority species. The NCDPA is located within the Chihuahuan Desert, which encompasses the majority of the Desert LCC, and many management questions and priorities stated herein would be applicable to other portions of the

Desert LCC. For example, water scarcity, protection and recovery of sensitive and imperiled species, changes in fire regime, and the spread of invasive species are all management concerns listed by NCDPA partners. These very points are also listed by the Desert LCC as part of its mission to provide scientific and technical support, coordination, and communication to assist natural and cultural resource managers, decision-makers, practitioners, and the broader Desert LCC community in addressing problems that are too large in scope for any one agency, organization, or individual to solve alone.

3. **Describe the primary management questions or concerns in this pilot area.**

The partnering agencies interested in the Northern Chihuahuan Desert Pilot Area are particularly interested in: 1) shrub encroachment into grasslands (i.e., the effect on blue grama (*Bouteloua gracilis*) or hairy grama (*Bouteloua hirsuta*) as the ranges of black grama (*Bouteloua eripoda*) and creosote (*Larrea tridentata*) extend north), 2) long-term monitoring of black grama grasslands to measure response of the grasslands to the higher temperatures, higher evapotranspiration rates, carbon sequestration capability, and more extreme weather events associated with climate change, 3) soil erosion related to climate change factors, 4) invasion by Lehmann lovegrass (*Eragrostis lehmanniana*) and other floral species and how timing of prescribed burns can impact native grassland communities, 5) identifying factors behind lack of recruitment by perennial grasses, 6) long-term projected climate change effects on riverine, spring, and gypsum dunefield habitats, and 7) recommended solutions for addressing climate changes on the ground within the NCDPA.

4. **Describe the major partners or partnerships working in the pilot area.**

Partners in the NCDPA have been working together to address issues related to invasion and removal of non-native plants and animals within jurisdictional boundaries such as saltcedar (*Tamarix* spp.) and oryx (*Oryx gazella*), fire regimes, and inventory of species diversity. The treatment of invasive plant species across the landscape has been prioritized by the partners, focusing on sensitive desert riparian habitat throughout and surrounding the entire San Andres Mountain Range, regardless of land ownership. Secondly, research evaluating habitat conditions, survey techniques, and disease issues related to native ungulates (desert mule deer [*Odocoileus hemionus*] and desert bighorn sheep [*Ovis canadensis mexicana*]) has transcended partner boundaries as we work toward common goals to improve management of these species.

Jornada Experimental Range is a USDA Regional Climate Hub (one of seven nationwide) for the entire southwest and is an innovative network designed to deliver science-based knowledge and climate-smart information to farmers, ranchers, and land managers in order to more effectively respond to climate change. Part of the Long Term Ecological Research Network created by the National Science Foundation to conduct ecological research at the landscape scale, JER is a Long Term Ecological Research (LTER) site and has provided specific guidance on ecosystem health and monitoring methodology as well as ecosite mapping. The JER has worked extensively with the Las Cruces District Office of the BLM and Fort Bliss to map ecosite states and trained land managers on monitoring methods for ecological health (http://jornada.nmsu.edu/esd and http://jornada.nmsu.edu/monit-assess;). Additionally, the JER is part of the National Ecological Observatory Network (NEON) providing continental-scale observations for examining ecological change over time. These associations are a few examples of the many networks in which partners of this proposal are currently engaged and contribute valuable expertise to the NCDPA.

In July 2009, the International Boundary and Water Commission (USIBWC), U.S. Section signed a Record of Decision (ROD) for River Management Alternatives for the Rio Grande Canalization Project(RGCP). The ROD included implementation of 30 habitat restoration sites along the Lower Rio Grande River Corridor. In 2011, USIBWC initiated consultation with USFWS in order to discuss potential impacts of the ROD implementation on endangered species, particularly the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). In 2012, USFWS issued a Final Biological Opinion committing USIBWC to establishing a minimum of 53 acres of dense riparian shrub habitat suitable for flycatcher breeding. These sites were identified and prioritized as requirements of the 2012 Opinion. Under Interagency Agreement, the USFWS/ SANWR began implementation of 5 pilot restoration sites, with the addition of 4 new sites in 2013.

5. **Briefly describe the types of conservation or management activities currently occurring in the pilot area.**

The BLM Las Cruces District Office manages 5.4 million acres of public land from the western side of the Guadalupe Mountains to the Arizona border, and from Sierra County and the southern edge of the Gila National Forest to the Mexican border and is engaged in vast habitat restoration efforts such as the Restore New Mexico Initiative. The goal of this Initiative is to restore disturbed lands on a landscape scale through an ambitious partnership approach (BLM, along with other federal and state agencies, local communities, soil and water conservation districts, ranchers and other private landowners, the energy industry and conservation groups) with a focus on controlling invasive brush species, improving

riparian habitat, and reducing woodland encroachment. To date, more than three million acres of impaired habitat have been treated, starting the transition to healthy ecological states. Additionally, the Organ Mountains-Desert Peaks National Monument was established on May 21, 2014, by Presidential Proclamation, and is managed by the BLM. The Monument includes 496,330 acres, and was established to protect significant prehistoric, historic, geologic, and biologic resources of scientific interest and falls within the NCDPA.

Jornada Experimental Range is involved in several conservation management activities including shrub removal, erosion control, and grazing deferment during drought periods. As mentioned above, the JER and BLM have collaborated on treating and monitoring shrub invasion into desert grasslands through the Restore New Mexico program led by New Mexico BLM. The JER is monitoring the effects of shrub removal in these treated and control areas relative to perennial grass cover and associated biota. The JER has also collaborated with SANWR to monitor fire effects of grass response to prescribed fire and grass response the removal of trees (*Pinus* and *Juniperus* spp.) via fire and with Fort Bliss to develop Ecological Site Descriptions. Furthermore, JER is developing State Maps which are spatial representations of vegetation states of the ecological sites occurring in a landscape. They are high resolution vegetation and soil maps that are linked to Ecological Site Descriptions (ESDs) and state-and-transition models (STMs). The JER also developed the Landscape Toolbox in collaboration with the BLM and the Nature Conservancy; this Toolbox is a coordinated system of tools and methods for implementing land health monitoring and integrating monitoring data into management decision-making (i.e., JER is a major contributor to the BLM's Chihuahuan Desert Rapid Ecological Assessment currently in progress (http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/chichuahuan.html).

The Armendaris Ranch, managed by Turner Enterprises, is a vast 362,885-acre private ranch which lies in south central New Mexico along the Rio Grande River. Research has included evaluating the effects of fire on range grasses and recovery of native riparian species after removal of saltcedar. The lava tubes of Jornada lava field on the Armendaris Ranch are the summer home for one of the largest bat populations in North America and researchers on the ranch are collecting data that will improve our understanding of 1) the emerging epizootic disease, white-nose syndrome, that is causing precipitous declines in hibernatory bat species across North America, 2) how up to 8 species of bats (including 5 that have a "special concern" conservation status) use the Jornada bat caves, and 3) the threat posed by white-nose syndrome to bat populations inhabiting the Jornada bat caves. Endangered species on the Armendaris Ranch are managed by the Turner Endangered Species Fund (TESF). Projects include reintroduction of the aplomado falcon and bolson tortoise (*Gopherus flavomarginatus*), along with populations of silvery minnows (*Hybognathus amarus*) and willow flycatchers (*Empidonax traillii*) present on the Ranch. The Armendaris Ranch, BLM, SANWR, New Mexico Department of Game and Fish (NMDGF) and other partners have successfully collaborated for many years on the restoration and state delisting of desert bighorn sheep in New Mexico.

The Tularosa Basin is home to the largest gypsum dunefield in the world encompassing approximately 275 square miles. White Sands National Monument has management jurisdiction of 115 square miles (approximately 40%) of the dunes and the remaining 160 square miles is managed by WSMR. Current research projects for WSNM include 1) evaluating whether lighter lizards are less likely to be eaten by predators and more likely to survive long enough to pass on their genes, 2) a large-scale ecological survey to better understand what lives in an ephemeral lake in the Chihuahuan Desert, 3) a LIDAR survey to evaluate how the dunefield is changing, whether it's growing, and whether plants affect the formation and movement of dunes, 4) estimation of insects, especially moths (Lepidoptera) at WSNM to determine species distributions within specialized habitats and to create species richness data, 5) and comparative phylogeography of dune restricted insects in the desert southwest. Management activities include collaborating with WSMR, JER, and SANWR for saltcedar treatment throughout the NCDPA. United by a common landscape, WSNM and Cuatrociénegas Flora and Fauna Protection Area (CC), Mexico (which also falls within the Desert LCC) became binational sister parks in 2006 when U.S. and Mexican officials signed a Joint Declaration of Sister Park Partnerships. As part of this cooperation, the staffs of WSNM and CC meet together annually to share research and resource management techniques. Cuatrociénegas Flora and Fauna Protection Area and the NCDPA are 460 miles from each other. Despite this, both share much more than just gypsum dunes fields: both are located in basins surrounded by mountains. The pilot area contains the Tularosa Basin and CC lies in the Cuatrociénegas valley. The geologic processes that form the gypsum dunes are very similar. Dissolved minerals in water are pulled to the lower part of the basin and steadily the concentration increases in shallow lakes. This happens as well in Lake Lucero in WSNM and in Laguna Churince in CC.

Since 2004, NASA-WSTF has conducted annual surveys of the night blooming cereus (*Peniocereus greggii*), a State-endangered species in New Mexico, to provide information on its life cycle and growth patterns.

White Sands Missile Range is managed by the U.S. Department of the Army and operated to support Department of Defense readiness programs. White Sands Missile Range is expansive with varied terrain ideally suited for military activities but remained relatively undisturbed with highly functional ecosystems and WSMR has foraged partnerships with all the NCDPA partners to understand climate change. Currently, WSMR is 1) investigating the home range and habitat

use of the American black bear (*Urus americanus*) within 629,679 acres of the Chihuahuan Desert, 2) began a five year study to understand the distribution and abundance of mesocarnivores and how they utilize habitat on WSMR, and 3) began a five year study to determine the presence, distribution, habitat utilization of the Tularosa springsnail (*Juternia tularosae*), and its relationship with White Sands Pupfish (*Cyprinodon tularosa*). NMDGF have determined the snail as a species of greatest conservation need and is included in their *Comprehensive Wildlife Conservation Strategy* Plan. Todsen's pennyroyal (*Hedeoma todsenii*) is a federally listed endangered species protected by the Endangered Species Act. Surveys and monitoring of this species have shown that it is limited in distribution to certain areas within the San Andres and Sacramento Mountains on WSMR; climate change may have a serious impact on this plant's existence. Saltcedar (*Tamarix chinensis*) is widely spread throughout the pilot study area and WSMR has been working cooperatively with SANWR to remove saltcedar from critical locations.

Fort Bliss consists of 1.1 million acres in the Chihuahuan desert of the Tularosa Basin. The primary land management goal is to sustain military training by conserving the land base that makes realistic training possible. The installation is finishing its Natural Resource Management Plan and has done a significant amount of natural resource inventory over the last 20 years. Several endemic species are known on Fort Bliss, all on mountains, the majority within the Organ Mountains. Climatic shift is the largest single threat to these species. McGregor Range, which is about 62% of Fort Bliss, is co-managed by the BLM in accordance with the Military Lands Withdrawal Act of 1999. The BLM manages cattle grazing on approximately one third of McGregor Range. Military land use is defined in the Fort Bliss Army Growth and Force Structure Realignment Environmental Impact Statement (https://www.bliss.army.mil/DPW/Environmental/documents/FortBlissEISCDCopyMarch2010.pdf). Conservation measures are in place to help conserve grasslands and water locations and support the training mission. Surface waters are ephemeral on Fort Bliss; playas have been inventoried and mapped. Otero Mesa is a significant grassland in the Chihuahuan Desert and approximately one third of the Otero Mesa is found within McGregor Range; Aplomado falcon and prey monitoring has occurred for many years in the grasslands of McGregor Range. Jornada Experimental Range is currently mapping ecological states across the installation. Fort Bliss was one of the DOD locations for a study of an Ecohydrological Approach to Managing Intermittent and Ephemeral Streams on Department of Defense Lands in the Southwestern United States, a SERDP. This project conducted monitoring and modeling of ephemeral water courses. This was a collaborative effort conducted by scientists from the University of Arizona, USDA-ARS's Southwest Watershed Research Center and Colorado State University.

San Andres National Wildlife Refuge has collaborated in several research and management projects including 1) quantification of the change in woody vegetation throughout the San Andres Mountain Range over the past several decades and assessment response of woody vegetation to prescribed burns 2) basic avian population dynamics and long-term monitoring using migratory bird banding during the spring and fall since 1995 to compliment point count surveys (conducted 1993-1996), 3) Conservation Assessment of Poling's Hairstreak (*Satyrium polingi organensis*), 4) developed a fire atlas for three million acres of the NCDPA, providing a spatially explicit and standardized archive of management history across large landscapes and multiple land management agencies (i.e., SANWR, WSMR, BLM, JER) to provide a framework to support more detailed sampling and monitoring efforts as well ancillary inputs to regional ecological models, and 5) mapping, monitoring, and treating invasive plant species throughout much of the NCDPA in collaboration with the JER, WSMR, WSNM, and NASA-WSTF. San Andres National Wildlife Refuge is also continuing riparian restoration work at nine pilot sites along the Lower Rio Grande River as part of an Interagency Agreement with USIBWC to restore suitable breeding habitat for the listed Southwestern Willow Flycatcher. The work includes the initial removal of invasive salt cedar, non-native vegetation control methods, then follow up planting with native riparian species. Monthly monitoring and site visits will be conducted to determine success/mortality rates, with subsequent re-plantings to achieve desired plant densities. Additionally, SANWR is conducting riparian restoration projects along the Lower Rio Grande River under partnerships and agreements with New Mexico State Parks and the Interstate Stream Commission on the Broad Canyon Ranch Property owned by New Mexico State Parks.

6. **At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.**

Deserts, by their very name, are seldom regarded as important reservoirs of biological diversity, but the Chihuahuan desert is extraordinarily rich in species, rare plants and animals, specialized habits, and unique biological communities. The NCDPA and CC contain the world's largest gypsum dune fields in a sea of desert. The Chihuahuan Desert is the most biologically diverse desert in the Western Hemisphere and one of the most diverse arid regions in the world, with CC having the greatest overall diversity. The Chihuahuan Desert was one of the few ecoregions where grizzly bears, wolves, and jaguars could be found at the same locality. The region of the CC supports more than 120 species of mammals, 450 species of birds, 110 species of fish, and more than 170 species of amphibians and reptiles. Some distinctive habitat types

in the NCDPA and CC include yucca woodlands, playas, gypsum dunes, intact Chihuahuan Desert Grasslands, and a diverse array of freshwater habitats made up of seeps, springs and riparian resources. Nearly a quarter of the world's cactus species thrive in the Chihuahuan Desert with the highest concentration at CC. Unlike other desert soils; the soils at these protected areas are most similar to those found in an aquatic system. Like the endemic species that occur in these areas, the Natural Resources Conservation Service has identified unique soil types that occur nowhere else.

Grasslands area a priority conservation issue within the NCDPA and across the southwest and the State of New Mexico has designated them a priority habitat. The Northern Aplomado Falcon is the major species of interest in this system. The Armendaris Ranch and WSMR were heavily involved in releases of fledgling falcons in hopes of re-establishing breeding pairs. Another grassland bird, the Sprague's' Pipit, has recently been made a candidate species by the USFWS; the grasslands on BLM, Fort Bliss, Armendaris Ranch, and WSMR have habitat for Aplomado Falcons and Sprague's pipits. Though conservation of grasslands is important to all of the partners, their use is different among partners. Portions of the Armendaris Ranch grasslands are grazed by bison and much of the McGregor Range grasslands on Fort Bliss and other BLM lands are grazed by cattle; all lands in the NCDPA are grazed by wildlife species. The grasslands on WSMR and Fort Bliss are utilized for military testing and training. The goal of WSMR is to manage natural and cultural resources in a way that supports and sustains the operation of the military mission. A collaborative effort to address the encroachment of shrubs into grasslands; understand habitat responses and erosional factors to climate changes; and identifying temporal management actions would be powerful conservation on a landscape scale.

The significance of springs and riparian areas are important in the NCDPA where ephemeral systems also have important ecological roles. Research conducted on Fort Bliss has shown that arroyo drainages are important stopover habitat for Neotropical migrant birds moving north through the Chihuahuan desert (Southwest. Nat. 57(1):31-38. 2012). Several riparian habitat surveys have been conducted in the NCDPA, including a complete survey of spring sites on WSMR in 1996 that recorded natural and man-made riparian habitat conditions, the NPS Chihuahuan Desert Research Network conducted Level II spring surveys on SANWR, and SANWR also developed a Water Resource Inventory and Assessment (WRIA) Summary in 2014.

7. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

The NCDPA covers five counties (Otero, Dona Ana, Lincoln, Sierra, and Socorro) in Southern New Mexico and has a population less than 400,000 according to the 2014 census (US Census Bureau). The historic culture has been based on habitation of Native American tribes, Spanish and European settlers, farming, and ranching of cattle, sheep and goats. More recently, the area has supported recreation, ranching, farming, military readiness activities, education and self-supporting communities such as Las Cruces, Alamogordo, and Socorro. White Sands National Monument is visited by up to 600,000 people a year, whereas WSMR, JER, and SANWR are closed to the public, but offer hunting opportunities that are highly sought-after. Local tribal organization view parts of the area as sacred and provide plants for ceremonial purposes. Climate changes have the potential to change the suitability of grasslands for ranching, water availability for native wildlife and plants, changes in fire and hydrologic regimes potentially harming property in the larger communities. Changes in climate may also alter the scenic values of recreation areas.

Increases in shrub density and reduced perennial grass recruitment and biomass will significantly affect economic values for ranching, which is a significant industry in the Chihuahuan desert. Most communities in southern New Mexico are built around the ranching communities. The Rio Grande is an important farming area and the reservoirs on the river to assist water management are also important local tourism locations. Projected climatic change reducing surface water flows will put serious stress on ranching and farming communities, tourism, as well as on drinking water availability for many of the communities. El Paso, Texas and Alamogordo, New Mexico are already using desalination of groundwater to augment potable water sources.

8. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

In its publication *Comprehensive Wildlife Conservation Strategy,* the NMDGF named the Chihuahuan semidesert grasslands as one of two key habitats in the Chihuahuan Desert ecoregion. It noted that desert grasslands are especially important to grassland birds, which have been declining in North America over the past 50 years. The NMDGF stated that the semidesert grasslands host 55 species of greatest conservation need and New Mexico Partners in Flight identified several species of birds as priority species that are known to occur on McGregor Range and Otero Mesa. The Nature Conservancy's Prairie Wings program has mapped grassland ecosystems that need to be preserved to save 13 species of birds including the Chihuahuan desert grasslands of southern New Mexico and the World Wildlife Fund designated the Chihuahuan Desert as one of the most biologically diverse arid regions on Earth. The Chihuahuan Desert has been

isolated from other arid regions such as the Sonora Desert; it is this isolation that has allowed the evolution of many endemic species.

