Central Colorado Plateau Conservation Analysis

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Introduction

This paper describes a conservation analysis of the Central Colorado Plateau. This area is defined by completed wildlands network designs[1] to the south, east and north-east (Map 1). This ecological analysis is simpler than the neighboring wildlands network designs, because it does not involve landscape scale data collection and modeling. We believe the simpler analysis is appropriate for the Central Colorado Plateau because this vast intact area provides an opportunity – not available in regions more dominated by human activities – to conserve a fully functioning landscape rather than a compromise.

This ecological analysis that was conducted stemmed from a workshop convened by Wildlands Network in October 2012. At this workshop there was agreement among the group that because threats exist on all sides of the Central Colorado Plateau (tar sands and oil shale development to the north, coal fired plants to the south, wind and solar development to the west, coal and gas development to the east), we should maintain the Central Colorado Plateau as a place that is a refuge from these activities and a place that allows permeability for wildlife movement away from or around these habitat fragmenting activities. At the October workshop there was also agreement among the group that what would be produced is a unique, new approach to fitting the Central Colorado Plateau into a missing gap in the Western Wildway without the need for a full Wildlands Network Design. Rather, this analysis would reverse the common thinking - showing the Central Colorado Plateau as a massive, roadless area refuge and landscape connection linking the surrounding Wildland Network Designs – and this is the reason it should be protected.

This Central Colorado Plateau Conservation Analysis focuses on defining core areas and riparian linkages in the Central Colorado Plateau. This mapping exercise is the result of a series of overlays of pre-existing GIS data of habitat connectivity in this important region of the U.S. southwest and intends to fill the gap between other wildlands networks along the Western Wildway.

Pre-existing studies and methods used in this conservation analysis were identified and developed during a mapping workshop organized by the Wildlands Network back in October of 2012. The workshop had the scientific expertise and participation of the following members of the conservation community: Jim Catlin, Kirk Robinson, Kim Crumbo, Kim Vacariu, Kurt Menke, Emanuel Vasquez, and Allison Jones. Corridor experts included: Paul Beier and Michael Soulé. Post-workshop reviewers were completed by David Theobald and Carlos Carroll. During the workshop we acknowledged the existence of previous studies and data that would be used to identify those protected or still natural areas throughout the Central Colorado Plateau. Also during the workshop, we recognized that this effort represents only the first step of a larger process in developing a wildlands network design. At the conclusion of the workshop, Wild Utah

[1] A Wildland Network Design is a term of art used by The Wildlands Network to indicate a planning tool for conservation actors – a blueprint for establishing core conservation habitats and achieving connectivity within a specific region.

Project was designated to take the lead and carry out the conservation analysis using our GIS capabilities. The overall goal of this conservation analysis was to produce a design of core areas and linkages that fills the gap between other wildland networks in the Western Wildway.

The data and pre-existing studies involved in this conservation analysis include: USFS inventoried roadless areas, USFS designated wilderness, BLM wilderness study areas, BLM designated wilderness, citizen's wilderness proposals for BLM and USFS lands, NPS roadless areas, National Hydrography Dataset, elk habitat, landownership data, and road data.

Final products of this analysis are: core areas definition, riparian linkages and restoration corridors definition, retrospective analysis, and major threats identification.

Description of the Analysis

The Central Colorado Plateau Conservation Analysis was developed using spatial overlays of different datasets in order to derive a seamless dataset of core areas and riparian linkages in the area of interest. The analysis and cartography was achieved using ArcGIS 10.1 and analysis tools available in this program. Methods used to carry out this analysis were developed during the mapping workshop of October 2012 and involved the following categories:

- Core Areas Definition
- Riparian Linkages Definition
- Retrospective Analysis
- Major Threats Identification

Core Areas Definition

Description: For the purposes of this conservation analysis core area are defined as: *"all agency roadless areas, BLM wilderness study areas, BLM areas with wilderness characteristics, Forest Service inventoried roadless areas, Forest Service and BLM designated wilderness, National Park Service roadless areas including National Monuments, National Recreation Areas, and National Parks, and Citizens' wilderness proposals".*

GIS data needed for this stage was acquired from federal agencies and conservation partners and analyzed in ArcGIS. By using advanced overlays and spatial analysis techniques it was assembled in a dataset that includes all roadless areas as required by the definition of "Core Areas". This assemblage involved tools such as: projection, buffer analysis, clipping, erasing, select by location, and feature editing. The

use of these tools and complementary GIS data (up-to-date landownership and roads data) was essential in fixing boundary issues identified in early steps of this analysis. The final result was a comprehensive and seamless dataset that included all roadless areas in the Central Colorado Plateau (Map 2).

Data Sources: Wilderness study areas, areas with wilderness characteristics, designated wilderness, US Forest Service inventoried roadless areas, National Parks, National Monuments, and National Recreation Areas roadless areas shapefiles were obtained from the following federal agencies: Bureau of Land Management, Forest Service, and National Park Service via web sites.

Citizen's wilderness proposals including the Utah Wilderness Coalition, Utah Forest Network, Citizen's Wilderness Proposal for BLM in Colorado, and the Southern Rockies Wilderness Alliance Proposal were acquired from Wild Utah Project and Rocky Mountain Wild.

Complementary data such as landownership and roads shapefiles were obtained from the Utah Automated Geographic Reference Center, Bureau of Land Management, and Colorado Department of Transportation.