The entire gypsum dunefiled in the Tularosa Basin is held together by a shallow water table that lies only feet below the base of the dunes, the abundance of water can be seen in the cotton groves that thrive throughout gypsum dunefield, at CC the same is true, in additions they have amazing wetlands and pools that support the highest level of diversity within the Chihuahuan desert, the high water table that supports these systems is vital to their survival. Monitoring techniques that measure current human impacts on the unique communities in the Northern Chihuahuan desert along with better understanding of potential climate change effects are sought through the Desert LCC Pilot Area process.

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

We envision the spatial data and climate models provided by the Desert LCC Climate-Smart Landscape Conservation Planning and Design process will enable the partners to adaptively manage ecosystems in a way that supports resiliency as the climate changes over time, provide guidance for the best techniques to implement monitoring for trigger points or climate thresholds for the NCDPA, and provide guidance for management issues given current and projected ecological pressures.

10. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

The partners for the NCDPA have demonstrated over the past few decades, we have a collective impact working together as a team. For example, the BLM's Restore New Mexico initiative began as a concept that has expanded into a significant and regionally important restoration and reclamation program involving numerous Federal and State agencies, conservation organizations, industry groups, and private landowners – over 300 different partners have participated in the effort thus far. To date, about 1.8 million acres of degraded land and impaired watersheds have been treated and is either restored to a more natural condition or in the process of doing so. The health of the land and the benefits to migratory birds and other wildlife cannot be overstated. For the past 100+ years a monoculture of creosote and mesquite, decadent and over stocked pinion/juniper woodlands, and degraded riparian areas dominated the New Mexico landscape. There are now almost two million acres of healthy, defragmented grasslands and woodland habitat and miles of healthy riparian areas.

11. **Describe resources available for implementing conservation planning and design activities in the future.**

The partners for the NCDPA are very interested in gaining more information on potential climate change impacts on grasslands and riparian habitat by climate change. A collaborative approach may help leverage already limited funds and staff for implementing recommended monitoring techniques. Some of the partners' expertise has been described in previous questions for this nomination form and may be applicable for the desired outcome from the Desert LCC Pilot Area process. For example, should the timing of prescribed burns be recommended to be modified to benefit or inhibit response by focal species, that information can be incorporated into appropriate management plans. Both WSMR and Fort Bliss can implement conservation planning through their Integrated Natural Resources Management Plan. Together they cover three million acres of defense lands that can't be recreated elsewhere.

12. **Provide a shapefile (or similar file) of the pilot area boundaries.**

Please see attached shapefile and .pdf map of the NCDPA.

13. **(Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.**

See following page for photos of the NCDPA. All photos by Mara Weisenberger.

Mixed shrub grassland in the San Andres Mountains.

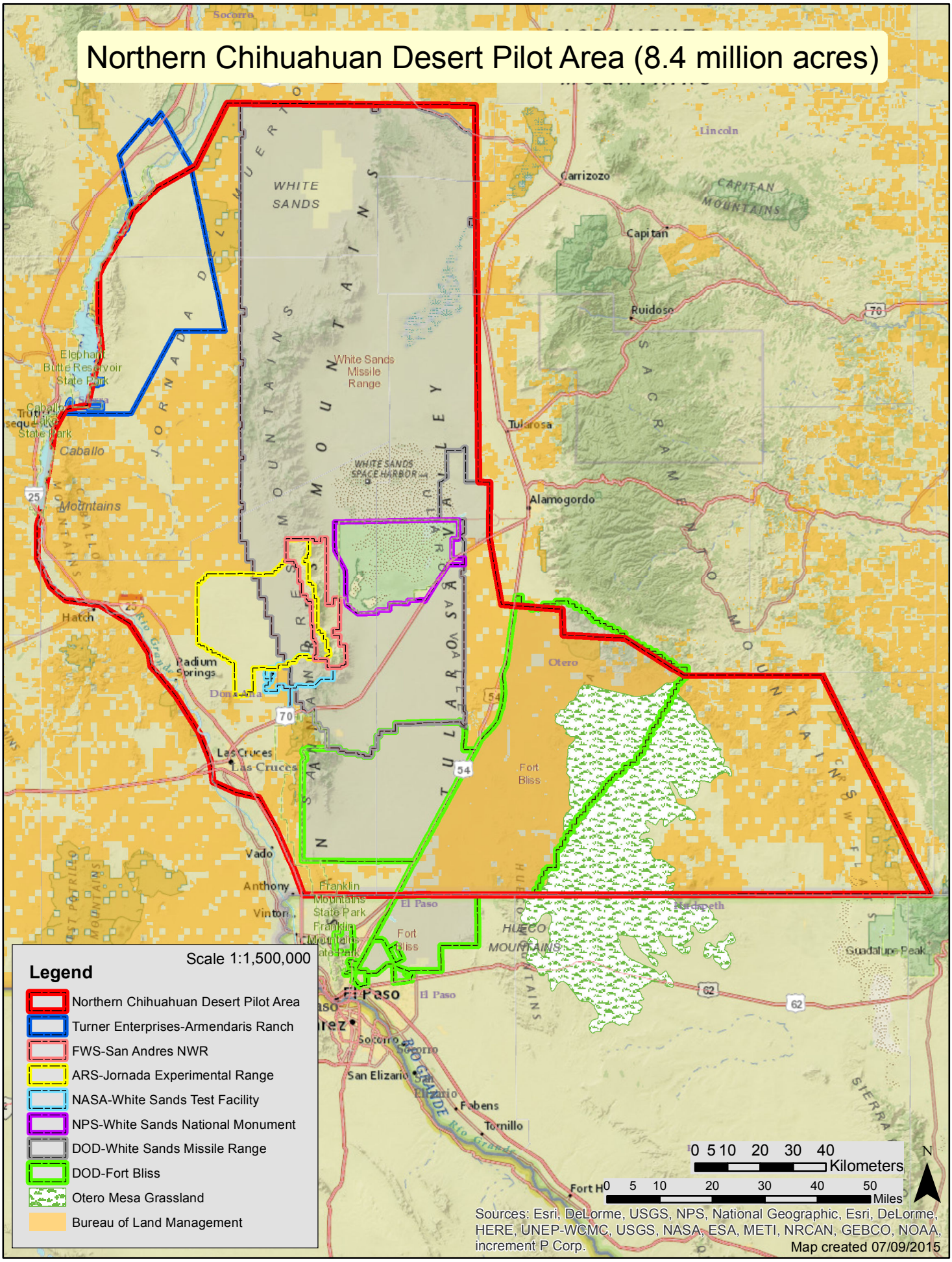
San Andres Mountains with Tularosa Basin.

Jornada del Muerto from Armendaris Ranch.

Aplomado falcon on Armendaris Ranch.

San Andres Spring on SANWR.

Lake Lucero on WSNM in the Tularosa Basin.


Northern Chihuahuan Desert Pilot Area (8.4 million acres)
Legend
Scale 1:1,500,000
Northern Chihuahuan Desert Pilot Area
Turner Enterprises-Armendaris Ranch
FWS-San Andres NWR
ARS-Jornada Experimental Range
NASA-White Sands Test Facility
NPS-White Sands National Monument
DOD-White Sands Missile Range
DOD-Fort Bliss
Otero Mesa Grassland
Bureau of Land Management
0 5 10 20 30 40 Kilometers
0 5 10 20 30 40 50 Miles
N
Sources: Esri, DeLorme, USGS, NPS, National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Map created 07/09/2015
WHITE SANDS
White Sands Missile Range
WHITE SANDS SPACE HARBOR
Carrizozo
Capitan
Ruidoso
Tularosa
Alamogordo
Lincoln
CAPITAN MOUNTAINS
Elephant Butte Reservoir State Park
Caballo
Hatch
Radium Springs
Las Cruces
Vado
Anthony
Vinton
Franklin Mountains State Park
El Paso
Fort Bliss
Otero
HUECO MOUNTAINS
Guadalupe Peak
Socorro
San Elizario
Fabens
Tornillo
Fort H
Rio Grande

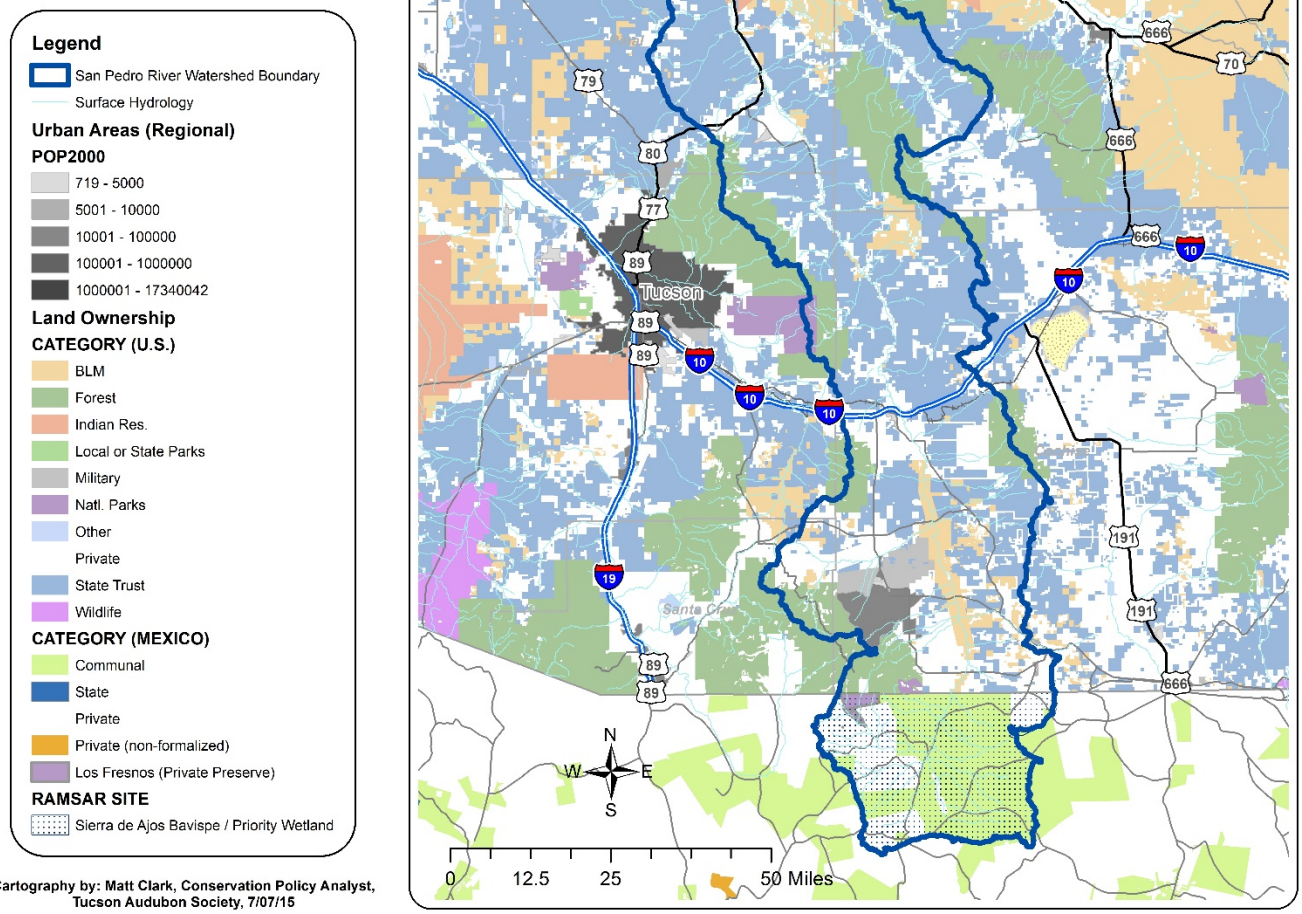
Landscape Conservation Planning & Design

<u>Nominated Pilot Area Name</u>:
San Pedro River Watershed (HUCs 15050202 and 15050203)

This nomination was prepared by Audubon Arizona, Cascabel Conservation Association, Friends of the San Pedro River, Lower San Pedro Watershed Alliance, Tucson Audubon Society, and Wildlands Network. It is endorsed by Arizona Land and Water Trust, Huachuca Audubon Society, Naturalia, and Sky Island Alliance.

Contact: Peter Else, Lower San Pedro Watershed Alliance, Chair, phone 520-487-1903, bigbackyardfar@gmail.com

San Pedro River Watershed Boundary



Cartography by: Matt Clark, Conservation Policy Analyst, Tucson Audubon Society, 7/07/15

1. Describe pilot area, why it was chosen, and describe resource concerns and ecological integrity: We are nominating the San Pedro River Watershed (HUCs 15050202 and 15050203) as a pilot landscape. Watershed-wide assessment and planning makes sense in terms of landscape-scale hydrology, biome representation, and cohesiveness of partnerships and associated management strategies, making the pilot scale more achievable. Water availability is the primary resource of management concern, as it affects the sustainability of the DLCC's priority resources.

As described in the Bureau of Land Management's (BLM) recent Madrean Archipelago Ecoregion Rapid Ecoregional Assessment (MAEREA), this watershed encompasses one of the most significant intact major riparian corridors in the DLCC region, includes the Sonoita Grasslands identified by the Commission for Environmental Cooperation (CEC 2010), and has abundant springs within the "sky islands," especially within the Huachuca, Whetstone, Catalina, Rincon, Galiuro, and Pinaleño mountain ranges and the Aravaipa region (DLCC Conservation Planning Atlas). The ecological integrity is extremely high: the Galiuro-Aravaipa-Santa Teresa region is rated by The Nature Conservancy (TNC) as the second most intact, unfragmented landscape within the Arizona–New Mexico region, after the Grand Canyon.

This watershed has outstanding biological diversity due to the convergence of Chihuahuan and Sonoran deserts, the bounding "sky islands," and its ~ 250 km riparian corridor. It functions as a principal hemispheric migration pathway for Neotropical birds (>250 migrating bird species and >100 breeding bird species) and supports 84 mammal species, 41 amphibians and reptiles, and 14 native fish species (TNC). Threatened, endangered and candidate species include: Southwestern willow flycatcher (SWWF-*Empidonax traillii extimus*) and Western yellow-billed cuckoo (WYBC-*Coccyzus americanus*); northern Mexican gartersnake (*Thamnophis eques megalops*); Gila chub (*Gila intermedia*), spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*); and Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*). Mexican spotted owl (*Strix occidentalis lucida*), jaguar (*Panthera onca*) and ocelot (*Leopardus pardalis sonoriensis*) occur in the mountain ranges and canyons. Grassland-dependent bird species include Arizona Species of Greatest Conservation Need: Arizona Botteri's sparrow (*Peucaea botterii arizonae*), Arizona grasshopper sparrow *(Ammodramus savannarum ammolegus*), Cassin's sparrow (*Peucaea cassinii*), and over-wintering Baird's sparrow (*Ammodramus bairdii*). Upland species include: lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), Sonoran desert tortoise (*Gopherus morafkai*), desert bighorn sheep (*Ovis canadensis mexicana*) and Chihuahuan pronghorn (*Antilocapra americana mexicana*).

2. Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision: This landscape sits in the very middle of the Chihuahuan/Sonoran desert transition area, key ecoregions of focus of the DLCC. In the upper reaches, Chihuahuan desert grasslands abut riparian resources, and in the lower reaches, Arizona Sonoran upland desert-scrub abuts riparian resources. In both the upper and lower watershed, springs and seeps are critical water resources that support the region's biodiversity, especially during periods of spring and pre-summer aridity. The watershed contains an elevational gradient of biomes (riparian, grassland, shrubland, chaparral, and forest) that traverse the watershed's "sky islands." All these resources are subject to present and increasing climate-change stressors, but can be amenable to conservation management through effects-based analysis leading to creative climate-smart strategies.

This landscape provides a scalable model to meet the mission of the DLCC, developing science-based information about the implications of climate change and other stressors for the sustainability of natural and cultural resources. It meets the vision of the DLCC by bringing together a high number and diversity of conservation partners to increase the resiliency of the ecosystem to environmental stressors and to conserve its many ecological and cultural values. The DLCC can achieve its mission by fostering a working group (including agencies and national and regional NGOs), collating available data and providing for its dissemination and use, and developing new climate-wise goals, objectives and strategies for these high-priority resources. Interest in the management of these resources is high, notably by conservationists and resource users in Cananea, Sierra Vista and Tucson, all regional population hubs, thus raising the potential for regional application of the climate-change adaptation strategies/actions that derive from this process.

3. Describe the primary management questions or concerns in this pilot area: Drought and water resource depletion are negatively affecting working landscapes and designated conservation properties within the watershed. The trend of deepening wells has already been initiated throughout this watershed, similar to what took place in the nearby Santa Cruz River watershed decades before. If effective measures are not identified and implemented, a cascading

negative effect on water resources will take place, affecting habitat quality, productivity of working landscapes, and the water security and sustainability of urban and rural populations.

Fragmentation of habitats and wildlife corridors from upgraded or new roads, power lines, the international border fence, and pipelines threaten the integrity of the watershed and wildlife connectivity in the region. The *Arizona Wildlife Linkages Assessment* has identified U.S. wildlife linkages that are vulnerable, and a recent Desert LCC-funded ecosystem conservation assessment identified landscape linkages important for biodiversity adaptation to climate change in the lower San Pedro watershed (Wilbor 2014). Fragmentation facilitates the spread of invasive species, including non-native grasses and weeds, bullfrogs, mosquito fish, and crayfish, negatively impacting native fish and frog populations.

Arizona is in year 16 of a state-declared drought emergency. Increasing temperatures and prolonged drought are contributing to a departure from natural fire regimes in the pine-oak and encinal oak woodlands and increasing the fire risk in the riparian gallery forests and mesquite bosques of the San Pedro River and tributary floodplains. Greater extremes in temperature and aridity are predicted for the Madrean sky islands. Annual mean precipitation is expected to decrease, resulting in reduced snowpack and streamflow, causing negative consequences for flora and fauna. Additionally, climate models are predicting more variable and higher-intensity precipitation events that will likely increase flooding and adversely impact communities and livelihoods in the valley.

Through the degradation of natural resources and the boom-and-bust cyclical abandonment of work forces, high-impact mining has had significant impacts on the natural and human environments, leaving social justice issues, widespread poverty and environmental degradation, foreclosing certain sustainable economic options in some areas.

4. Describe the major partners working in the pilot area. Many groups have worked to conserve the San Pedro River watershed, including the nominating partners:

The Lower San Pedro Watershed Alliance (LSPWA) has worked with the nominating partners to unify conservation-minded landowners, agencies, NGOs, and other supporting groups and individuals to protect this threatened watershed. LSPWA has 194 members, 95 of whom are landowners in the lower San Pedro region, representing over 9,200 acres in private land and over 70,000 acres in leased lands associated with three ranches. Through education, cooperative research, outreach, collaborative conservation projects, and conservation planning, LSPWA seeks to link partner organizations with each other and with private landowners, making on-the-ground conservation more achievable.

Cascabel Conservation Association (CCA) is dedicated to the collaborative stewardship of the Middle San Pedro River watershed in a way that promotes the health, stability and diversity of the whole community and strives to integrate the needs of the land with the needs of a sustainable human community through educational, economic, agricultural, contemplative and other conservation-related endeavors.