Methods: First, we analyzed all roadless areas shapefiles for data integrity and boundary correspondence. We found that boundaries in National Park units did not match with the landownership layer. In most of the cases, the boundaries in National Park units were found an average of 600 feet behind the boundary line in the landownership layer. Fixing this problem required creating a buffer of 600 feet on the NPS layer and clipping the buffered layer with the landownership layer.

Second, all roadless area layers were combined in a single layer by using the Merge tool available in ArcMap. After this, we clipped this single layer using the Central Colorado Plateau boundary. The result of this was a seamless layer of Core Areas.

Lastly, for data quality purposes we proceeded to analyze the Core Areas Layer and we found some areas with boundary issues. There were few areas were boundaries did not match and it was creating some gaps in areas between USFS and BLM roadless areas. Since this problem was found only in few places, we proceeded to clean up the dataset manually.

Limitations: During the assemblage of Core Areas we found boundary issues in the National Park roadless areas shapefile. Also, we identified that some roads were missing in this layer.

Mapping products: Central Colorado Plateau Core Areas shapefile

Riparian Linkages Definition

Description: Map 3 shows riparian linkages and restoration corridors between and among core areas. Riparian Linkages and Restoration Corridors are defined as follows:

"Riparian Linkages are perennial streams and rivers (artificial waterways) on Federal Lands and State Lands".

"Restoration Corridors are perennial streams and rivers (artificial waterways) on Private Lands".

The purpose of this map is to show connectivity among Core Areas in the Central Colorado Plateau.

Data Sources: Perennial streams were derived from the National Hydrography Dataset (NHD). This dataset was acquired at high resolution from NHD's website.

Methods: Riparian Linkages and Restoration Corridors were derived in the following manner:

a) Perennial streams extraction: In this step we used NHD data to derive all those streams with perennial characteristics. When analyzing the NHD dataset, we found that perennial streams were represented by perennials streams, artificial paths, and perennial lakes inside the NHD dataset. In order to derive perennial streams, we use select-by-attributes tool and by using the codes 46006, 55800, and 39009 as parameters, we obtained perennial streams in the study area. Finally, we cleaned up the dataset by using the select-by-location tool and eliminating all artificial paths that would connect to intermittent streams.
b) Riparian Linkages: By using the clip tool we extracted perennial streams inside Core Areas.
c) Restoration Corridors: This step required the extraction of private lands from the landownership dataset. After private

lands were extracted, we used this layer to clip perennial streams inside private lands. As a final result, we obtained Restoration Corridors layer.

Limitations: When analyzing the NHD data, we found that most of major rivers are classified as artificial paths in the NHD dataset and it was extremely difficult to segregate perennial streams from the artificial paths category.

Mapping Products: Riparian Linkages layer and Restoration Corridors Layer.

Retrospective Analysis

The purpose of this analysis was to determine the degree of overlap of the Central Colorado Plateau with hydrologic features (springs and streams), pre-existing conservation proposals, and important wildlife habitat. This analysis required the use of spatial analysis by using the tools available in ArcGIS. By clipping, selecting, and table statistics analysis we were able to determine degrees of overlap in each of the layers mentioned above. The results of this analysis will be left to further discussion to determine whether the overlapped layers should be included in the final wildlands network design (WND). Below there is a description of each retrospective analysis performed in this stage:

Perennial Springs

Description: Perennial springs were derived from the National Hydrography Dataset. Map 4 shows the total of perennial springs inside of the study area, and springs captured by core areas. A total of 2,747 springs were found inside the study area and 1,611 springs are captured by core areas. The percentage of springs capture by cores areas is 58.6%.

Data Sources: National Hydrography Dataset (NHD) provided by USGS via web site.

Methods: After extracting perennial springs from the NHD dataset, we calculated springs inside the Central Colorado Plateau and springs captured by core areas using the following steps:

First, by using select-by-location in ArcGIS we selected the springs inside the Central Colorado Plateau boundaries. Then we analyzed the attached attribute table and calculated total number of springs.

Second, also by using select-by-location tool, we determined the number of springs captured by cores areas. After this, we determined the percentage of springs inside core areas.

Mapping products: Perennial springs shapefiles

Perennial Streams

Description: Perennial streams were found in the following categories in the NHD dataset: perennial streams, artificial paths, and artificial lakes. This analysis determines the number of miles of perennial streams found inside the study area. Maps 5-6 show that the majority of the perennial streams are concentrated in the west side of the study area. A total of 4,936 miles of perennial streams were found inside the study area and 2, 550 miles of perennial streams captured by core areas. This represents 51% of perennial streams captured by core areas.

Data Sources: National Hydrography Dataset (NHD) provided by USGS via web site.

Methods: After extracting perennial streams from the NHD dataset, we calculated miles of perennial streams inside the Central Colorado Plateau and perennial streams captured by core areas using the following steps:

First, by using the clip tool available in ArcGIS, we extracted perennial streams inside the Central Colorado Plateau boundaries. Then we analyzed the attached attribute table and calculated total number miles for perennial streams.

Second, also by using clip tool, we selected perennial streams inside core areas. Finally, we calculated the percentage of perennial streams captured by core areas.

Mapping products: Perennial streams shapefiles

Intermittent Streams

Description: Intermittent streams are defined in the National Hydrography Dataset as "*streams that contain water for only part of the year, but more than just rainstorms and at snowmelt*". For the purposes of this analysis we extracted intermittent streams from the NHD dataset. After

analyzing the resulting layer, we found that dry creeks and washes were also included under the intermittent streams category. We found it difficult to segregate dry creeks and washes from intermittent streams and advise that the number calculated in this analysis tends to overestimate number of miles of intermittent streams. In this analysis, it was calculated that a total of 56,190 miles of intermittent streams are inside the study areas. The total miles inside cores area is 30,473. This represents 54% of intermittent streams captured by core areas (Maps 7-8).