Audubon Arizona (AA), a state office of the National Audubon Society (NAS), works to connect people with nature using education, science and advocacy to protect birds, other wildlife and their habitats for the benefit of humanity and earth's biodiversity. *Huachuca Audubon Society (HAS)*, a local chapter, works to conserve and restore natural ecosystems in the upper watershed. *Tucson Audubon Society (TAS)*, also a local chapter, promotes the protection and stewardship of southeast Arizona's biological diversity through the study and enjoyment of birds and the places they live. TAS founded, and in cooperation with AA, co-administers the Arizona Important Bird Area (IBA) program and keeps bird survey records for the avian science initiative. This watershed encompasses two Global IBAs. TAS is also a member of the Sky Island Restoration Cooperative (SIRC).

Friends of the San Pedro River (FSPR) coordinates its activities with the BLM managers of the San Pedro Riparian National Conservation Area (SPRNCA) and is dedicated to the conservation and restoration of the river through advocacy, education, and interpretation.

Arizona Land and Water Trust (ALWT) believes the preservation of southern Arizona's working landscapes and ecosystems to be vital to the well-being of all residents, present and future, and has protected more than 36,000 acres through conservation easements, donations and fee acquisition.

Sky Island Alliance (SIA) is a science-based conservation organization dedicated to the protection and restoration of the rich natural heritage of native species and habitats in the Sky Island region of the southwestern United States and northwestern Mexico.

Naturalia acquired the 10,000-acre Rancho Los Fresnos preserve in the headwaters of the watershed from TNC in 2005. It is a private reserve, project site and training ground for partnerships with the Northern Jaguar Project, the Ajos-Bavispe National Forest Reserve and Wildlife Refuge, SIA, USFWS, Universidad de Sonora, University of Arizona, and Instituto Tecnológico Superior de Cananea.

The Wildlands Network (WN) works in the western hemisphere to connect our national parks and wilderness areas via wildlife corridors to give our forests and animals enough space to thrive and adapt to climate change. The organization is presently building a program in Mexico to establish a network of conservation practitioners, which will include this watershed in its purview.

In addition to the nominating partners, other groups are also playing a major conservation role in the pilot area:

Ndeh Nation (of the San Carlos Apache) is the oldest residing society in the watershed. This nation has historical ties to much of the region, regulatory authority over land at the north end of the watershed, and spiritual ties to the Earth as a whole.

The Nature Conservancy (TNC) has been involved for 40 years in conservation work in the San Pedro Valley, which is one of their two primary focus areas in Arizona. The Conservancy has worked with private landowners, corporations, and government agencies and entities to protect and preserve more than 100,000 acres in the watershed, focusing on restoring the San Pedro River ecosystem.

The Upper San Pedro Partnership (USPP), a consortium of 21 local government, state and federal agencies and organizations, has had the task of ensuring an adequate long-term groundwater supply for both residents and the upper San Pedro River since 1998. Projects include scientific monitoring, reporting, and community water savings programs and education.

Natural Resource Conservation Districts (Hereford, San Pedro, Redington, and Winkelman NRCDs) and the Natural Resources Conservation Service (NRCS): NRCD members are primarily local ranchers and farmers. With advisement from the NRCS, NRCDs identify and implement conservation actions and best management practices that alleviate environmental stressors at a local scale.

Lower San Pedro Working Group: Cooperating landowners are ASARCO, BHP-Billiton (BHP), Resolution Copper Mining (Resolution), U.S. Bureau of Reclamation (BoR), Salt River Project (SRP), AzGFD, TNC, Audubon Arizona, CCA and Bureau of Land Management (BLM).

Other partner agencies and conservation organizations include the U.S, Fish and Wildlife Service, Saguaro National Park, and the U.S. Forest Service. Partner economic and community development interests include Pinal Partnership Open Space and Trails Committee and the Copper Corridor Economic Development Coalition.

5. Describe the types of conservation or management activities currently occurring in the pilot area:

Land Management/Preservation/Conservation Easements – Naturalia, BLM, CCA, Saguaro-Juniper Corporation (S-JC), LSPWA, TNC, Pima County, SRP, AzGFD, BHP, Resolution, ASARCO, and the BoR have established protections and implemented management activities (including grazing and ORV restrictions) to conserve and protect riparian habitat and its associated wildlife values on 355,674 acres of land on and adjacent to the San Pedro River. At Rancho Los Fresnos, Naturalia uses prescribed fire to enhance habitat for prairie dogs and Huachuca tiger salamanders, as well as 400 bird and 180 butterfly species.

Restoration Actions – TNC and SRP have restored former agriculture and/or aquaculture lands with giant sacaton and other native grasses. BHP has planted over 3,100 cottonwood and willow trees along the San Pedro River. ASARCO has restored 129 acres of agricultural land to mesquite and 650 acres to cottonwood/willow habitat. AzGFD will implement restoration actions on part of its 1,000 acres deeded acres of riparian habitat as part of a Natural Resource Damage Assessment and Restoration program at their Lower San Pedro Wildlife Area.

Federally Listed Species Protections/Management – BoR and SRP purchased and manage lands in the lower San Pedro Valley to facilitate recovery of the endangered SWWF and threatened WYBC. BoR has constructed fish barriers on Aravaipa Creek, Hot Springs Canyon and will construct a barrier on Redfield Canyon to protect native fish within these tributaries. Resolution has constructed a bullfrog exclusion fence to protect native lowland leopard frogs on the 7B Ranch conservation property. BLM manages the SPRNCA to protect a variety of federally listed and BLM sensitive species.

Reductions In Groundwater Pumping/Water Rights – TNC and BOR have partnered in the acquisition of 3 Links Farm to reduce groundwater pumping on the property by 90%. TNC has also reduced groundwater pumping on the San Pedro Preserve, the Aravaipa Preserve, and the H&E properties. SRP has reduced groundwater pumping on their properties. BLM holds instream flow rights for the protection of the San Pedro River within the SPRNCA and on Aravaipa Creek.

Environmental Awareness – Most of the resident conservation land-managing groups promote sustainable uses of the ecosystem in order to preserve the unique values of the San Pedro watershed.

6. At pilot area scale, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest: Our principal goal for this pilot area is to protect and preserve all the riparian resources of the San Pedro River watershed. Rare perennial desert streams (e.g. Babocomari River and Hot Springs, Redfield, Buehman, and Aravaipa Canyons) are critical elements of the watershed. Conserving riparian and aquatic resources requires maintaining groundwater levels, perennial flow, and intact floodplains for overbank flooding, allowing for dynamic riparian and aquatic community persistence. By accomplishing these objectives, we are protecting and enhancing the diverse flora and fauna that depend upon this riverine ecosystem.

Meso-riparian and xero-riparian habitat along intermittent and ephemeral connected desert washes are essential elements of the landscape, contain denser and richer vegetation due to increased water flow, and serve as primary wildlife migration corridors between grasslands and mountain ranges that flank the valley. We seek to prevent fragmentation and degradation of these corridors by infrastructure projects and roads and to enhance them where they may have already been compromised.

Seeps and springs are crucial to wildlife in the watershed and increasingly threatened by drought and climate change, and we seek to protect and restore them wherever they are found. Strategies to achieve this include enhancing water capture and recharge, maintaining and protecting them from potential harm by livestock, and restoring those that have been damaged.

Degradation of grasslands by shrub invasion is a major ecological and rangeland concern in the San Pedro watershed. A primary goal is to halt the invasion by removing or thwarting advancing shrubs and by restoring native grasses on degraded lands and land abandoned by agriculture or damaged by past overgrazing.

From the human perspective, we seek to identify prospects for sustainable economic development that complement the natural resources and rural aesthetic that drew people to the region in the past and will continue to provide a basis for ecotourism and sustainable enterprise in the future.

7. Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios: Principal climate-change scenarios modeled by the U.S. Global Change Research Program for this watershed project an increase in annual mean temperature of up to 5.5°F through 2070 and a decrease in annual mean precipitation of 6%–9%. These changes will result in greater stress on agriculture and increased energy and water use by human communities. These communities, as well as local farming and ranching operations, are all outside Active Management Areas (AMAs) and depend upon private wells and groundwater for domestic and agricultural purposes. Water uncertainty is a vulnerability on every level, but especially so for rare desert riparian and grassland ecosystems.

Abandoned or greatly reduced mining operations have resulted in significant under-employment and poverty around the communities of San Manuel, Mammoth, Dudleyville, and Winkelman. Social and economic vulnerability can lead to political support for any industry that might bring jobs to the region, often without much forethought about the sustainability of such industries, potentially compounding the stress on resources caused by climate change.

Irrigated farming and pastureland have declined along the river but are still important in certain areas. Cattle ranching remains an important economic activity throughout the watershed. Increasing temperatures, a longer growing season, and decreasing rainfall increase the groundwater that farmers pump to maintain fields and pastures. Farmers often must replace older, less efficient irrigation equipment, deepen wells, and fallow part of their acreage to maintain production. These climatic changes also reduce livestock forage on the range, which can cause desert scrubland to expand, further degrading grassland quality. Less forage reduces the land's carrying capacity, diminishing rancher income. More expenses and less cultivated acreage increase the cultural and economic vulnerability of farming and ranching operations.

While the current 16-year drought threatens traditional ranching and farming, large population increases are still projected for Arizona over the next several decades. Recent proposed real estate developments and re-zonings within the watershed—in Sierra Vista (Tribute), Benson (Vigneto), and San Manuel (23,234 acres zoned for 30,500+ dwelling units)—have raised concerns over surface and groundwater availability and reliability due to potential impacts to riparian resources. If drought conditions continue and/or if there is a run on water resources by development interests, the effects on rural human communities and riparian resources could be devastating.

8. Describe why people in the pilot area value grasslands, streams, springs/seeps, and riparian resources: A broad spectrum of people are concerned about the economic, recreational, scientific, and conservation value of these resources, including ranchers, conservationists, hunters, and those involved in the ecotourism industry. Grasslands provide forage for cattle and serve as habitat for declining grassland birds. Streams support endangered fish while providing drinking water and riparian vegetation for birds, insects, mammals and other wildlife. Springs and seeps create isolated habitats that support rare aquatic plants and associated micro and macro fauna. Riparian habitat is essential to western hemispheric migratory and breeding bird species, serves as a corridor that provides cover and foraging opportunities for terrestrial wildlife and facilitates connections among regional sub-populations. Riparian zones and their diverse wildlife provide opportunities for human health and recreation, including hiking, bird-watching, and seasonal hunting.

Water is vital to all life – water resources and associated habitats are inherently scarce in the desert, with many competing demands. Increasingly, not all of these demands can be met, particularly in the face of extended drought and the uncertainty and variability of climate change. Grasslands are under pressure from invasive exotics, conversion to desert scrub, unsustainably managed cattle grazing, and sprawling residential development. Declines of Baird's and Grasshopper sparrows emphasize that conservation of remaining grasslands is a priority. Streams and springs are tapped routinely as water sources for ranches and communities and are altered and diverted and often go dry sooner and for longer periods downstream as a result. Unsustainable groundwater pumping for communities, farms and ranches leads to an overdraft of water resources. The livelihoods and goals of people involved in working landscapes, ecological tourism and recreation, and habitat protection depend on these increasingly scarce resources of the desert landscape. Wet-dry mapping has documented reductions in the length and persistence of some perennial reaches of the San Pedro River.

9. Describe how the DLCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area: Climate-smart planning and design provides an opportunity to develop and expand partnerships among scientists, managers, and NGOs to develop voluntary adaptation strategies and actions for conserving riparian resources, grasslands, springs and seeps. We seek to understand which riparian conditions, driven by climate change, are most susceptible to altered fire regimes, which will have a significant impact on species of concern, ecosystem function, and riparian services. What types of best management practices are available for mitigating the effects of increased fire risk in riparian corridors? How can we increase groundwater recharge to buffer projected increasing temperatures overall, combined with a decreasing winter rain pattern? Could tributary projects in the uplands, such as trincheras, check-dams, and meander inducement, help buffer climate impacts and enhance stream and spring flows to increase their resiliency during drought? Which adaptive management strategies will increase grass cover in the uplands while decreasing shrub invasion and non-native species encroachment? Which measures are effective at slowing run-off, decreasing erosion, and enhancing recharge, elevating groundwater levels that contribute to the resiliency of riparian resources to climate change?

We seek project design elements that may spatially direct where certain grassland conservation/restoration techniques (e.g., brush management, prescribed fire, etc.) would be most effective, considering land use patterns and climate projections. The Department of Interior (DOI) has indicated that planning activities and mitigation plans

should be performed within the context of landscape-scale planning. Currently, the San Pedro River watershed is subject to imminent threats similar to those that degraded the watersheds of the Sun Corridor, making adaptation to climate change challenging. Both ecosystem and human communities need, and would greatly benefit from this planning and design process. The key to protecting this watershed is building a very strong culture of conservation.

10. Describe how developing collaborative adaptive management actions for Desert LCC focal resources help human communities in the pilot area adapt to projected climate change: By developing collaborative adaptive management actions for grasslands and riparian resources, human communities will have a much greater chance of developing and maintaining sustainable and resilient rural and urban economies. Sustainable development and working landscapes, low-impact enterprise, high-value habitat protection, and sustainable outdoor recreation will all depend upon how well human communities join together to protect the focal resources from hotter and drier conditions currently being experienced, and projected to continue, due to climate change.

Though restoration of highly disturbed areas has its place, protection of relatively pristine areas often tends to be more cost effective given limited resources, especially as it relates to actual outcomes in biodiversity. Landowners taking voluntary actions to protect identified wildlife linkages, critical and high-value habitat, grasslands, and flows in streams and springs can be cost effective and achievable. Conservation elements of the U.S. San Pedro watershed were recently identified by the BLM's MAEREA.

Voluntary actions to protect focal resources and focal areas include sustainable livestock grazing plans promoted by local natural resource conservation districts, grassland restoration and improvement plans, landowner collaborative conservation projects, conservation easements, fee purchase of land for high-value wildlife habitat and ecological education, implementation of conservation policy objectives in county comprehensive plans, development of additional multi-species habitat conservation plans, continued negotiation of reasonable hunting limits, and the expansion of cooperative research agreements.

11. Describe resources available for implementing conservation planning and design activities in the future: *DOI's American Great Outdoors Initiative* focuses on local, grassroots conservation initiatives that promote recreational opportunities which support sustainable economies based on working landscapes, cultural and historic heritage and ecotourism.

US Department of Agriculture's Working Lands for Wildlife Habitat Initiative focuses on cooperative efforts to assist ranchers and farmers in preserving their way of life while strengthening rural economies and conserving endangered species.

Pinal County's Open Space and Trails Master Plan and Comprehensive Plan identified the lower San Pedro watershed as containing high value and critical habitat, proposed and adopted County Trail Corridors (including the Arizona Trail), and proposed or planned open space. *Pima County's* Sonoran Desert Conservation Plan, Comprehensive Plan and draft Multi-Species Habitat Conservation Plan identify the San Pedro River as a "Priority Habitat and Corridor," a "Proposed Nature Preserve," an area of ranch preservation, cultural and environmental significance, and an "Important Riparian Area" (IRA). Saguaro National Park East and the Rincon Wilderness Area are included in this proposal. In *Cochise County*, Arizona Land and Water Trust (ALWT), a regional land trust operating in southeastern Arizona, has taken the lead, managing a $16M Sentinel Landscapes Partnership program to achieve conservation protections for open space around Fort Huachuca. The Trust also operates its Desert Rivers Initiative in the San Pedro and Gila watersheds, paying ranchers/farmers for water lease agreements to benefit river flows and riparian ecosystems. In the upper San Pedro aquifer, TNC has partnered with Cochise County on river recharge basins to increase base flows at the 1,811-acre River Stone Ranch near Sierra Vista and the 285-acre Mansker tract.

BLM is currently revising its SPRNCA Resource Management Plan (final ~May 2017), which will guide management for the next 15–20 years on this 57,000-acre, 44-mile section of the San Pedro River corridor. The RMP process involves significant evaluation of current resource conditions and desired conditions, as well as spatial planning to achieve objectives. The draft RMP and EIS are projected for completion in January 2016. The 7B Ranch near San Manuel has been designated as an addition to the SPRNCA by Senator McCain's recent amendment to the National Defense Authorization Act.

12. Provide a shapefile (or similar file) of the pilot area boundaries. [see attached]

Optional Questions

13. Describe any additional conservation opportunities in this pilot area.

Previous and Current Conservation Opportunities

In Pinal County, **Spirit Hollow**, approximately one linear kilometer of river, is managed by SRP for SWWF and WYBC; BOR has an additional **50 acres adjacent and south of Spirit Hollow** being managed by SRP for SWWF. **Mercer Ranch**: Mike Mercer has planted native Arizona cottontop, sacaton, plains bristlegrass and plains lovegrass along the river's floodplain, using significantly less water than previous crops. Partners: USFWS, Mercer family. Adjacent to Mercer Ranch, Resolution Copper's 3,200-acre **7B Ranch**, east of the town of Mammoth, covers seven river miles and is managed by TNC to eliminate invasive species and restore wetlands. It will be the newest addition to the SPRNCA. Another **7 miles of river, with significant water rights**, contiguous and to the south of the 7B, is owned by BHP. Combined, these two properties represent the largest intact mesquite bosque (7,000-acres) in Arizona and the southwest and are adjacent to **San Manuel Crossing**, a 160-acre BLM parcel. All these properties are included in the Lower San Pedro Global Important Bird Area (IBA) and contain cottonwood-willow forest supporting SWWF and WYBC. **Aravaipa Canyon**: Flanked by TNC preserves, this 58,900-acre wilderness is noted for its wildlife and creek, supporting native fish. Partners: BLM, AzGFD. AzGFD's **Lower San Pedro Wildlife Area,** comprising the Aravaipa Crossing and Triangle Bar Ranch totaling 1,000 acres of deeded land, is an important section of the river managed for conservation. SRP's **Stillinger Preserve** and **Adobe Preserve** are managed by TNC, and the Adobe Preserve, combined with BoR's **Cook's Lake/Cienega Seep**, totals 320 acres. Extending north from **Dudleyville Crossing** at Schwenesen's Double Check Ranch, **TNC** is restoring two ponds and waters, and re-seeding native grasses, on their 6,900-acre **San Pedro River Preserve**. Partner: BoR.

Pima County conservation/mitigation parcels include **Buehman Canyon**, an EPA /ADEQ-designated "Outstanding Arizona Water" that flows through a 1,000-acre wildlife corridor from the Santa Catalina Mountains to the river. Partners: Pima County, US Forest Service (USFS), TNC. **Bingham Cienega**: Pima County's 503-acre parcel includes a restored spring-fed marsh with cattails, native grass, mesquite, cottonwood and willow. Partners: Pima County, TNC. **A-7 Ranch**: Pima County's 6,829-acre fee simple property (41,000 acres with State Trust lease lands) was purchased with $2 million of voter approved Open Space Bonds to conserve wildlife corridors from the Santa Catalina Mountains to the river. Partners: Pima County, TNC. Pima County also acquired the 12,330-acre **Six Bar Ranch** (2,200-acres along Edgar Canyon, and 1,130 acres adjacent to Buehman Canyon (3,330 acres in fee simple plus State Trust and USFS leases purchased with $11.5 million of voter approved Open Space Bonds). Most recently, Pima County acquired the **M Diamond Ranch**, which includes 624 acres of deeded land and 7,800 acres of state grazing leases for a total of 8,424 acres. The National Park Service oversees important conservation lands in **Saguaro National Park–Rincon Mountain District**, and their mission is to "preserve unimpaired the natural and cultural resources and values of the National Park system for the enjoyment, education, and inspiration of this and future generations." (For specific web references for many of these Pima County areas, see optional Question 15.)