Data Sources: National Hydrography Dataset (NHD) provided by USGS via web site.

Methods: Extracting intermittent streams was achieved by using select-by-attributes tool in ArcGIS. Then, we clipped the intermittent streams layer with the Central Colorado Plateau to calculate total miles of intermittent streams inside the study area. Also, by using the same procedure we calculated the number of miles captured by core areas.

Mapping products: Intermittent streams shapefiles

TNC portfolio of conservation sites for Colorado Plateau and High-Plateaus

Description: Map 9 shows that the Central Colorado Plateau overlaps with a total of 11,027,423 acres of the Colorado Plateau and High-Plateaus Ecoregional Plans produced by the Nature Conservancy. This corresponds to a total of 85 TNC portfolio sites. The total acres of portfolio sites captured by cores areas is 4,494,171 (72 sites). This represents a 41% of total TNC portfolio acres captured by core areas.

Data Sources: TNC portfolio of conservation sites, Colorado Plateau, and High-Plateaus layers provided by The Nature Conservancy.

Methods: First, we overlaid the conservations sites (TNC portfolio) layer onto the Central Colorado Plateau layer. Then we use select-by-location tool to extract TNC portfolio sites that intersect with the boundaries of the Central Colorado Plateau. After this, we proceeded to calculated acres from the table of attributes. We used the same process for core areas.

Mapping products: TNC portfolio sites shapefiles

Elk Crucial Habitat

Description: Elk crucial habitat is defined as: *"habitat on which the local population of a wildlife species depends for survival because there are no alternative ranges or habitats available. Crucial value habitat is essential to the life history requirements of a wildlife species. Degradation or unavailability of crucial habitat will lead to significant declines in carrying capacity and/or numbers of wildlife species in question"* (UDWR).

In the analysis we estimated a total of 2,721,726 acres of Elk crucial habitat inside the study area. The acres inside core areas correspond to 1,414,355. This represents 52% of elk crucial habitat captured by cores areas (Maps 10-11).

Data Sources: Rocky Mountain Elk habitat datasets acquired from Utah Department of Wildlife Resources (UDWR) and Colorado Parks and Wildlife (CPW).

Methods: We derived crucial habitat from the dataset provided by UDWR using a select-by-attributes tool. This process was simple, given that crucial habitat constitutes one of the attributes in the dataset.

When deriving crucial habitat for Elk for Colorado, it was necessary to assemble a seamless layer by merging the following layers: Elk severe winter range, winter concentration areas, summer concentration areas, and production areas. This step was supervised by Allison Jones in order to ensure data quality.

Once we obtained crucial habitat data for Colorado and Utah, we estimated acres of elk crucial habitat inside CCP study area and cores.

Mapping products: Elk crucial habitat shapefiles

Carrol et al. 2013 Mexican Wolf Connectivity Corridor

In 2013, after we had completed the initial draft of the Central Colorado Plateau Conservation Assessment, a team of conservation scientists completed a spatially explicit model that predicted best pathways through the Colorado Plateau and elsewhere in the southwest to ensure future genetic interchange and long-term population viability for Mexican wolves. As such, we updated this report to include an overlay of this map with the Colorado Plateau Conservation Assessment. Carroll et al's analysis is much more than a static corridor analysis linking large known current and/or potential core areas. Rather, this model combined habitat data for wolves with

population viability analyses (PVA) in order to actually develop quantitative recovery criteria for population connectivity. It did this by first establishing the large, current and possible meta population centers not only for Mexican wolves (i.e. Blue Range, Grand Canyon Ecoregion and Southern Rockies), but then also modeled potential dispersal from these three cores areas up to the Northern Rockies. Carroll et al. performed a PVA in which population performance across all 4 core areas and across a range of scenarios was compared with alternative population size and connectivity criteria. Then Carroll et al. used "effective-distance metrics" derived from habitat data to evaluate what rates of dispersal could be expected between the reintroduced (or as of now hypothetical) populations. In a nutshell, they assessed what rate of natural dispersal (i.e. numbers of wolves moving from one core to another per unit time, such as a generation) between the potential core populations could be achieved given the distribution of habitat. Map 12 shows, in the context of our Conservation Assessment for the Plateau, Carroll et al.'s results in terms of potential habitat linkages between the existing/potential wolf-population core areas in the
western United States (the red lines represent linkages with the "least-cost distance" between all cores, with the thicker lines denoting the paths with the highest likelihood of wolves successfully dispersing ; the darker gray shading represent areas with the highest importance for connectivity based on the "resistance distance model"; see Carroll et al. for explanation of these sub-models used in their paper). Of note, two of the Least cost pathways come through our study area, including intersection with our Colorado Plateau core areas.

Major Threats Identification

In this section of the conservation analysis, we present a display of major threats that could potentially affect the conservation of the Central Colorado Plateau. By using a cartographic overlay we overlapped the following layers onto the CCP study area: proposed blue castle nuclear plant, current transmission lines/utility corridors, future transmission lines, proposed renewable energy zones, and 2477 road claims for Utah. This cartographic overlay is given in the following order:

- Map 13 Proposed Blue Castle Nuclear Plant
- Map 14 Existing transmission lines/utility corridors
- Map 15 Future transmission lines
- Map 16 Proposed renewable energy zones

Discussion and Conclusions

This analysis represents a new and different approach to identifying potential linkages and core areas that might, if analysis were conducted, become a wildlands network. Our analysis provides another approach to fitting the Central Colorado Plateau into a regional set of wildlands networks, an important first step in filling this wildlands network gap.