In Cochise County, conservation/mitigation parcels include **Hot Springs Canyon**, where five landowners and TNC signed conservation agreements covering 1,700 acres of a wildlife corridor connecting the Muleshoe Ranch to the river. Partners: Cascabel Conservation Association, Saguaro-Juniper Association, BLM, private landowners. **H & E Land & Cattle**: TNC is restoring natural washes and native grasses on this 570-acre property, improving the floodplain and returning water to the river. Partner: ADWR. **Muleshoe Ranch Cooperative Management Area**: TNC manages 57,500 acres in the Galiuro Mountains to restore native grasslands and streams, creating habitat for native loach minnow, desert pupfish and spikedace. Partners: BLM, USFS, AzGFD. **Three Links Farm**: TNC purchased and placed conservation easements on 2,209 acres, restoring water to, and permanently conserving, 836.9 acres along a six-mile stretch of the river where beavers have returned. Partners: BOR, SRP, private landowners. **BLM** manages the SPRNCA, the first ever of only two NRCAs, which is part of the **National Landscape Conservation System**, whose mission is "to conserve, protect, and restore these nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations."

In Santa Cruz County, still within the watershed, Audubon Arizona oversees the 8,000-acre grassland/encinal oak savannah **Appleton–Whittell Research Ranch**. The adjacent **Babocomari Ranch** has a considerable land area in conservation easements as well.

Additional Conservation Opportunities

Many of the future opportunities for the watershed will stem from government and foundation funding to pursue specific conservation objectives. The current Regional Conservation Partnership Program is one such program, which has a primary focus on grassland restoration. The combined NRCS/USFWS Working Lands for Wildlife program for recovery of the southwest willow flycatcher is another collaborative agency initiative. Purchase of critical parcels for conservation with the use of Land and Water Conservation Fund moneys may again be important in the valley. The BLM has an interest in filling out its Cascabel Conservation Area, which it began acquisition of in the mid-1990s. Additional funding in the Fort Huachuca area is provided by the Sentinel Land Partnership, which is an ongoing program. The Walton Family Foundation's Freshwater Conservation Initiative has provided important funding in the watershed in the past and may be an important future player. In 2012 the USFWS unveiled its Collaborative Conservation Initiative for the Lower San Pedro Valley, which included a possible wildlife refuge. That initiative was halted until a Landscape Conservation Design (LCD) could be completed for the valley. With its resources and mandate that are inextricably tied to ecosystem protection, the USFWS may again be able to offer national recognition and conservation opportunities on a voluntary basis, once an LCD is completed.

http://www.fws.gov/southwest/refuges/Plan/PDFs/LSPRCI%20Planning%20Update%201.pdf

A developing concept that may provide future conservation benefits is an "ecosystem services market," which describes a system in which private landowners that provide ecosystem services can access financing to protect, restore and maintain ecological functions and values while diversifying their incomes and passing along their lands, with the associated benefits, to future generations.

http://onlinelibrary.wiley.com/doi/10.1111/j.1936-704X.2010.00075.x/full
http://www.fs.fed.us/rm/pubs_other/rmrs_2008_jones_g003.pdf
http://www.ariesonline.org/case_studies/sanpedro.html
http://conference.ifas.ufl.edu/aces10/Presentations/Wednesday/Coyote-B-E/PM/Yes/0135%20P%20Booth.pdf

14. Discuss any additional benefits, concerns, or key points of which reviewers should be aware.

This San Pedro nomination area is nested in the larger Transboundary Madrean Watersheds nomination, but because of the area's binational hydrological and ecological relevance, regional partners chose to submit a separate nomination for the San Pedro watershed while still endorsing the larger area nominated by Wildlands Network. Groups collaborating in these two areas are already coordinated in their nominations. As the process becomes clearer through the DLCC's workshops, we will explore either merging them, or further segmenting the larger Madrean watersheds region, if a smaller conservation planning and design scope is more appropriate as a pilot landscape.

The rapid assembly of partners for this nomination process requires either board approvals for NGOs or departmental review for agencies that are actually being listed as nominating partners. We anticipate many other partners will participate in the data collation, planning, and design phases after a pilot area is actually established.

15. Provide links to any additional documents or resources that you feel are important for considering this nomination. *(Including established goals and objectives associated with springs, streams, grasslands.)*

San Pedro Watershed Pilot Area Nomination Links/Resources, arranged by questions in this nomination form:

Question 1: Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area. *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)*

http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/madrean.html
http://www.epa.gov/nerlesd1/land-sci/san-pedro.htm and http://www.epa.gov/esd/land-sci/pdf/database.pdf
http://fws-case-12.nmsu.edu/case/Case(07-2004).pdf
http://www.doi.gov/news/pressreleases/upload/Arizona-San-Pedro-River-Final.pdf
http://www.tucsonaudubon.org/~tucsonau/images/stories/conservation/Final%20Report%20for%20AGFD%20Heritage%20Fund%20(I07009).pdf and

http://cals.arizona.edu/climate/ws/arc2007/Kirkpatrick.pdf and
http://www.researchgate.net/publication/238095060_EFFECTS_OF_WILDLAND_FIRES_ON_BUFF-BREASTED_FLYCATCHERS_AND_OTHER_FOREST_BIRDS_IN_SOUTHEASTERN_ARIZONA and
http://www.coopunits.org/Arizona/People/Christopher_Kirkpatrick/Tech_Publications/
http://tucsonaudubon.org/cuckoo
http://aaronflesch.com/Presentations/Flesch.%20%202007.%20%20Identification%20and%20habitat%20of%20birds%20in%20the%20San%20Pedro%20River%20Valley%20in%20Sonora%20Mexico.pdf
http://aaronflesch.com/Publications/Reports/Grassland%20Birds%20of%20Rancho%20Los%20Fresnos_Final%20Report_ADFlesch.pdf
http://www.academia.edu/6225289/AN_INTRODUCTION_TO_THE_HERPETOFAUNA_OF_MAINLAND_SONORA_M%C3%89XICO_WITH_COMMENTS_ON_CONSERVATION_AND_MANAGEMENT
http://eebweb.arizona.edu/SIAC/General%20Insects%20of%20Los%20Fresnos.html and
http://eeb19.biosci.arizona.edu/siac/los%20fresnos.html
http://www.fs.fed.us/rm/pubs/rmrs_p067/rmrs_p067_103_109.pdf
http://ag.arizona.edu/research/azfwru/cjc/conwaylab/Dominic%20LaRoche/Presentations/RIN%20Drought%20Poster%20V3.pdf
http://www.researchgate.net/publication/229682895_Avian_Density_and_Nest_Survival_on_the_San_Pedro_River_Importance_of_Vegetation_Type_and_Hydrologic_Regime
http://www.mirror-pole.com/apif_web/bib.html and http://www.partnersinflight.org/bcps/plan/pl_az_10.pdf and
http://mirror-pole.com/apif_web/
http://aziba.org/News/BHP_AvianStudies2011FinalReport_lr.pdf and http://aziba.org/?page_id=461 and
http://aziba.org/?page_id=539a and http://az.audubon.org/sites/default/files/documents/sanpedro_spring2015.pdf
http://www.willcoxrangenews.com/news/article_fa9b7a7a-d5e8-11e1-854e-0019bb2963f4.html
http://www.blm.gov/style/medialib/blm/az/pdfs/nepa/library/resource_management/safford.Par.44115.File.dat/NRST-SPRNCA_PFC.pdf and
http://www.blm.gov/style/medialib/blm/az/images/san_pedro.Par.85171.File.dat/legislation_USC.pdf
http://wgbis.ces.iisc.ernet.in/envis/doc98html/enriver616.html
http://nmconservation.org/dl/TNCAZ_Grasslands_Assessment_Report.pdf
http://www.abcbirds.org/newsandreports/special_reports/habitatreport.pdf

Arizona Game and Fish Department (AZGFD), 2012. Arizona's State Wildlife Action Plan: 2012-2022. Arizona Game and Fish Department, Phoenix, Arizona. 233 p.

Avila-Villegas, S. and J. Lamberton-Moreno, 2013. Wildlife survey and monitoring in the Sky Island Region with an emphasis on Neotropical Felids. Pp. 441-447, In Merging Science and Management in a Rapidly Changing World: Biodiversity and Management of the Madrean Archipelago III, USDA Forest Service Proceedings RMRS-P-67. 2013. 593 p.

Marshall, R., Turner, D., Majka, D., 2012. Cumulative effects analysis for proposed SunZia transmission line. Arizona Chapter of The Nature Conservancy, Center for Science and Public Policy. 3 p.

Question 2: Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision. *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)*

http://pubs.usgs.gov/sir/2010/5126/ and http://pubs.usgs.gov/sir/2013/5040/
http://arizona.openrepository.com/arizona/handle/10150/186513
http://azconservation.org/projects/grasslands

Question 3: Describe the primary management questions or concerns in this pilot area. *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)*

Wilbor, S.L., 2014. An ecosystem conservation assessment of the lower San Pedro watershed in Arizona. Masters of Science thesis, School of Natural Resources and the Environment, University of Arizona. 131 p.

http://www.fs.fed.us/rm/pubs_rm/rm_gtr272/rm_gtr272_281_301.pdf and
http://www.fs.fed.us/rm/pubs/rmrs_p016/rmrs_p016_088_090.pdf and
http://www.rangenet.org/trader/Kreuper_etal_2003.pdf and
http://www.fs.fed.us/rm/pubs_rm/rm_gtr229/rm_gtr229_321_330.pdf and http://globalrangelands.org/dlio/10893
http://www.fws.gov/southwest/es/Documents/R2ES/Southwestern_Willow_Flycatcher_FINAL_Recovery_Plan_Appendix_G-H.pdf
https://sustainability.asu.edu/docs/gios/apra_conference/WildlifeLinkages.pdf
http://azdot.gov/business/environmental-planning/programs/wildlife-linkageshttp://azdot.gov/docs/default-source/planning/wildlife_connectivity_guidance_overview.pdf?sfvrsn=2
http://www.azgfd.gov/w_c/documents/PimaCountyWildlifeConnectivityAssessment.pdf and
http://www.azgfd.gov/w_c/documents/FinalPinalReport20130416.pdf
http://corridordesign.org/linkages/arizona
http://azconservation.org/projects/natural_infrastructure/data_sources/
http://www.edf.org/sites/default/files/San_Pedro-FINAL.pdf

Question 4: Describe the major partners or partnerships working in the pilot area. *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)*

LSPWA - https://sites.google.com/site/lowersanpedro/home; CCA - http://cascabelconservation.org/; AA - http://az.audubon.org/; HAS - http://huachuca-audubon.org/wordpress/; TAS - http://www.tucsonaudubon.org/; FSPR - http://sanpedroriver.org/wpfspr/about-the-friends/; Naturalia - http://www.naturalia.org.mx/; ALWT - http://alwt.org/; WN - http://www.twp.org/; SIA - http://www.skyislandalliance.org/map.htm; http://www.skyislandalliance.org/wildlife.htm; http://www.skyislandalliance.org/jaguars.htm; http://www.skyislandalliance.org/landscape.htm; Northern Jaguar Preserve - http://www.northernjaguarproject.org/who-we-are/our-mission/; USPP - http://usppartnership.com/
http://www.fws.gov/endangered/news/bulletin-spring2009/conservation-in-sonora-and-arizona.html

Question 5: Briefly describe the types of conservation or management activities currently occurring in the pilot area.

See Question 13.

Saguaro-Juniper Corporation – http://saguaro-juniper.com/

Question 6: At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.

http://nemo.srnr.arizona.edu/nemo/characterizations/sanpedro/SP_Sec8Plan030907final.pdf

Question 7: Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.

http://udallcenter.arizona.edu/publications/sites/default/files/58_en.pdf

Kunkel, K.E, L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, K.T. Redmond, and J.G. Dobson, 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 5. Climate of the Southwest U.S., NOAA Technical Report NESDIS 142-5, 79 pp.

Question 8: Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.

http://webcms.pima.gov/UserFiles/Servers/server_6/File/Government/Flood%20Control/Reports/wqpriority-streams.pdf
http://www.azwater.gov/azdwr/StatewidePlanning/WaterAtlas/SEArizona/PlanningAreaOverview/EnvironmentalConditions_ProtectedAreas.htm
http://lawschool.unm.edu/nrj/volumes/45/1/03_colby_economic.pdf
http://cwatershedalliance.com/

http://ag.arizona.edu/azaqua/watershed/San%20Pedro%20River%20Basin.htm
http://water.usgs.gov/lookup/getwatershed?15050202 and http://water.usgs.gov/lookup/getwatershed?15050203
http://waterdata.usgs.gov/usa/nwis/uv?site_no=09470500 and http://pubs.usgs.gov/sir/2013/5040/
http://repository.azgs.az.gov/category/place-keywords/san-pedro-watershed
http://cfpub.epa.gov/surf/huc.cfm?huc_code=15050202 and http://cfpub.epa.gov/surf/huc.cfm?huc_code=15050203
http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/SEArizona/Hydrology/UpperSanPedro.htm
http://www.tucson.ars.ag.gov/unit/Publications/PDFfiles/1863.pdf
http://www.waterinfo.org/san-pedro-river
http://azconservation.org/projects/water/wet_dry_mapping

Question 9: Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.

http://www.nature.org/ourinitiatives/regions/northamerica/mexico/explore/restoring-grasslands-through-prescribed-burns.xml
http://www.blm.gov/style/medialib/blm/az/pdfs/nepa/library/fire_plans/san_pedro_fire_plan.Par.59342.File.dat/StDavidCommunity2.pdf
http://www.blm.gov/style/medialib/blm/az/pdfs/nepa/library/fire_plans/san_pedro_fire_plan.Par.32181.File.dat/HerefordCommunity.pdf
http://azmemory.azlibrary.gov/cdm/ref/collection/feddocs/id/631
http://www.sciencedirect.com/science/article/pii/S0022169411004549
http://azconservation.org/downloads/category/san_pedro_river/
http://www.utsa.edu/LRSG/MOREScience/2007fall/UTSA-Sem-DG.pdf
http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.324.4117
http://earthjustice.org/news/press/2014/court-upholds-the-san-pedro-river-s-right-to-water

Question 10: Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.

The process of identifying focal areas that would be most beneficial to promote the conservation of biodiversity has already been initiated in the lower San Pedro watershed by S.L. Wilbor in his recent Master of Science thesis.

http://www.azgs.az.gov/sanpedroriver2009.shtml
http://www.researchgate.net/publication/267099001_San_Pedro_River_Basin_Data_Browser

Question 11: Describe resources available for implementing conservation planning and design activities in the future. *(Include information about partner's willingness or ability to implement conservation activities on the ground.)*

http://nemo.srnr.arizona.edu/nemo/index_old.php?page=characterization#sp
http://www.pima.gov/cmo/sdcp/habitat.html and http://www.pima.gov/cmo/sdcp/maps.html
http://pinalcountyaz.gov/Departments/ParksTrails/Documents/FINAL%20Open%20Space%20and%20Trails%20Master%20Plan.pdf and
http://pinalcountyaz.gov/Departments/PlanningDevelopment/ComprehensivePlanUpdate/Documents/Complete%20CompPlan.pdf
http://americasgreatoutdoors.gov/
http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/whip/?&cid=stelprdb1047041,
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/whip/?&cid=stelprdb1046975 and
http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/SWWF/SWWFC.pdf

Buehman Canyon –http://www.pima.gov/cmo/sdcp/Parks.html,
http://gis.pima.gov/data/contents/metadet.cfm?name=uniq_wat

Bingham Cienega – http://www.saguaro-juniper.com/i_and_i/san_pedro/bingham_cienega.html

http://rfcd.pima.gov/reports/pdfs/bingham_cienega_source_water.pdf

http://www.worldcat.org/title/fire-management-plan-for-bingham-cienega-preserve-pima-county-arizona/oclc/57378734, and http://www.jstor.org/stable/40021832?seq=1#page_scan_tab_contents

A7 Ranch – http://www.pima.gov/cmo/admin/Reports/ConservationReport/PDF/Chapters/Reserves/A7%20Ranch.pdf

Hot Springs Canyon – http://saguaro-juniper.com/i_and_i/photostations/hsc_usgs/hsc_usgs.html

Six Bar Ranch – http://www.pima.gov/cmo/admin/Reports/ConservationReport/PDF/Chapters/Reserves/Six%20Bar%20Ranch.pdf

ALWT – http://alwt.org/. Sentinel Landscapes Partnership – supports efforts to promote working lands, protect wildlife habitat, and ensure military readiness at military bases; major funding for this project is provided by the Departments of Agriculture, Interior and Defense's Readiness and Environmental Protection Integration program, and other funding sources. http://sentinellandscapes.org/ and http://www.usda.gov/wps/portal/usda/usdahome?contentid=2015/04/0090.xml. Desert Rivers Initiative – http://alwt.org/misc/desertRiversInitiativeNew.shtml funded by the Walton Family Foundation

16. Provide photos or other visual materials that will help to give reviewers a sense of place. *(Include photo credits and captions).*

http://www.blm.gov/az/st/en/prog/blm_special_areas/ncarea/sprnca/photos.html
http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/arizona/howwework/san-pedro-slideshow.xml

Photographs and supporting figures are included on the following pages.

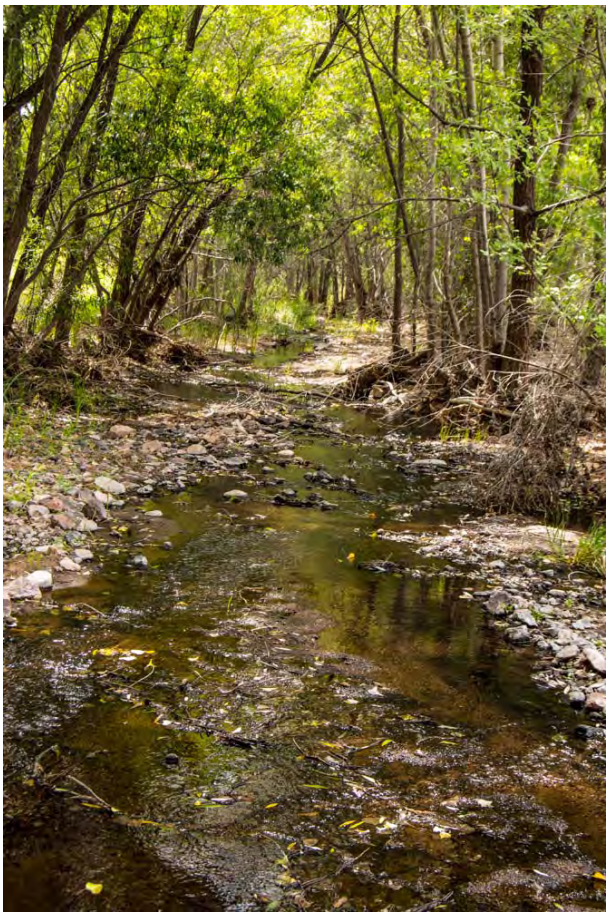
Arroyo Los Fresnos, Headwaters of the San Pedro River, Photo by Juan Carlos Bravo

Grasslands, Coronado National Memorial, Photo by Matt Clark

Native Grass Pasture, Lower San Pedro Watershed, Photo by Scott Wilbor

Grasslands of the Upper San Pedro, Photo by Juan Carlos Bravo

Aravaipa Creek, Photo by Mick Meader



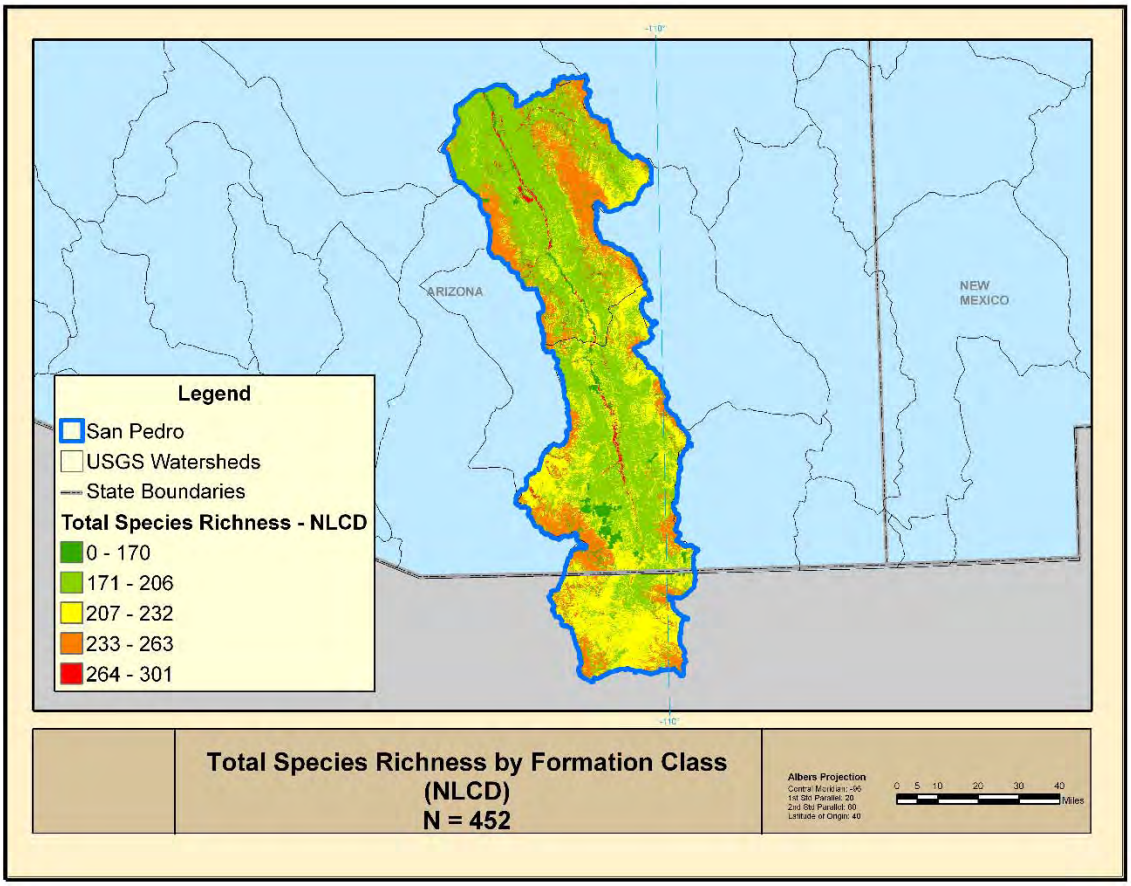
Hot Springs Canyon, Photos by Mick Meader

Clay Deposition at the Zapata Wash/San Pedro River Confluence, Photo by Sue Kelly

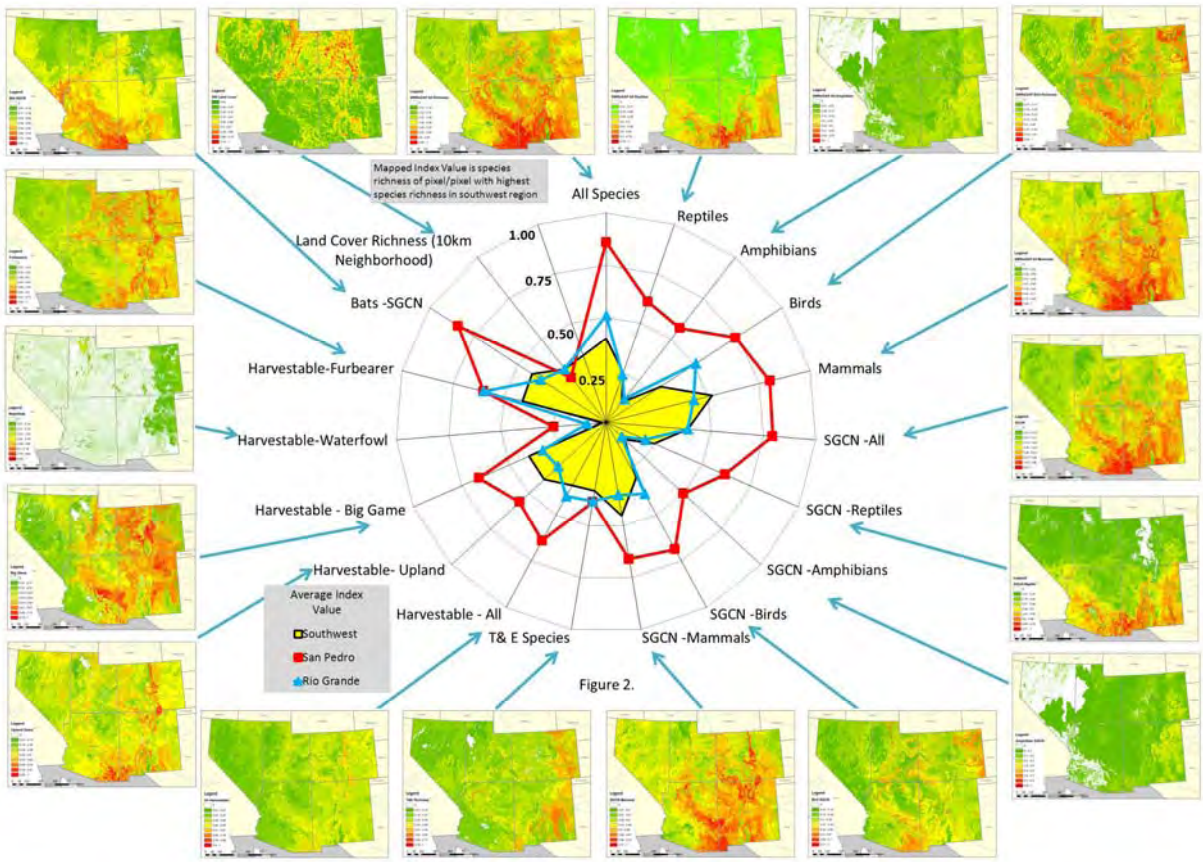
Mesquite Bosque, Resolution's 7B Ranch, Photo by Scott Wilbor

Beaver Dam, Lower San Pedro River, Photo by Gilbert Urias

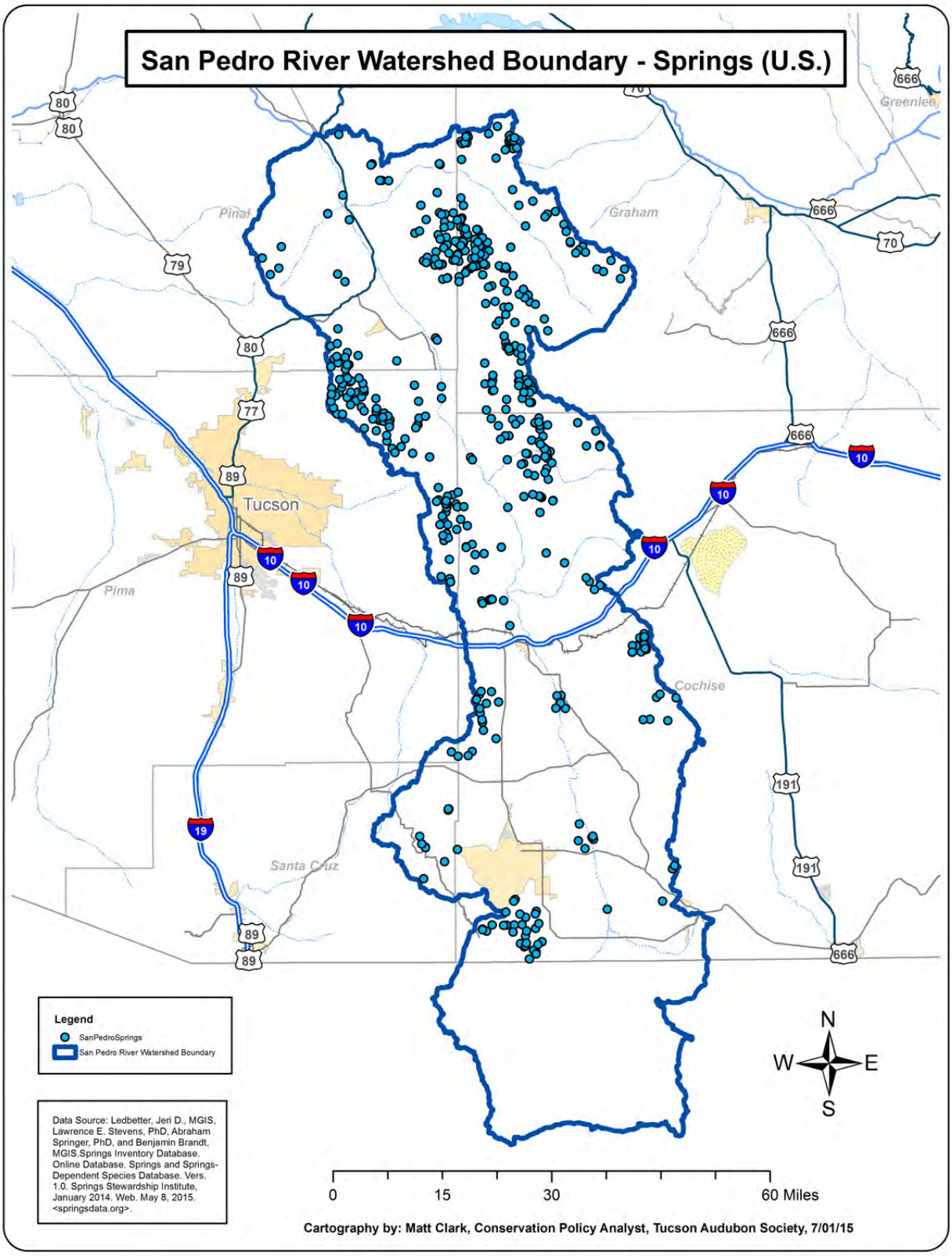
Border Fence Crossing the San Pedro Valley, Photo by Matt Clark



Total species richness by formation class for the San Pedro watershed. Courtesy of William Kepner, EPA.



Biodiversity metrics for Southwest region portrayed as a radar graph. This shows that the species richness for the San Pedro Valley (red line) is richer than that of both the Rio Grande Valley (blue line) and the Desert Southwest as a whole (yellow area). May 2011, courtesy of Dr. William Kepner, EPA.



Springs within the U.S. portion of the San Pedro watershed.

(Cover Page)

DLCC Pilot area nomination

Transboundary Madrean Watersheds

Primary contact nominator:
Juan Carlos Bravo
Director of Operations in Mexico
Wildlands Network

Endorsing nominators:
Organizations: Arizona-Sonora Desert Museum, Buenos Aires National Wildlife Refuge, Cascabel Conservation Association, Cuenca Los Ojos, Defensa Ambiental del Noroeste A.C., IMC Vida Silvestre, Leslie Canyon National Wildlife Refuge, Lower San Pedro Watershed Alliance, Naturalia A.C., Northern Jaguar Project, Patagonia Alliance, Pima County Office of Sustainability and Conservation, Pronatura Noroeste, Reserva de la Biosfera Janos, Río Grande Joint Venture, Reserva Nacional Forestal y Refugio de Fauna Silvestre Ajos-Bavispe, Rocky Mountain Bird Observatory, San Bernardino National Wildlife Refuge, Sky Island Alliance, Sky Island Restoration Cooperative (see participating stakeholders below), Sonoran Joint Venture, The Nature Conservancy- Mexico and Northern Central America, Tucson Audubon Society, Western Geographic Science Center (USGS), Western Wildway Network.

Individuals: Citlali Cortés/Instituto Politécnico Nacional, Rodrigo Sierra/UNAM, Sandra L. Haire, Ph.D., Ivonne Cassaigne/Alianza Nacional para la Conservación del Jaguar.

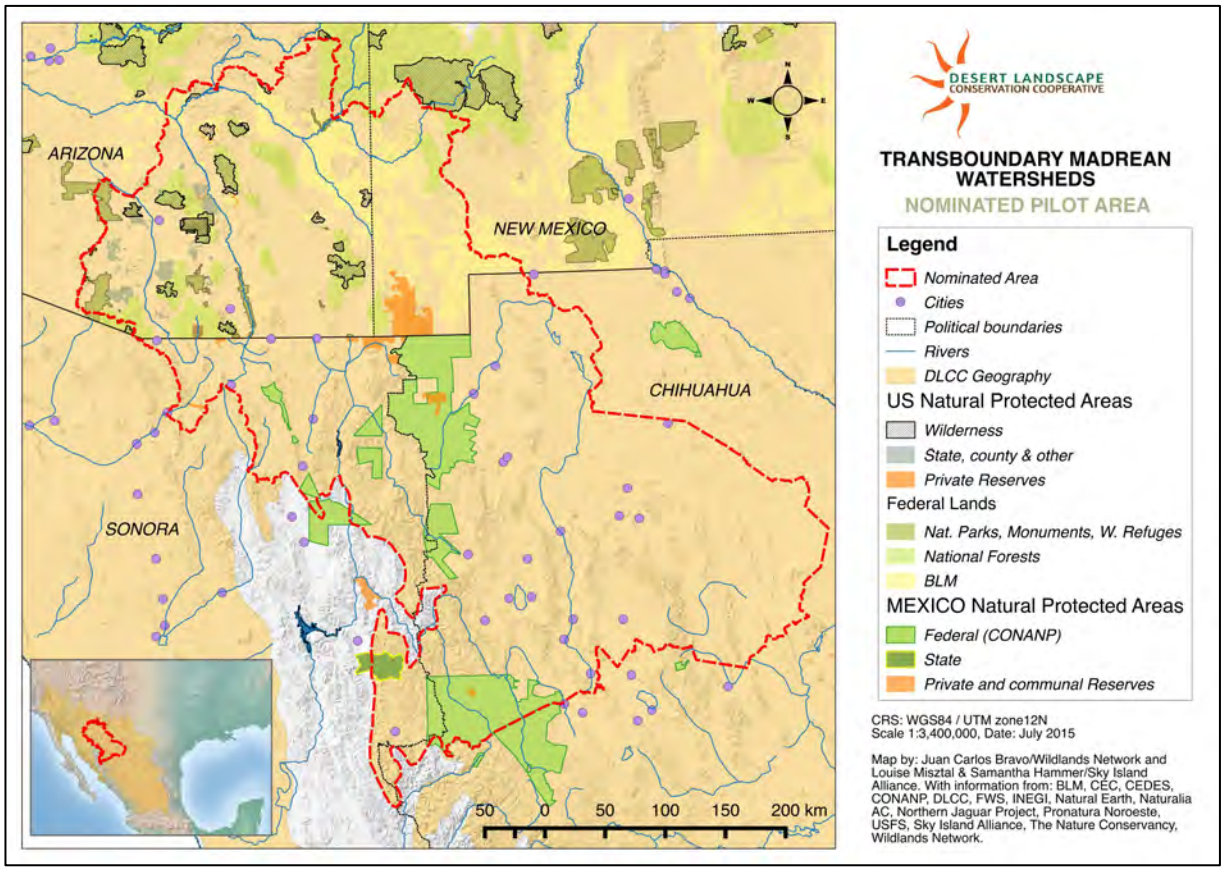


Figure 1. Limits of the nominated *Transboundary Madrean Watersheds* Area

1. Pilot area description:

The Transboundary Madrean Watersheds proposed pilot area covers approximately 18 million hectares of four states in two countries: Arizona and New Mexico in the U.S., and Sonora and Chihuahua in Mexico. Boundaries were determined by hydrographic basins to ensure continuity among freshwater and terrestrial communities and are as follows: to the north the Gila River watershed; to the west the Santa Cruz River watershed into Mexico, the arroyo Cocóspera watershed, the Upper Río Sonora and the limits of the DLCC Geography; to the south: the Tutuaca Natural Protected Area, and the CEC's priority grasslands area of Valles Centrales; and to the northeast the closed basins of Casas Grandes. The Area, includes the Madrean Archipelago (MA), characterized by isolated forested mountain ranges surrounded by a "sea" of intervening flatlands, and expands east to include adjacent grasslands. The MA is a unique mid-latitude sky island complex where temperate and subtropical climatic regions interrelate with tropical climates, it forms a corridor between two important mountain ranges in North America: the Rocky Mountains and the Sierra Madre Occidental. Notable resources of management concern within the Area include water and riparian ecosystems, as it encompasses the headwaters of two major economically significant basins: the Colorado and the Yaqui. It also includes the largest grasslands in the DLCC geography as well as significant portions of thornscrub ecosystems, some of the most endangered and unknown in the Sierra Madre Occidental, and forests under varying management regimes, all of them important as carbon sinks and erosion buffers, as well as relevant for their complex hydrology.

Ecological integrity in the Area is as diverse as its other features. While the Area encompasses urban, mining and agricultural areas that are heavily degraded, it also holds some of Mexico's last standing remnants of temperate old growth forests, the best-preserved cienegas in any North American grassland, one of the largest black tail prairie dog colony complexes anywhere, the few remaining herds of Mexican pronghorn, and reintroduced Mexican wolves on both sides of the border, all in need of increased protection. It also encompasses ecosystems needing or undergoing active restoration and rehabilitation through better water, soil, ecosystem, and fire management.

2. Importance and connection to the larger Desert LCC

Centrally located in the DLCC, the Area's significance cannot be overstated as it serves the role of crucible for the cooperative's defining geographic and biological features, at a scale large enough to involve a wide range of stakeholders in the LCPD process. As a testament to its rich diversity of species and habitats, the area has been recognized by Conservation International as one of only 35 Global Biodiversity Hotspots and lies at the junction of four Global 200 WWF-Ecoregions. With more than 4,000 vascular plant species, this Area serves as the last stronghold in the U.S. for magnificent predators such as the Mexican wolf and the jaguar and harbors the highest diversity of mammals, birds, bees, and ants anywhere in the conterminous U.S.

The Area nominated encompasses Grassland Priority Conservation Areas identified by the CEC, including the Janos Biosphere Reserve and the Valles Centrales, a trilateral priority. It includes 17 Important Bird Areas in the U.S., Sentinel Landscapes identified by the Western Regional Partnership, extensive lands targeted for conservation action identified in the Sonoran Desert Conservation Plan by Pima County, the BLM's southeast Arizona focal Areas and the USFWS's Mogollon Rim Emphasis Area. In Mexico it incorporates eight Priority Land Conservation Areas, and eight Hydrological Conservation Areas identified by CONABIO, nine Areas of Importance for Bird Conservation and a Ramsar site, the San Pedro River, the last major undammed river in the southwestern U.S.