The special conservation value of the Central Colorado Plateau is unique. In the Western states, there are four large clusters of connected roadless areas and this study area is one of these (Map 1). This part of the Plateau is 6.2 million hectares in size and about 58% of this is comprised of roadless lands. Linked intact wildlands throughout this area include National Park units, BLM, and Forest Service roadless lands. Today, only a tiny fraction of these lands are designated as wilderness and most lack clear protection. Our retrospective analysis further shows that most of the best wildlife habitat and riparian areas/streams in this study area are associated with these roadless areas. Thus, the Central Colorado Plateau is comprised largely of de facto wilderness and is already well connected. By nature, this area also provides high quality climate change refugia because of the diversity of elevation ranges within this part of the Plateau.

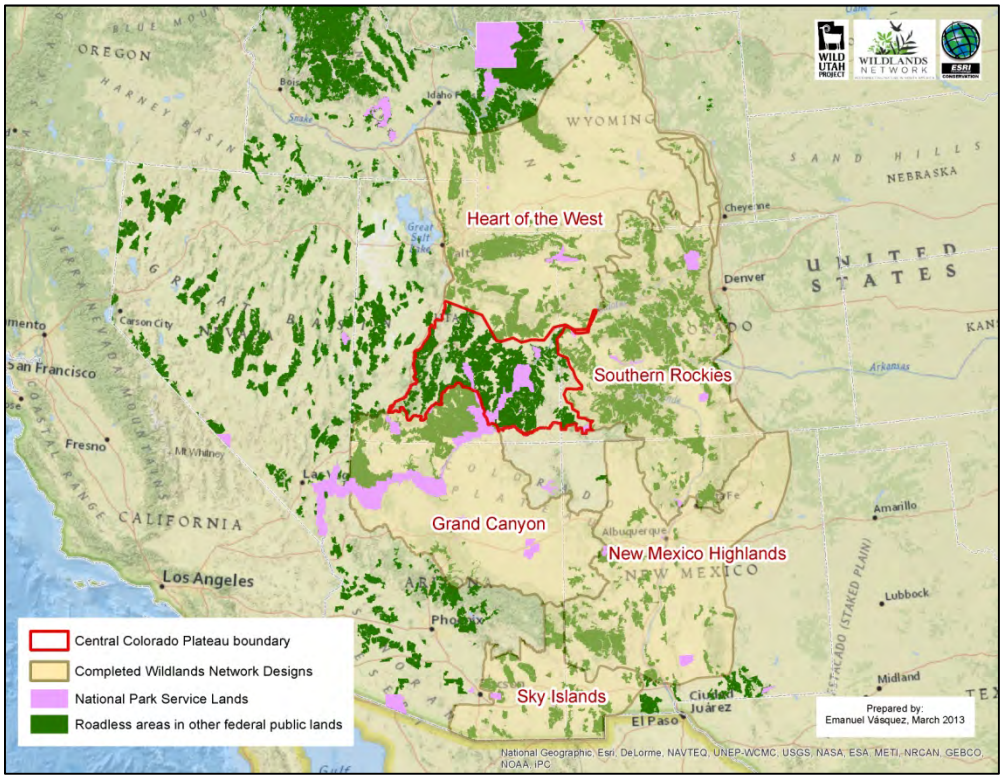
"This is the healthiest most intact country in the West" noted Michael Soulé, a world renowned conservation biologist. The Central Colorado Plateau is, by and large, a connected set of roadless areas that completes a landscape linkage to wildlands networks to the north, south and east.

While this region is not a major target for future fossil energy development, a number of serious threats now occur in the areas surrounding the Central Colorado Plateau. To the north and east coal, tar sands, oil shale and oil and gas development are ramping up. To the west and south, large-scale solar energy is being proposed. The rugged and wild nature of this area has mostly deterred new major transmission lines from crossing this area. The fact that much of this land has not yet been targeted for major industrial development is a rarity in the west, and we should do all we can to work to preserve these intact and connected tracts of roadless lands and valuable wildlife habitat for the long term.

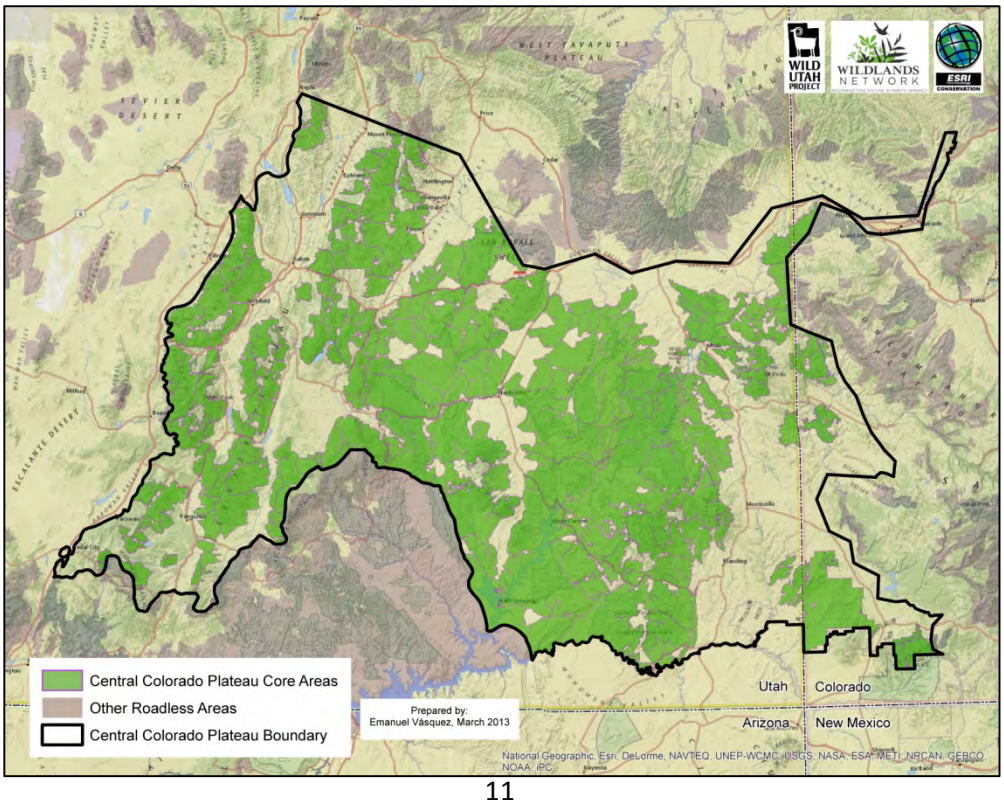
As renowned corridor modeler Paul Beier put it, *"There is no place outside of Alaska to have this big of an opportunity to connect with surrounding regions…with this much intact wilderness—why would we give up some or part of it?"*