Its more than 2,000 springs are keystone ecosystems, that often are the only source of water for miles around, and these are currently becoming better mapped and documented with DLCC-supported science. The Area includes the greatest extent of protected desert grasslands in the U.S. and Mexico, some of them under the stewardship of endorsers in this proposal, all under heavy pressure from inappropriate grazing and agricultural expansion. It also holds the bi-national watersheds of the San Pedro, Cocóspera, Sonora, San Bernardino, Bavispe, and Santa Cruz rivers as well as a myriad of smaller drainages. It provides altitudinal and latitudinal gradients for lower elevation species to migrate in response to climate change, and is home to potentially endangered natural communities and habitats at summits of sky islands that have nowhere to go and will require adaptation intervention if they are to survive. The area also presents a unique opportunity to compare the response of similar landscapes to the radically different fire management policies of Mexico and the U.S.

3. **Primary management questions or concerns.**

Water availability in a changing climate: Based on climate-change models, the Area will experience some of the greatest extremes in temperatures and aridity in North America. Warming is expected to be greatest in summer and annual mean precipitation is likely to decrease. Increased aridity in the Area is expected to have negative impacts on its flora and fauna, as many desert species are already at their physiological limits for temperature and water; thus adaptation planning will be crucial to ensure their continued survival. Reduced snowpack and streamflow are associated with increased heat, drought, insect outbreaks, increasing size and severity of wildfires, and with detrimental effects on wild and domesticated plant and animal species. Spring ecosystems, which may be climate refugia, are at risk of drying, demanding that we learn **how to adequately steward and restore them where possible.** Water harvesting and riparian restoration techniques have been implemented in some locations however **it is unclear what mixture of social, technical and financial capacities are needed to make them prevalent to the point of effectively addressing water issues on a regional scale.** Managers in the Area are also concerned about **how changes in water availability and in timing and intensity of precipitation will affect management of sensitive aquatic species** like the endangered Chiricahua leopard frog, Gila chub, Apache trout, and Huachuca water umbel.

Habitat conversion: The spreading of land use change for agriculture, increase in road density and ecosystem degradation are the most significant threats to the persistence of adequate habitats to sustain biodiversity and ecosystem processes, in light of climate change and ongoing invasive species expansion. Reserve designations, private lands conservation, and the fostering of sustainable land use practices have all been implemented in the Area with varying degrees of success. **A critical question that remains to be answered is how can these and other mechanisms protect and enhance habitat in perpetuity for as many species as possible,** as currently many depend on short-term funding and on organizations still in the process of becoming resilient land-stewards.

Connectivity: The Area presents specific connectivity challenges in the form of the border infrastructure and enforcement activities on the U.S. side, including Border Patrol construction of roads, installation of flood lights, and more than 50 miles of border fence, which inhibit water and wildlife movement, alter landscapes, ecosystems, communities and populations. The effects of these impacts are compounded by the widening of Highway 2 in Mexico, a road running parallel to the border. Addressing the issue of proportionate and adequate border infrastructure that remains permeable to wildlife will require an unprecedented level of collaboration of government and non-government partners, while building appropriate wildlife crossings throughout Highway 2 could set a precedent for connectivity planning and infrastructure in northern Mexico. **Many tactical questions for each of these issues need to be addressed on all the political, administrative, technical and biological levels.** Critical questions that the DLCC Landscape Conservation Design will help answer are **where on the landscape are the most important corridors to protect given the expected effects of climate change**, and **how and where management jurisdictions can work together to protect and restore corridors** beyond their boundaries.

Wildlife recovery: The Area is already the stage of multiple keystone and indicator species recovery projects, including Chiricahua leopard frogs, black-footed ferrets, jaguar, pronghorn antelope, prairie dogs, American bison, beavers and Mexican wolves. The question this poses is **how to effectively manage species recovery actions in a mosaic of jurisdictions, land uses and land tenures,** keeping in mind that as far as nature is concerned it is all one single ecoregion as well as the best choice to harbor recovering populations of species of concern to one or both countries.

Incompatibility of cross-jurisdictional and cross-border data and cartography: Methods for selecting, collecting, systemizing and distributing data differ significantly between land management agencies, between practitioners and between countries, posing limits to the level of effective and consistent planning and management. Nowhere is this more evident than here, where land management has increasingly become a binational and multi-stakeholder endeavor. If selected as a pilot area we believe partners could help answer the following questions: **What are the minimum necessary data conventions to effect consistent, international conservation plans and actions? How can an LCC help agencies on both countries generate compatible data?**

Erosion/riparian habitat degradation. Negative effects of accelerated erosion and sedimentation on water quality have been well documented in the Area. However, rates of sediment delivery in aridlands are poorly known due to the ephemeral nature of local streams, lack of monitoring, and large flood-recurrence intervals. **Understanding**

hydrological nuances is necessary for effective restoration, since natural hydrology is crucial to ecosystem function. For instance flood pulses allow riparian forests to regenerate and fend off invasives, maintain rich floodplain vegetation and nutrient cycling, and maintain the turbidity that native fish have evolved with.
Presence of small and disconnected sky islands. While the topographical collage of the MA is largely responsible for its intrinsic diversity, it also represents a formidable challenge for conservation, having no large and contiguous swaths of similar land that can be described, studied and managed by relatively simple, overarching, single-agency tactics. The question then becomes **how can topographically diverse regions be effectively conserved with limited resources?**

4. **Major partners or partnerships**

Conservation stakeholders in the Area have long known that international partnerships are the only way to achieve success. Over several decades, we have been strengthening ties and sowing common ground for long-lasting collaborations. **Many agencies and stakeholders collaborating on the ground had to be left out of this answer for the sake of brevity.**

Wildlands Network (WN) advances the vision of a continental corridor expanding from Alaska to the Sierra Madre Occidental. It has supported Pronatura's thick-billed parrot sanctuary for 15 years and contributed in 2007 to the expansion of the Northern Jaguar Reserve, which is co-managed by the Northern Jaguar Project and Naturalia, A.C. Its new program in Mexico seeks to establish a network of practitioners for this area and beyond. **Sky Island Alliance (SIA)** is a binational conservation organization that works with volunteers, scientists, land owners, public officials, and government agencies to establish protected areas, restore healthy landscapes, and promote public appreciation of the area's unique biological diversity. **Rocky Mountain Bird Observatory (RMBO)** has worked with partners in the area since 1996, building capacity for integrating grassland birds into broader conservation programs and prioritizing efforts based on risk assessment. RMBO, IMC-Vida Silvestre, and Pronatura Noreste, with support from WWF, ABC, CEC, and USFWS-NMBCA, have developed an extensive network for restoration of private rangelands. TNC managing Rancho El Uno explores best practices for rancher outreach, and supports research such as monitoring programs and bird survival studies. **Sky Island Restoration Cooperative (SIRC)** is a binational community-based collaborative working to improve and coordinate restoration across the Madrean Archipelago and nurture an understanding of the importance of biodiversity for human well-being. SIRC includes the following: *Arizona Department of Environmental Quality (ADEQ), Arizona Game and Fish Department (AZGFD), Arizona Geological Survey (AZGS), Bat Conservation International (BCI), Borderlands Restoration, L3C (BR), Cuenca Los Ojos (CLO), Hummingbird Monitoring Network (HMN), Natural Resources Conservation Service (NRCS), Sky Island Alliance (SIA), U.S. Bureau of Land Management (BLM), U.S. Bureau of Reclamation (BOR), U.S. Fish and Wildlife Service (FWS), U.S. Forest Service (USFS), Coronado National Forest (CNF), U.S. Geological Survey (USGS), U.S. National Park Service (NPS).* **U.S. Geological Survey (USGS)** is a federal agency that conducts research as part of the Climate and Land Use Change Mission Area, it uses monitoring and remote sensing to understand and address the effects of climate and land use change. The Land Change Science Program seeks to understand the patterns, processes, and consequences of changes, using models to predict scenarios of future conditions. Partners of the USGS include all agencies described in the SIRC (above). **Sonoran Joint Venture (SJV)** is a public/private partnership whose mission is "…to protect, conserve, restore and enhance bird populations and their habitats." The SJV region includes the southwestern U.S. and northwestern Mexico, and overlaps with much of the proposed Area. Several endorsing Partners have collaborated on writing the SJV Bird Conservation Plan. **Cuenca Los Ojos (CLO)** is a binational group that has protected 100,000 hectares in both countries, leading regional efforts for water harvesting and riparian restoration. CLO has collaborated extensively with SIA, Naturalia, Ajos-Bavispe Reserve and TNC. The **Ajos-Bavispe** Federal Protected Area is a collaboration hub with a history of joint projects with CLO, SIA, Naturalia, numerous private ranchers, Arizona parks, FWS and the NPS. The reserve provides leadership and expertise in fire-management in northeastern Sonora. **Arizona-Sonora Desert Museum (ASDM):** The Arizona-Sonora Desert Museum is widely recognized throughout the world as a model institution for innovative presentation and interpretation of native plants and animals of the Sonoran desert region. The mission of the Arizona-Sonora Desert Museum is to inspire people to live in harmony with the natural world by fostering love, appreciation, and understanding of the Sonoran Desert. **Naturalia** is a Mexican conservation non-profit group, founded in 1990, that co-manages Los Fresnos with TNC – a private reserve serving as project site and training ground for partnerships with the Ajos-Bavispe reserve, SIA, FWS, Universidad de Sonora, University of Arizona and Instituto Tecnológico de Cananea. It

has also collaborated regionally on wolf reintroduction and is preparing a beaver translocation to Cuenca Los Ojos' properties. **The Nature Conservancy (TNC)** in the region has been a main partner of Naturalia and SIA for over 10 years and is assisting CLO in obtaining a Native Fish Refuge designation for the arroyo Cajón Bonito. TNC also joined forces with CONANP, UNAM, and Tutuaca Mountain School to reintroduce bison to Janos and assists numerous academic institutions engaging in research in the biosphere reserve. **Individual researchers** from universities in both the U.S. and Mexico have been working in the region for many decades. Those endorsing this nomination bring scientific expertise in the areas of animal ecology, mammalogy, avian ecology, socio-environmental interactions, and botany.

5. **Types of conservation or management currently occurring.**

Governments of both countries have established and manage the parks and protected areas listed below. In addition, several private and communal lands in the area are managed for conservation while multiple partnerships are working on several of the management questions described above.

In México: Reserva Nacional Forestal y Refugio de Fauna Silvestre Ajos-Bavispe, Área Sujeta a Conservación Ecológica Arivechi-Cerro Las Conchas, Reserva de la Biosfera Janos, Área de Protección de Flora y Fauna Campo Verde, Área de Protección de Flora y Fauna Tutuaca. Reserves in Mexico have designated areas of influence where landowners may apply for funding to support restoration and conservation activities and where park managers can coordinate efforts with other conservation stakeholders outside park limits.

In the U.S.: BLM National Conservation Areas (San Pedro Riparian NCA, Las Cienegas NCA) and Areas of Critical Environmental Concern; USFWS national wildlife refuges (San Bernardino NWR, Leslie Canyon NWR, and Buenos Aires NWR); national parks and monuments (Chiricahua NM, Coronado NM, Saguaro National Park); national forests (Coronado NF and Gila NF); and Wilderness Areas. These various jurisdictions perform a variety of management actions for conservation.

6. **Goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to partners.**

Agencies and partners in the region have done extensive site and region plans for more than two decades. All of them have included goals/objectives that are related to the conservation of some or all the priority resources identified by the DLCC. Notable among these plans are the following:

- *Sky Islands Wildlands Network, Conservation Plan, An Extraordinary Plan for a Place Beyond Compare*. 2000. Wildlands Network and Partners.
- Conservation Action Plan for the Upper San Pedro River Basin in Mexico. 2007 by TNC and partners. Which identifies measurable objectives for riparian areas, grasslands and associated wildlife.
- The Janos Biosphere Reserve's Management Plan specifically identifies goals concurrent with the DLCC's, stating as the main objective of the Reserve "*To preserve the grasslands, shrubs, temperate forests and riparian vegetation...*"
- The Tutuaca Reserve's Management Plan includes the goals of identifying large-scale threats and the species affected by them to then engage in increased coordination with agencies outside the reserve as a means to foster the conservation of said species.
- Ajos-Bavispe Reserve's Integral Fire Management Plan highlights the need for fire in forest and grasslands ecosystems.
- SIA is working to inventory and assess springs in different sky island groundwater basins, and conduct restoration actions to ensure these water resources remain available to enhance wildlife resiliency to climate change.
- SIRC goals include: increasing involvement with partners in Mexico and private and tribal lands in the U.S.; increasing the scale of restoration and embracing the watershed/landscape approach.
- The Chihuahuan Desert Grassland Bird Conservation Plan includes bird population targets for the region.
- The Sonoran Joint Venture Bird Conservation Plan summarizes the status of avian species, prioritizes these species, provides habitat discussions and conservation recommendations, and lists Focus Areas for conservation action for a significant portion of the pilot area.

7. **Vulnerabilities of the human communities within the pilot area.**

Human population in the largest cities located in the Area has swelled to more than one million people. The large and mid-sized urban areas here are characterized by fast demographic growth, associated with the *maquiladora* industry, and the economic exchange across the border. Mining presence is also notable as the Area is adjacent to one of the top five copper producers in the world, in addition to encompassing hundreds of extractive operations of diverse sizes and scopes. Besides the urban and industrial centers, multiple rural communities and Mexican *ejidos* are highly dependent on the natural base of the area for small to large-scale ranching, farming, and logging. Native American presence (Apache, Ak-Chin, Hohokam, Pascua Yaqui, and Tohono O'odham) is also significant, particularly in the area between Arizona and New Mexico. The main vulnerabilities of the human communities are related to the exposure to climate change impacts on the natural base they are dependent on and to the capacities and resources they possess to cope with or adapt to these impacts.

The primary driver of human vulnerability in the area is water availability. Climate change together with demographic pressures will impact agricultural and ranching productivity through drought and further land use changes, affecting rural livelihoods directly, and the urban availability of food and raw materials indirectly. The high complexity of water uses by the industrial, urban, rural and, the recently recognized, environmental sectors could promote more competition and emergence of socio-economic conflicts in the coming years. In cities and towns, the aging or lack of adequate infrastructure and resources to deal with increasing temperatures, wastewater treatment, and water supply will impact differentially the poorest social groups, and expand the gap of inequality. This also could translate to more ecological pressure for the watersheds providing freshwater and receiving wastewater. Finally, cultural practices, associated with land and water, are at risk of disappearing due to decreased availability of clean water and adequate land. Rural communities also face economic expropriation by other socio-economic groups, as in the case of tribes giving up water rights, or communal owners selling their land to more competitive agro-businesses because of climate-change related struggles.

8. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

Urban development, background contamination from mineral ore deposits, irrigation, sewage effluent, and processes linked to global climate change all have the potential to alter the stability of the fragile and unique systems in the Area. Despite the critical role natural resources play in maintaining human and environmental health, current understanding of the manner in which natural and human-caused forces interact to limit these resources—including their quality and quantity (such as through spatiotemporal changes in precipitation, evapotranspiration, pumping of groundwater, and release of contaminants)—is inadequate.

Ranching in grasslands and shrub ecosystems is key to the area's economy, cultural identity, and social structure but most of the time it is marginal economically, driving many ranchers to (a) a vicious cycle of unsustainable grazing intensity and reduced forage quality, (b) conversion to agriculture –including, central pivot row cropping– and unsustainable groundwater extraction, or (c) sale of ranches to developers, of which the last option is the most socially (and ecologically) disruptive. The projected hotter, drier, and less predictable climate will likely result in shifts to less productive ecosystems and vegetation, which will exacerbate the tough economic situation that ranchers find themselves in and increase the rate of grassland and riparian degradation and the decline of ranching culture. The grasslands that area ranchers depend upon for livestock forage have been declining in quality and extent over the past 50 years. In the Valles Centrales GPCA, the rate of conversion to cropland has reached 6% annually in recent years. Conversion to cropland and development has led to over-pumping of groundwater and drying of the seeps, springs, and streams that provide water for livestock. Ranching decline, economic and social shifts could lead to increased migration of people from the area with the associated social risks for rural migrants and the influx of new landowners, many of them with no attachment to the land. Arizona and New Mexico are important bird watching destinations where the industry's seasonal revenues contribute millions of dollars to the local economies; Sonora and Chihuahua are gradually growing their eco-tourism industries.

9. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

The isolated nature of MA in the area and the patchwork of land ownership in the U.S. and Mexico presents unique challenges to large-scale landscape conservation and restoration. Landscape Conservation Planning and Design can help the network of partners already pooling resources in the region to strategically target them to grasslands, streams, and springs most likely to benefit from management action, particularly actions that can help ecosystems resist, re-align, or more easily transition as the climate changes.

A commonly cited challenge for managing resources in this region is a lack of data sets that seamlessly cross the border. This hinders managers' ability to understand the full regional context in which they are working, and therefore to prioritize actions. A single, multinational, multi-jurisdictional Smart Plan and Design, challenging as it may be, could become the bedrock for conservation initiatives in decades to come. It would also test the limits of effective large-scale planning methods to be implemented elsewhere.

10. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

Human communities in the region rely on ecosystem services and many people live off the land via traditional uses such as livestock grazing. Ecotourism is a huge economic driver and is dependent on the conservation of biological diversity and the water and ecosystems that support it. The well-being of human communities in the Area is directly linked to the health of the ecosystems surrounding them.

As the Area becomes more arid there will be increasing demand for water from human communities and the environment. We believe Landscape Conservation Design will help partners identify collaborative management strategies and target protection and restoration efforts to benefit both natural and human communities. Agencies organizations and others in the region recognize the importance of working across management jurisdictions and other boundaries, if conservation of populations and ecosystems is to be achieved in the region given the nature of sky islands.

The majority of the focal resources in Mexico are on private lands, so the LCPD process will provide the information and adaptive management tools needed to increase the resiliency of landowners and the resources they manage in the face of increased temperature, decreased precipitation, extreme weather events, and shifting natural communities. Spatially explicit targeting of adaptation strategies will provide a framework for adjusting current landowner programs as well as identify the scope and scale of needed programs so that the partnerships can begin to effectively identify and coordinate the necessary resources to proactively implement on the ground actions.

11. **Describe resources available for implementing conservation planning and design activities in the future.**

SIA and WN are both committed to facilitating the collaborative efforts necessary for trans-boundary planning. SJV offers avian expertise; birds are good surrogates and easy to monitor gauges of the effectiveness of conservation actions. Other partners have graciously offered resources, including venues and logistical support to assist such exercises. It goes without saying that all endorsing organizations and individuals have on-the-ground capacity, willingness to design and implement specific conservation actions in key sites within the proposed region, and decades of experience carrying out conservation work in the area that all of them plan to continue. They have also established positive working relationships with many private and communal landowners on both sides of the border, and can tap into their networks to monitor indicators and effect needed changes in the landscape. This network of supporters expands, through some of the groups in the region, to thematic experts and policy influencers outside the boundaries of the region but who've been instrumental in designing and implementing long-term conservation and management solutions. Potential funders include RGJV, SJV, WWF, FWS, NFWF, NMBCA, USFS International Programs, BLM, NPS, TNC, CONANP, and variety of private foundations many of which are already supporting the work of the nominators.