While there are some threats in this area from renewable energy development and other uses, this Central Colorado Plateau is a place of refuge from these activities and a place that allows permeability for wildlife movement away from and around fragmented habitat in the region surrounding the Central Colorado Plateau.

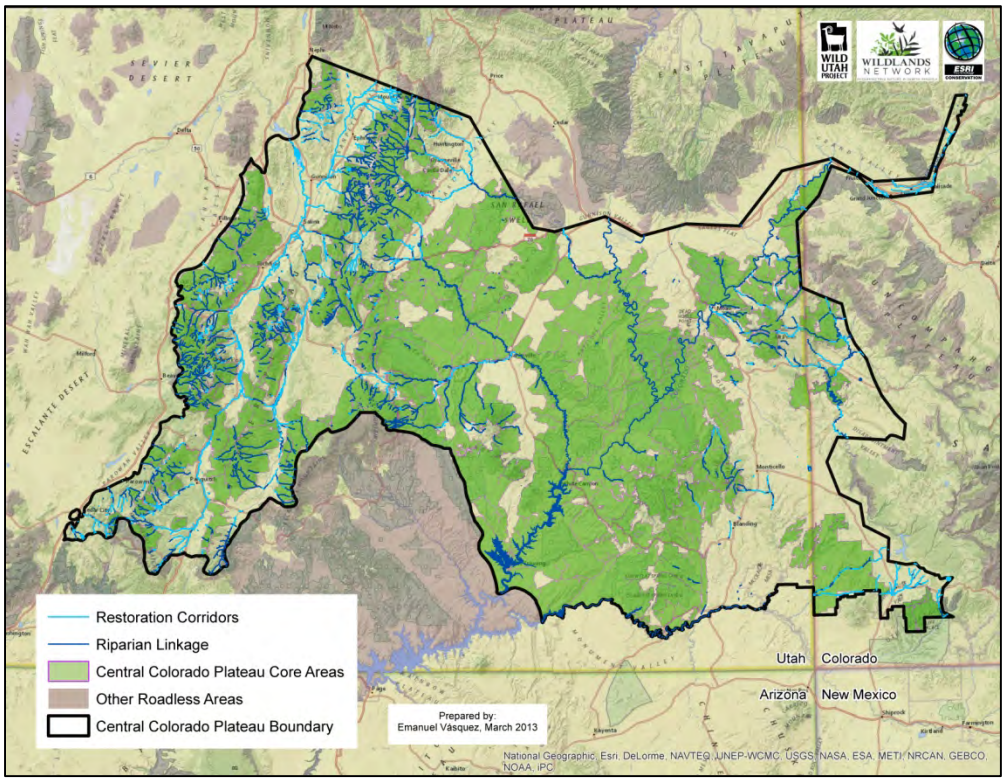
Map 1
Roadless areas in the West U.S.



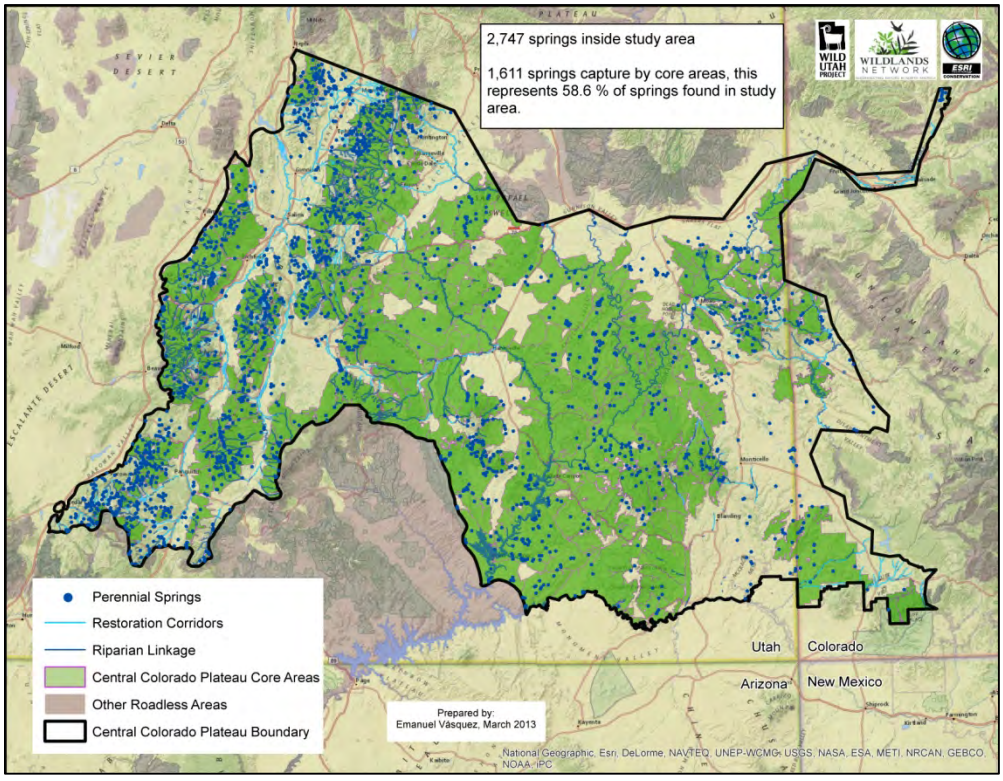
Map 2
Central Colorado Plateau Core Areas



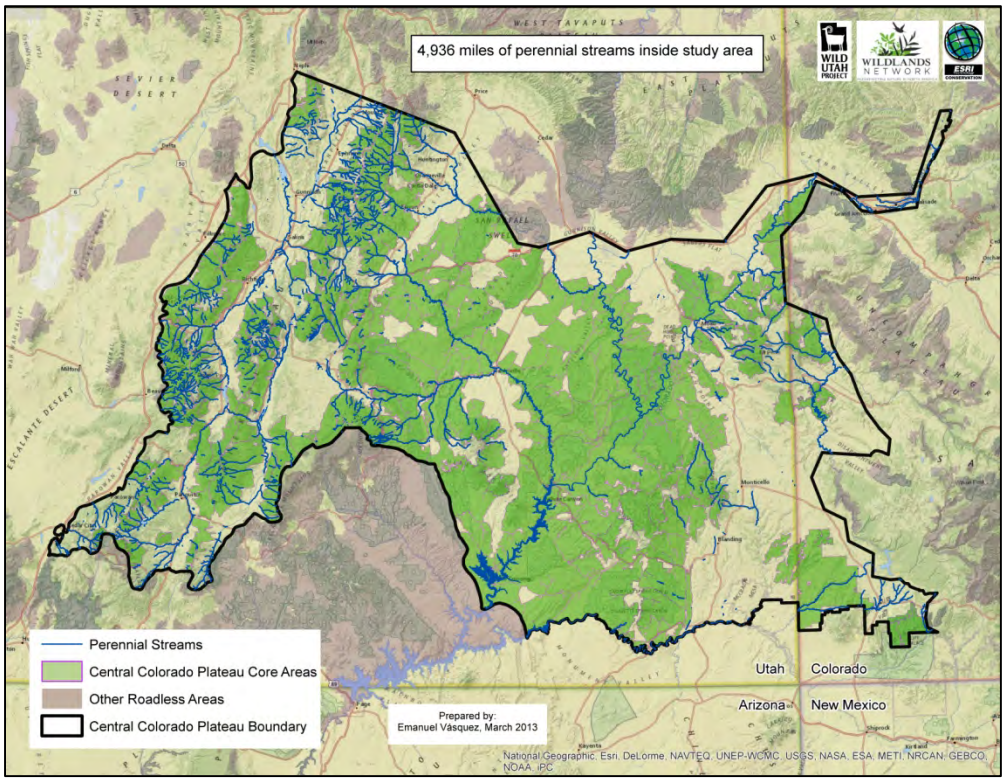
Map 3
Riparian Linkages and Restoration Corridors