12. **Shapefiles attached**

13. **(Optional) Additional conservation opportunities in this pilot area.**

- Many stakeholder organizations cover large geographies and have sufficient resources to replicate the LCPD process in other areas if this is selected as a pilot area.
- Partners in the Sierra San Luis are working on two separate designations for the Upper Bavispe watershed, a fish sanctuary at Cajón Bonito, and a Wildlife Critical Habitat designation for the Sierra San Luis and adjacent areas.
- CONANP has proposed a new protected area, Sierra del Nido-Valles Centrales, in the proposed pilot area. The LCPD process could inform preserve design to maximize its ecological value while addressing any community concerns. The LCPD process will also be available to CONANP staff as they articulate the need and footprint of the proposed protected area.
- Springs and streams are an important part of the corridor picture for wide-ranging mammals of management interest, which presents the opportunity to bring together the interests of different agencies and parties to increase their effect on such a large-scale.

14. **(Optional) Additional benefits, concerns, or key points of which reviewers should be aware.**

- The region includes the whole San Pedro River watershed, a binational basin of such hydrological and ecological relevance, that a separate pilot area nomination is being presented by partner groups and endorsed by Wildlands Network. Groups collaborating in these two areas are already coordinated in their nomination and as the process becomes clearer through the DLCC's workshops, we will explore either merging them, or further segmenting the Transboundary Madrean Watersheds – if a smaller conservation planning and design scope is more appropriate as a pilot landscape.
- Historically, fire in landscapes of the proposed area supported healthy ecosystems and human communities by contributing to summer stream flow and water quality, and by creating habitats for fish and other aquatic organisms. Today, fire as a pivotal process is increasingly disrupted by a host of stressors, including changing climate, and dispersal of invasive species (e.g., *Pennisetum ciliare, Bromus rubens*), that alter fire frequency and change plant species composition. In addition, the dominant management practice of fire suppression in the US side of this landscape has resulted in conversion of valuable grasslands to woody vegetation. However, one of the great strengths of the Area for understanding these pressing and complex drivers of change is the maintenance of less altered fire regimes and ecologies in some locations in México.
- Apart from these habitat conservation mechanisms, the region also includes significant portions of the Mexican gray wolf recovery areas of both countries.

15. **(Optional) Links to additional resources important for considering this nomination.**

http://springstewardshipinstitute.org/
http://www.cec.org/atlas/map/?lang=es
http://www.skyislandalliance.org/misc/SIRC2014/SIRC%202014%20Annual%20Report.pdf
http://rmbo.org/v3/Portals/0/Documents/International/ChihuahuanDesertGrasslandBirdPlan2012v1.0.pdf
http://sonoranjv.org/plans/conservation-plan/
Estrategia para la Conservacion de los Pastizales del Desierto Chihuahense (ECOPAD):
http://www.biodiversidad.gob.mx/ecosistemas/pdf/2007%20Ecopad%20Final.pdf
Plan de Acción para la Conservación y Uso Sustentable de los Pastizales del Estado de Chihuahua 2011-2016:
http://www.rmbo.org/v3/Portals/0/Documents/International/Grasslands%20Chihuahua%202011-FINAL%28web%292may.pdf
Ecoregional Conservation Assessment of the Chihuahuan Desert:
http://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/Chihuahuan%20Desert%20Report.pdf
An Ecological Analysis of Conservation Priorities in the Apache Highlands Ecoregion:
http://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/Apache_Highlands_Report.pdf
Assessment and Revision of North American Grassland Priority Conservation Areas:
http://www3.cec.org/islandora/en/item/4200-assessment-and-revisions-north-american-grassland-priority-conservation-areas-en.pdf

16. **(Optional) Photos**

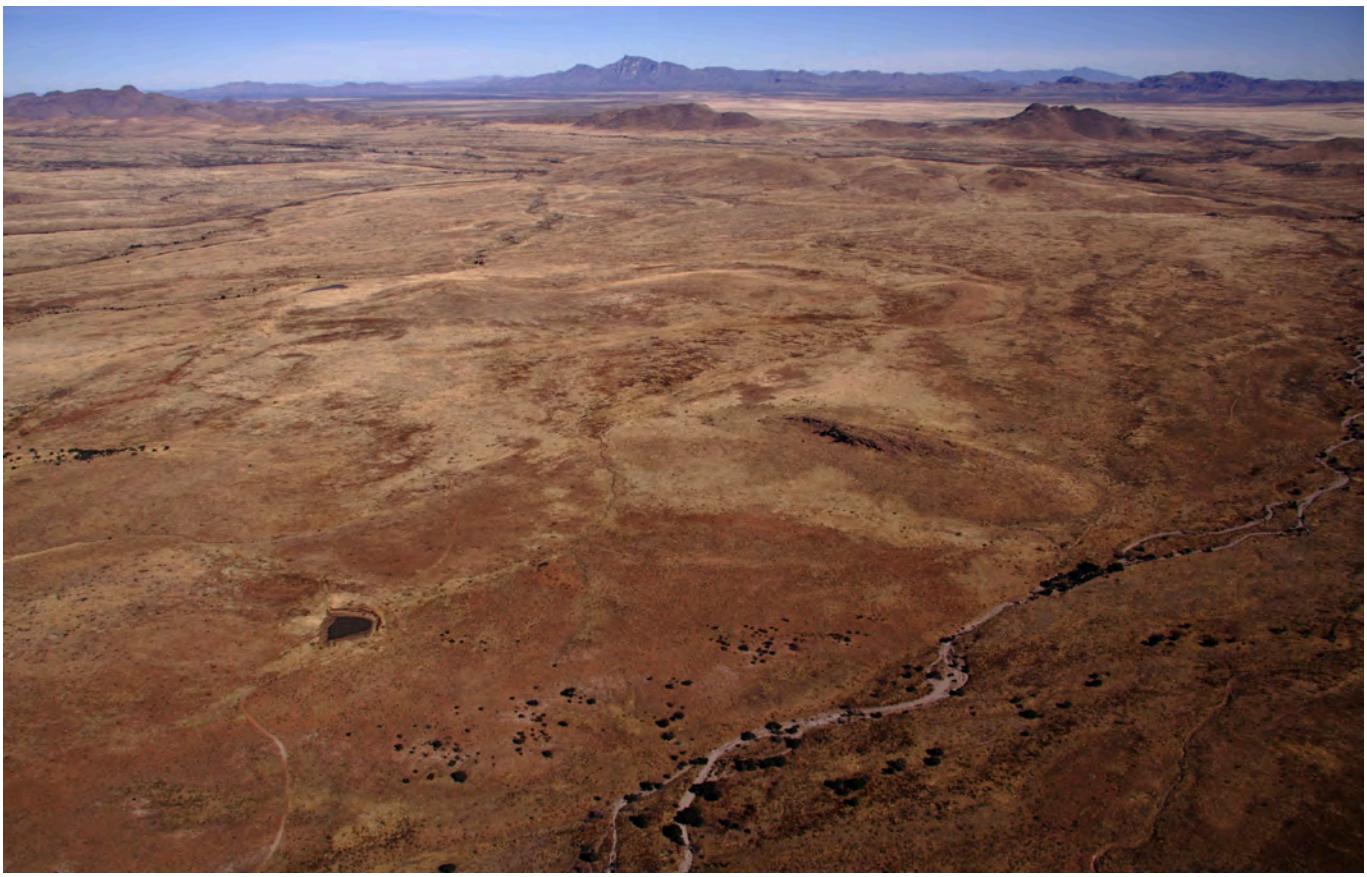
Moonrise over the Huachuca mountains as seen from Los Fresnos, Naturalia's private reserve in Mexico.
Juan Carlos Bravo

Grasslands at Janos Biosphere reserve. Rodrigo Sierra Corona

Endangered Mexican Pronghorn in the Valles Centrales grasslands. Pedro Calderón

Aravaipa canyon. Carianne Campbell

Buenos Aires National Wildlife Refuge. Sally Flatland

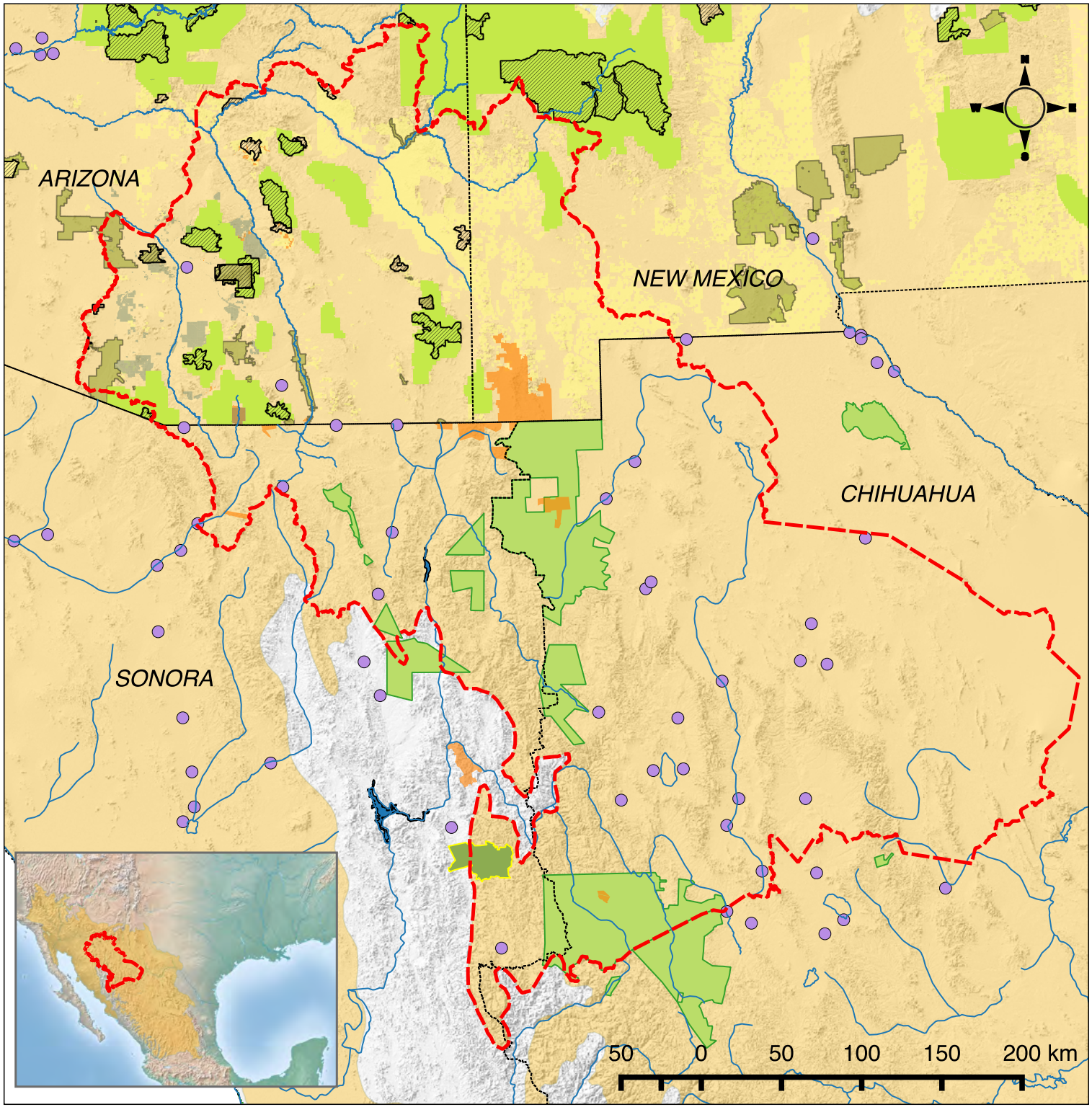

Arizona-Sonora border as seen form the air. Rodrigo Sierra Corona

Sky Islands of Sonora and Arizona. Carianne Campbell

Black-tailed prairie dog, in Janos, and beaver in a tributary of the San Pedro. Grasslands and riparian areas are shaped by the complex structures these species build on them. They present a management challenge as they are "Threatened" and "Endangered" respectively in Mexico, yet can be legally treated as pests in parts of the U.S. Juan Carlos Bravo

Bison from the translocated herd established in El Uno, Janos. Juan Carlos Bravo

Springs in thornscrub ecosystems establish fragile refugia for species particularly sensitive to climate change. Juan Carlos Bravo.



DESERT LANDSCAPE CONSERVATION COOPERATIVE

TRANSBOUNDARY MADREAN WATERSHEDS

NOMINATED PILOT AREA

Legend

- *Nominated Area*
- *Cities*
- *Political boundaries*
- *Rivers*
- *DLCC Geography*

US Natural Protected Areas

- *Wilderness*
- *State, county & other*
- *Private Reserves*

Federal Lands

- *Nat. Parks, Monuments, W. Refuges*
- *National Forests*
- *BLM*

MEXICO Natural Protected Areas

- *Federal (CONANP)*
- *State*
- *Private and communal Reserves*

CRS: WGS84 / UTM zone12N
Scale 1:3,400,000, Date: July 2015

Map by: Juan Carlos Bravo/Wildlands Network and Louise Misztal & Samantha Hammer/Sky Island Alliance. With information from: BLM, CEC, CEDES, CONANP, DLCC, FWS, INEGI, Natural Earth, Naturalia AC, Northern Jaguar Project, Pronatura Noroeste, USFS, Sky Island Alliance, The Nature Conservancy, Wildlands Network.

United States Bureau of Reclamation – Pilot Area Nomination **July 10, 2015**

Pilot area name: Upper Verde River Watershed, Yavapai County, Arizona

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

John Munderloh, Town of Prescott Valley, Water Resources Manager; and Chair Upper Verde River Watershed Protection Coalition (UVRWPC) Technical Advisory Committee - 928-759-3105, jmunderloh@pvaz.net

Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area. *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)* The Upper Verde River Watershed pilot area includes the Prescott Active Management Area (PrAMA) Groundwater Basin and the Big Chino Sub-basin that together form the headwaters of the Upper Verde River. The PrAMA is the population center for the area with approximately 120,000 people, and the Big Chino Sub-basin is the prospective future water supply for that population center.

The proposed pilot area is the area of concern for the UVRWPC. Applied science research projects were developed as part of the watershed planning to better understand stressors, such as drought and climate change, on ecosystems and hydrologic processes. The UVRWPC also received a grant from Western Lands and Communities in 2014 to conduct a scenario planning exercise addressing the impacts of climate change. More information on the watershed planning process is included at question #4. A link to the plan with the Scenario Planning Report is included at question #14.

Priority issues are protecting the dry season flow of the Upper Verde River, and reaching safe-yield in the PrAMA by managing the groundwater resources that support the river, its dependent ecosystems and people. The priority management issue of concern is groundwater supply is not sufficient to meet demand. In order to reach safe-yield in the PrAMA, communities plan to export groundwater from the Big Chino sub-basin. Many concerns have been raised about the impacts of increased groundwater pumping on the springs that provide most of the dry season flow in the Upper Verde River. Of ecologic importance is the riparian forest and rare flowing stream supported by perennial flow in the Verde River. Integrity of the riparian forest and flowing stream in the Upper Verde River depend on groundwater outflow from the PrAMA and Big Chino Sub-basin aquifers.

Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision. *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)* The pilot area was identified in the US Bureau of Reclamation's Water 2025 as one of the areas in the country most likely to have water conflicts by 2025. The PrAMA is one of five actively managed groundwater basins in Arizona and has a legislative goal

of reaching Safe-Yield by 2025 (Arizona Revised Statutes §45-562). PrAMA communities have been granted legislative authority to develop groundwater from the neighboring Big Chino sub-basin (ARS §45-555) to support this goal. The Upper Verde River depends on groundwater outflow from the PrAMA groundwater basin and Big Chino Sub-basin for its dry season flow. The Verde River Watershed is located within the Desert LCC planning area and provides significant cultural and ecological value to the Desert LCC region. The Verde River flows for approximately 200 miles through the Desert LCC in central Arizona and provides one of the largest and best supported riparian habitats in the Desert Southwest. It also accounts for approximately 40% of the surface water supply to the Salt River Project, a USBR reclamation project and major water supplier for the Phoenix metro area.

Implementation of the UVRWPC Watershed Restoration and Management Project plan will provide valuable answers to uncertainties, as well as data to refine and inform models, such as the USGS Northern Arizona Groundwater Flow Model. Results of this effort and the associated scenario planning process can be incorporated into the larger Desert LCC planning area. The Desert LCC three focal ecosystem types; arid grasslands and shrublands, streams, and springs exist in the proposed pilot area. Another conservation of critical concern is change in the wildfire regime creating greater risk for catastrophic events. The vegetation management project designed as part of the UVRWPC watershed planning effort addresses issues surrounding forest thinning, groundwater recharge, as well as the health of riparian areas and associated ecosystems.

Describe the primary management questions or concerns in this pilot area. *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)* The primary management concern is maintaining groundwater levels to support spring flow in the face of climate change and population growth. Within the project area, only around 2% of the total precipitation is recharged to the aquifer on a long-term basis. Most of the precipitation is evaporated from the land surface or transpired by plants. One of the system stressors is the change in wildfire regimes and the associated invasion of woody species onto grasslands and overly-dense woody vegetation in forested areas. This woody vegetation is primarily composed of evergreen Pinyon/Juniper that consumes water year-round, reduces soil moisture, increases erosion and runoff velocities, and increases the danger of catastrophic wildfire. Restoring grasslands is expected to increase the length of time that precipitation remains in the watershed and increase the opportunity for groundwater recharge to occur.

Ongoing drought has negative impacts on communities, and, according to anecdotal reports from economic development managers, adversely affects the ability to attract businesses to the area. It is a major societal stressor, creating animosity and conflict within and between communities.

Describe the major partners or partnerships working in the pilot area. *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)* The UVRWPC, established in 2006, is a formal partnership of local governments including Yavapai County, the Yavapai-Prescott Indian Tribe, the City of Prescott and the Towns of Prescott Valley

and Chino Valley. It is a science-based workgroup charged with protecting the base flow of the Upper Verde River while balancing the reasonable water needs of residents who live and businesses that operate within watershed boundaries.

A Watershed Planning Taskforce, formed in 2012, is a UVRWPC interdisciplinary subcommittee comprised of stakeholders in the area's water future. Membership includes UVRWPC partners, Arizona State Land Department, Arizona Game & Fish Department, Prescott National Forest, USDA Natural Resources Conservation Service, The Nature Conservancy, City of Cottonwood, retired scientists, US Bureau of Reclamation (PAXO), local ranchers and landowners, business owners, economic development professionals, and private citizens. Taskforce members finalized the Upper Verde River Watershed Restoration and Management Project Plan in December 2014 with funding from Reclamation. They continue to meet every six weeks to assist with and monitor plan implementation.

In 2004, the City of Prescott and Town of Prescott Valley signed an Intergovernmental Agreement to purchase a water ranch property in the Big Chino Sub-basin and share the water and associated costs. In 2010, the City of Prescott, Town of Prescott Valley and Salt River Project reached an agreement related to management of the water resources in the Big Chino Sub-basin. In 2012, these three parties reached a subsequent detailed agreement ("Comprehensive Agreement #1) to jointly monitor and model hydrologic conditions in the Big Chino Sub-basin with the goal of using this information to develop a mitigation plan for groundwater pumping. This agreement has resulted in $5.5 million committed to hydrologic monitoring and mitigation. Progress toward installing equipment and conduct various hydrologic and geophysical surveys is on track to be completed by 2017.