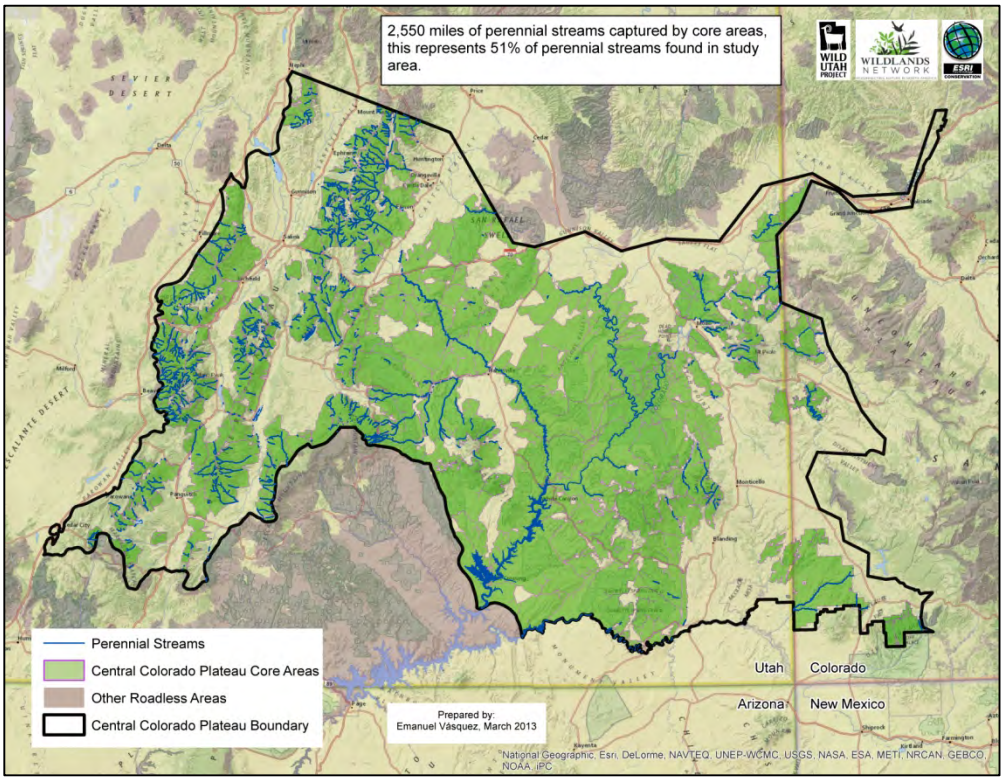
Map 4
Perennial Springs



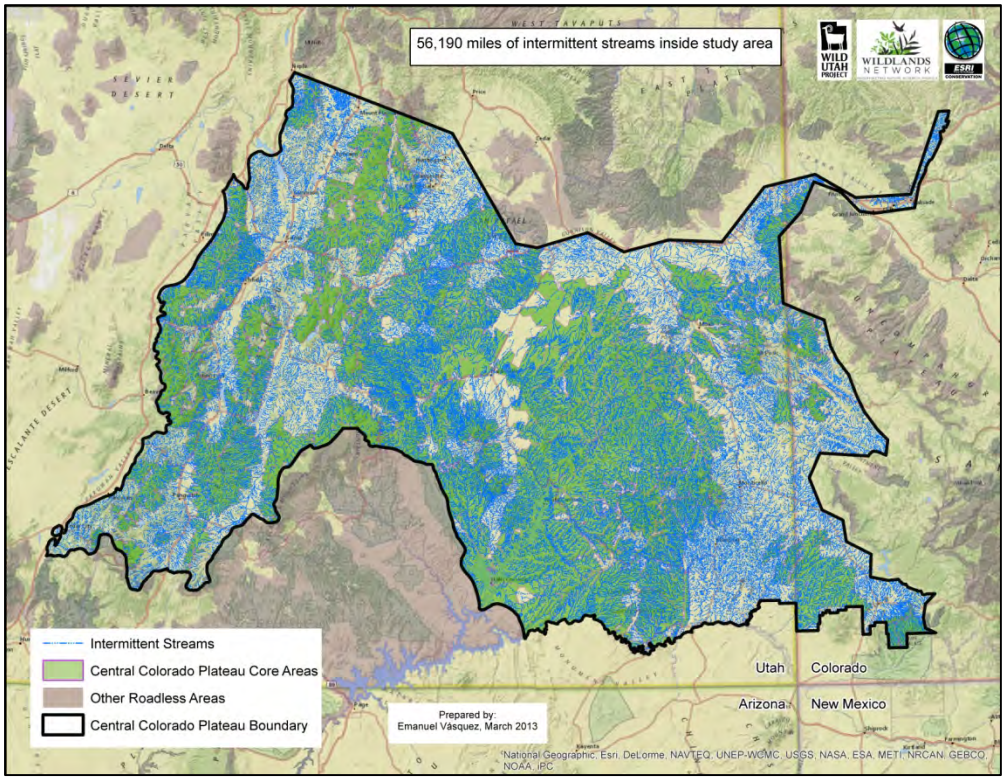
Map 5
Perennial Streams



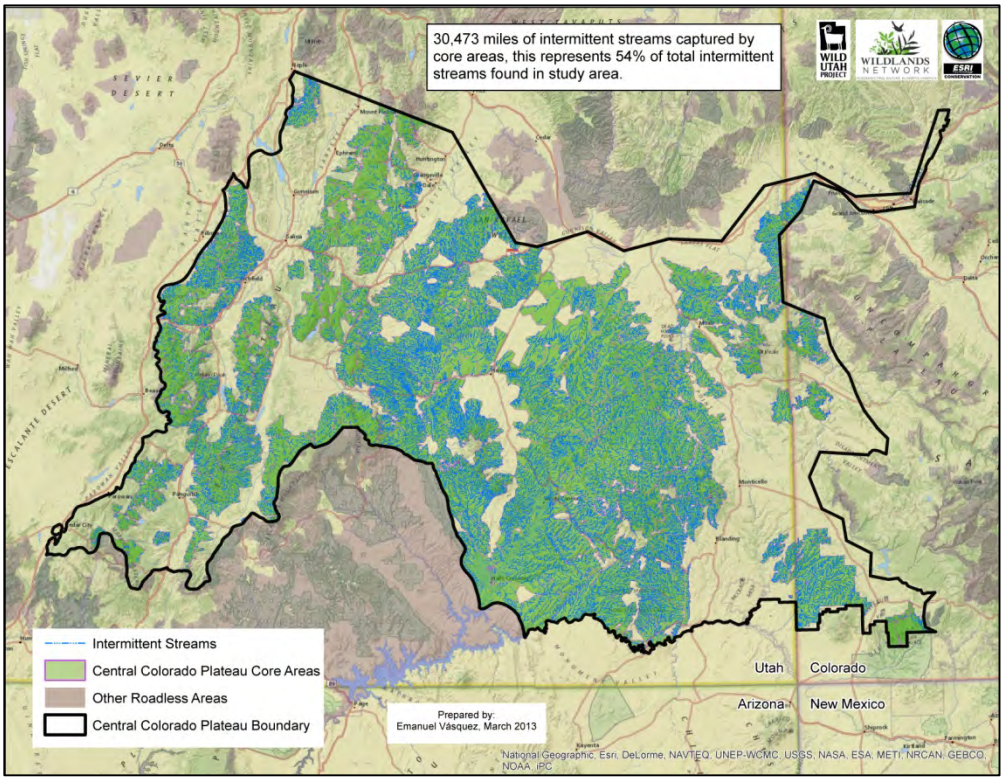
Map 6
Perennial Streams Captured by Core Areas