The pilot area dovetails with the recently approved resource conservation partnership grant from the USDA Natural Resources Conservation Service awarded to the Arizona Game & Fish Department (AZFD) with the UVRWPC as a major implementation and funding partner. Other Partners in that effort include Prescott National Forest and Salt River Project.

Briefly describe the types of conservation or management activities currently occurring in the pilot area. Water conservation and management activities are prescribed by the 1980 Groundwater Management Act (Act) for water users within the Prescott AMA. This Act prohibits new irrigated agriculture and new subdivisions from accessing groundwater within the PrAMA, requires that subdivision prove availability to a 100-year Assured Water Supply, requires mandatory conservation requirements, water use reporting, hydrologic monitoring and modeling and water management plans under the guidance of the Arizona Department of Water Resources (ADWR). The Big Chino Sub-basin has no water management structure, however, the Coalition is actively working to manage invasive woody species and City of Prescott, Town of Prescott Valley and Salt River Project are jointly investing around $5.5 million into a hydrologic monitoring and modeling project, with the ultimate goal of designing a mitigation plan and groundwater management plan for the sub-basin.

At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your

partners. The health of the Upper Verde River Spring and its riparian resources are closely linked to the health of grasslands in the Big Chino Sub-basin through the aquifer that underlies the grasslands and supports the springs. Grassland restoration in the basin floor and forest thinning in the higher elevations are a primary focus of the Coalition's Watershed Restoration Plan. Restoring proper watershed functions will improve groundwater recharge rates and increase the drought resiliency of the springs.

Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios. Communities within the pilot area are largely dependent on groundwater. The social and economic wellbeing of these communities depend on sustainable groundwater supplies. Reaching Safe Yield in the PrAMA is necessary to attract jobs and retain intellectual resources from the area's schools and colleges. The ability to reach Safe Yield in the PrAMA depends on groundwater imported from the Big Chino Sub-basin, and both groundwater basins contribute dry season flow to the Upper Verde River, an important cultural resource for the communities in the pilot area. Climate change is projected to reduce recharge to these groundwater systems.

Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources. Historically, grasslands have provided income to the area through grazing and hay cutting activities. People in the area also understand the importance of grasslands to antelope, a species of concern for AGFD, and the link between healthy grasslands and the Upper Verde River. Grasslands have been negatively impacted by encroaching woody plants, reducing groundwater recharge to the Upper Verde Springs, reducing antelope range, and grazing land. The encroaching woody vegetation also increases the risk of catastrophic wildfire, which destroys soil profiles for plant re-growth and increases sediment loading to the Verde River and downstream storage reservoirs (Bartlett and Horseshoe).

Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area. Documenting effects to groundwater recharge from grassland restoration is unknown. Increasing groundwater recharge by restoring grasslands is one of the primary objectives of the UVRWPC. The change to surface runoff due to grassland restoration and woody vegetation removal have been widely studied and documented, but the change to groundwater recharge in areas with bimodal precipitation patterns and alluvial aquifers has been ignored in all but a limited number of studies. The Big Chino Sub-basin includes the unique spatial relationship of encroaching woody vegetation existing in close proximity to an underlying regional aquifer that is also being heavily instrumented for a hydrologic monitoring and modelling program.

Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes. The pilot area has notoriously variable groundwater recharge events that are dependent on specific climatic and watershed conditions. Managing watershed conditions to make the most of recharge events when they occur will help mitigate the increasing variability due to climate change. Maintaining

or improving groundwater recharge by improving watershed conditions in the face of climate change will provide water security to communities that are predominantly dependent on groundwater. It will also reduce ongoing animosity and distrust, by removing uncertainty over future water supply security resulting from climate change.

Describe resources available for implementing conservation planning and design activities in the future. *(Include information about partner's willingness or ability to implement conservation activities on the ground.)* Prescott owns a water ranch consisting of 4,500 acres. The City of Prescott, Town of Prescott Valley and Salt River Project have dedicated $5.5 million toward hydrologic monitoring and modeling in the pilot area. Annual dues from Coalition partners support its ongoing efforts. A $1 million grant recently received by UVRWPC, in collaboration with AGFD, supports brush clearing in the pilot area. Water providers in the pilot area and have authority to implement conservation activities in their service area. The UVRWPC is a science-based working group with the primary objective of collaboration among stakeholders to get projects in the ground.

Provide a shapefile (or similar file) of the pilot area boundaries. Shapefiles are attached with the nomination form e-mail.

(Optional) Describe any additional conservation opportunities in this pilot area. Other opportunities are included in the Coalition's Watershed Restoration and Management Project Plan. Specific conservation projects are detailed, and in general include installation of gabion structures in ephemeral washes to increase recharge, inducing recharge by managing well pumping locations and timing, harvesting and recharging rainwater, taking advantage of additional runoff from developed areas, groundwater management tools to protect the existing integrity of the groundwater basins, and low-impact development policies.

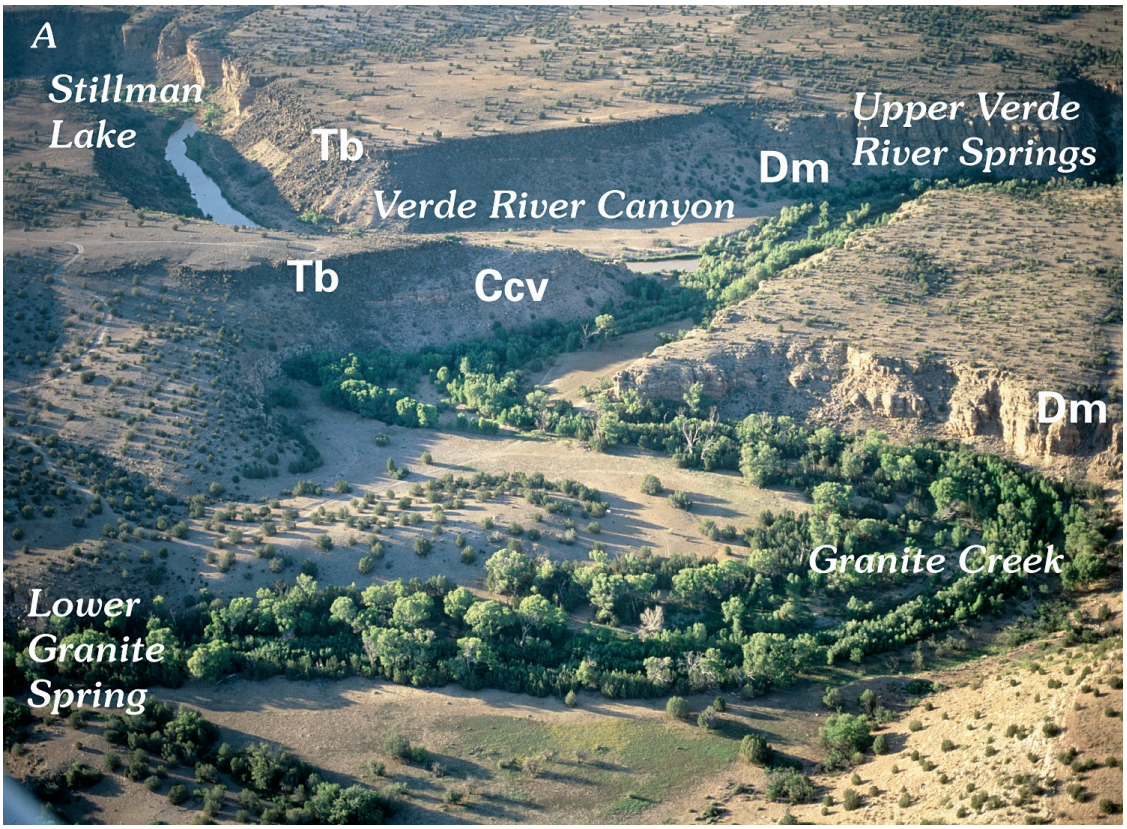
(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware. Applied research results are broadly transferable to other areas operating across similar landscapes. The UVRWPC over the last nine years and the watershed taskforce over the last three years have effectively partnered to address resource issues of concern in the Upper Verde River Watershed. These same issues are being faced by other communities within the Desert LLC.

(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination. *(Including established goals and objectives associated with springs, streams, grasslands.)* Watershed Restoration and Management Project Plan http://www.uvrwpc.org/Downloads/WatershedPlan.pdf Prescott AMA Fourth Management Plan http://www.azwater.gov/azdwr/WaterManagement/AMAs/PrescottAMAFourthManagementPlan.htm

Upper Verde River Watershed Protection Coalition –Pilot Area Photos

(**Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.** *(Include photo credits and captions).*

Dense Pinyon/Juniper encroachment, Big Chino Sub-Basin (John Rasmussen)



Upper Verde River Area showing riparian forest (Source: USGS, The Verde River Headwaters, Wirt et. al. 2005)

Landscape Conservation Planning & Design
Pilot Area Nomination Form

(Total pages should be 6 or less)

Background information:

The Desert Landscape Conservation Cooperative (LCC) is designing a process that will:

- produce spatially explicit data and information about focal resources chosen by the Desert LCC partners (grasslands/shrublands, streams, and springs, including riparian and aquatic resources);
- seek to understand the effects of climate change and other landscape stressors on natural resources;
- integrate social, cultural and economic information to understand what these resources might look like in the future; and
- look at specific focal areas to develop collaborative adaptation responses that are useful and implementable by our partners.

Landscape design is the integration of societal values with ecological goals, using science based in landscape ecology to provide a variety of scenario plans that describe where conservation can best be achieved and how it relates to measurable goals. In 2014-2016, the Desert LCC is engaging interested parties in determining design priorities, compiling and curating existing information and resources, determining what additional information, tools, or resources are needed, and developing plans for 2-3 pilot landscape conservation designs within the Desert LCC geographic area.

We are currently requesting nominations for pilot areas of interest to our partners.

Due Date: July 10, 2015

For questions and to submit nomination forms, please contact: Duane Pool at duane.pool@rmbo.org

Additional information:

Desert LCC Website: www.usbr.gov/dlcc

Desert LCC Conservation Planning Atlas: http://dlcc.databasin.org/

Desert LCC Critical Management Questions:

http://www.usbr.gov/dlcc/resources/docs/DLCCCMQs.pdf (English)

http://www.usbr.gov/dlcc/science/2013/docs/DLCCCMQs-handoutSPA.pdf (Spanish)

Pilot area name:

Point of contact (nominator) for pilot area: *(name, affiliation, title, phone number, email address)*

Erica Stewart, BLM, Wildlife Biologist, 928-317-3295, estewart@blm.gov

1. **Briefly describe the pilot area, including a description of why boundaries were chosen, primary resources of management concern, and ecological integrity of the area.** *(As appropriate, discuss resource based boundaries ecoregions/watersheds/species distribution maps, etc., existing strategies and partnerships, and boundaries related to existing Desert LCC Critical Management Questions.)*

The Western Arizona Riparian Pilot Study area spreads across multiple jurisdictions and land managers, and occurs within the Lower Colorado River Basin, which is further divided into smaller watersheds. Water management applies to these watersheds, as well as the floodplains and riparian areas of the Colorado and Gila Rivers.

This focal area includes projects that include 3 main working groups: The Mittry Lake Working Group and the Limitrophe Coordinated Restoration Partnership that include Federal, state, community, and private organizations operating under MOUs and Cooperative Management Agreements (CMA); and the NAU Research Group that operates under a CMA (in review status) with Northern Arizona University to conduct habitat restoration and research. Through these working groups, the ability to leverage and match funds from multiple sources, and have large scale "shovel ready" projects is what these partners have been working towards over the last 5 years.

The systems include some of the most valuable, diverse and potentially vulnerable natural resources in Southwest Arizona. These riparian areas, floodplains, and wetlands include recreation, water storage, groundwater recharge, water quality, soil conditioning, fish and wildlife values, and wildland urban interface (WUI) to name a few.

The Lower Colorado and Gila River Systems are a major component of the approved 2010 Yuma Field Office Resource Management Plan and the 2012 Lower Sonoran Resource Management Plan that respond to issues related to managing for healthy riparian vegetation while providing for multiple use and in accordance with the Clean Water Act (CWA), and internal Standards and Guidelines. Additional criteria are found in the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), priority wildlife habitat designations, existing activity plans, and the current Lower Colorado River Fire and Phoenix District Management Plans.

This area has a strong history of partnering. They all have a keen interest in participating due a variety of reasons such as mitigation offsets, border and national security, research and conservation and restoration of historical vegetation. **Explain why this area is important and how it connects to the larger Desert LCC geography, mission and vision.** *(Include information about Desert LCC priority resources and other conservation issues in the pilot geography.)*

This pilot area includes challenges about soils condition, water quality, threatened and endangered species and their habitats, invasive species, and wildland fire. In addition, this area includes many native riparian restoration areas including those that have minimal and great genetic diversity with their ongoing studies as it relates to climate change.

2. **Describe the primary management questions or concerns in this pilot area.** *(Include information about how stressors, identified by the Desert LCC, are affecting resources and human communities.)*

A primary concerns exists about the lack of quality geo-spatial data for this focal area. It is widely known that the lower Colorado and Gila Rivers are highly departed from their historic conditions. However, a data gap exists in the availability of a consistent geo-spatial layer that is able to depict the extent of the invasive issue. Vegetation data bases such as NISIMS, LANDFIRE, AZ Game and Fish and REA data all fail to provide spatial information at a landscape scale.

3. **Describe the major partners or partnerships working in the pilot area.** *(Include a brief history of partners working together and why, and what each partner contributes to the partnership.)*

Support and /Partnerships include USFWS, National Wildlife Refuges, US Bureau of Reclamation (BOR), USGS, US Customs and Border Protection (CBP), Natural Resource Conservation Service (NRCS), Natural Resource Conservation Districts (NRCDs), Arizona Association of Conservation Districts (AZACD), Gila Watershed Group, University of Arizona, Arizona State Land Department, AZ Game and Fish Department, Northern Arizona University (NAU), Lower Colorado River Multi-Species Conservation Program (LCR MSCP), Arizona Western College, Arizona State Forestry (ASF), International Boundary and Water Commission, Cocopah Indian Tribe, Yuma Proving Grounds, Marine Corp Air Station, Yuma County Sheriff, City of Yuma Police Department, Desert Botanical Gardens, Yuma Crossing National Heritage Area, local farmers and private land owners.

4. **Briefly describe the types of conservation or management activities currently occurring in the pilot area.**

The Mittry Lake Working Group and the Limitrophe Coordinated Restoration Partnership that include Federal, state, community, and private organizations operating under MOUs and Cooperative Management Agreements (CMA); and the NAU Research Group that operates under a CMA (in review status) with Northern Arizona University to conduct habitat restoration and research.

5. **At the scale of the pilot area, describe any goals and/or objectives related to conservation of grasslands, streams, springs/seeps, and riparian resources or species of interest to your partners.**

The goal of this focal area is to use the most integrated multiple-use management practices to enhance resource values that include borderland public safety, Federal, state, and community partnerships, recreation, water, and plant and wildlife ecological functions to achieve a working landscape. Through the AZ Strategies, Sustainability, Heritage, Community, and Operational Excellence set the workload priorities to sustain the health and productivity of public lands for the use and enjoyment of present and future generations. Early landscape level planning efforts allow for long term project implementation facets including manual, mechanical, chemical, and biological control.

6. **Describe the social, cultural, and economic vulnerabilities of the human communities within the pilot area, relative to projected climate change scenarios.**

The Lower Colorado and Gila River systems compose some of the most valuable, diverse and potentially vulnerable natural resources in Southwest Arizona. These riparian areas, floodplains, and wetlands include water storage, groundwater recharge, water quality, soil conditioning, fish and wildlife values, Nationally

Registered and culturally sensitive sites, and wildland urban interface (WUI) to name a few. In order to maintain, protect, improve and restore natural function in these systems and the inherent and extensive land ownership, stakeholders and complex issues, designation through the BLM Programs as a Focal and Pilot Area is warranted. As the healthy lands process evolves and as information becomes available information from efforts such as the Regional Ecosystem Assessments (REAs) and/or other regional level assessment tools and methodologies will be used in order to further refine both focal and project areas. Data gaps currently identified area built into project area activities.

7. **Describe why people in the pilot area value or are concerned about grasslands, streams, springs/seeps, and riparian resources.**

   There are numerous partners that have a history of work in the focal area due to wildlife loss of habitat, reduction in population numbers, water management, wildland fire management, and community recreation and outreach. They all have a keen interest in participating due a variety of reasons such as mitigation offsets, border and national security, research and conservation and restoration of historical vegetation.

8. **Describe how the Desert LCC Climate-Smart Landscape Conservation Planning and Design project would contribute to the achievement of objectives in this pilot area.**

   Through the collaboration of partnerships, many projects are shovel-ready allowing for easy implementation upon obtained funding. There are numerous partners that have a history of work in the focal area. They all have a keen interest in participating due a variety of reasons such as mitigation offsets, border and national security, research and conservation and restoration of historical vegetation.

9. **Describe how developing collaborative adaptive management actions for Desert LCC focal resources (grasslands, streams, springs/seeps, and riparian resources) help human communities in the pilot area adapt to projected climate changes.**

   This pilot area is primarily riparian or aquatic with much community involvement from concessions to weekend recreationist. Continued community involvement within the pilot area would help the transition to the required changes due to climate change.

10. **Describe resources available for implementing conservation planning and design activities in the future.** *(Include information about partner's willingness or ability to implement conservation activities on the ground.)*

    This area has a strong history of partnering. It is difficult to assess the exact match that may be received. However, over the last five years: BR has contributed over 11.5 million in Tamarisk treatments, infrastructure creation, and Environmental compliance assistance; ASF has contributed approximately 2 million in hazardous fuels reduction and wildfire suppression; CBP has contributed over 4 million in river clean-up, vegetation treatment, and mitigation planning; NAU has contributed over 3 million in restoration implementation and research; Cocopah Indian Tribe has contributed over 1 million in restoration work; LCR MSCP has contributed approximately 125

million in land conversion, restoration, and monitoring; and BLM has contributed approximately 10 million on planning and implementation of restoration projects. Many other partners have also contributed time and funds towards restoration, maintenance, monitoring, and protection of these lands.

11. **Provide a shapefile (or similar file) of the pilot area boundaries.**

Included is the overall Western AZ Riparian Focal area (Pilot Study Area) and it individual project areas. The project areas include Gila, Mittry, North, and Wetlands.

12. **(Optional) Describe any additional conservation opportunities in this pilot area.**

Within the Western Arizona Riparian pilot study area, there are numerous opportunities to enhance threatened and endangered species habitat. With continued management, and additional data needs filled, information about declining populations, including the Yuma Ridgeway Rail, can lead to better oval species management.

13. **(Optional) Discuss any additional benefits, concerns, or key points of which reviewers should be aware.**

14. **(Optional) Provide links to any additional documents or resources that you feel are important for considering this nomination.** *(Including established goals and objectives associated with springs, streams, grasslands.)*

15. **(Optional) Provide photos or other visual materials that will help to give reviewers a sense of place.** *(Include photo credits and captions).*