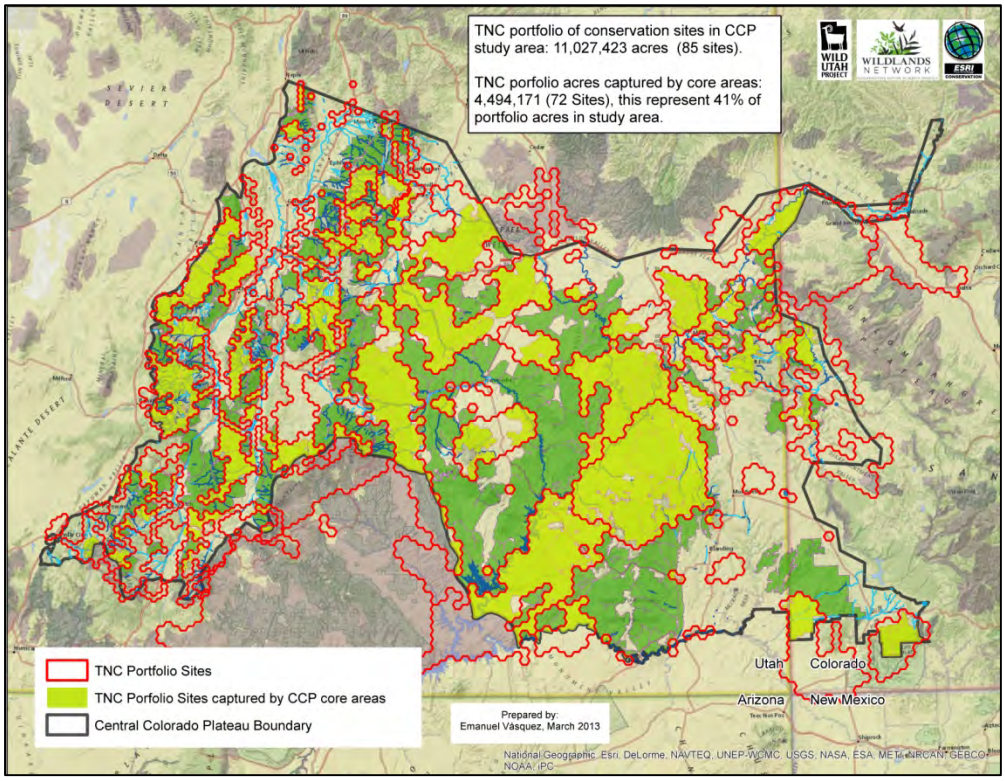
Map 7
Intermittent Streams



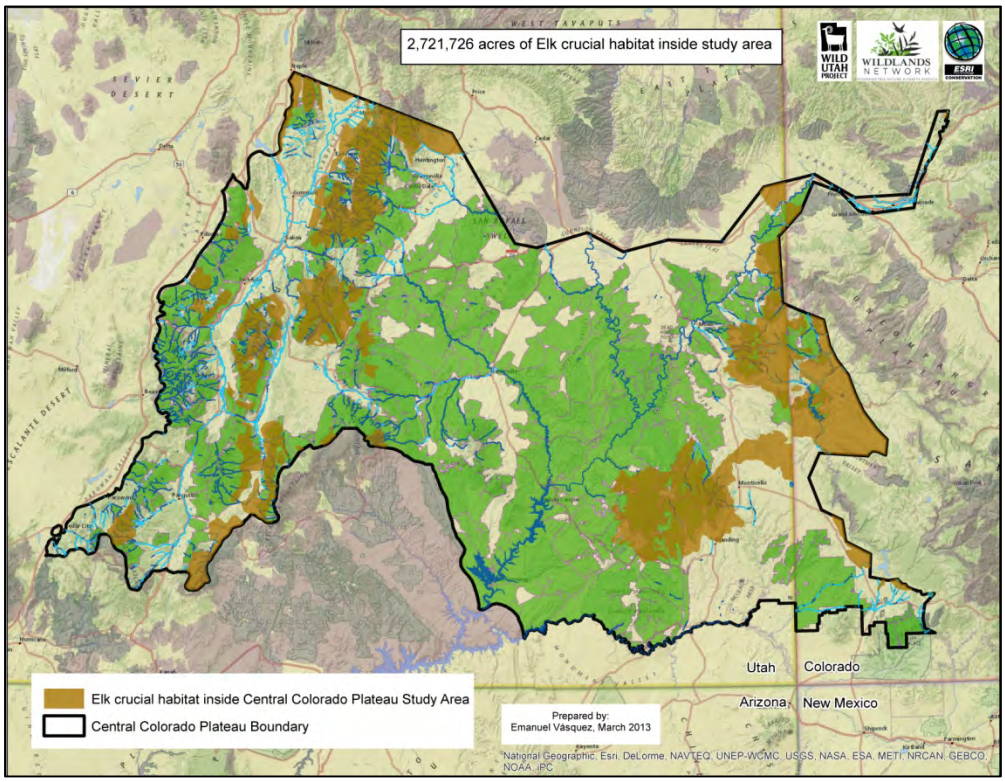
Map 8
Intermittent Streams Captured by Core Areas



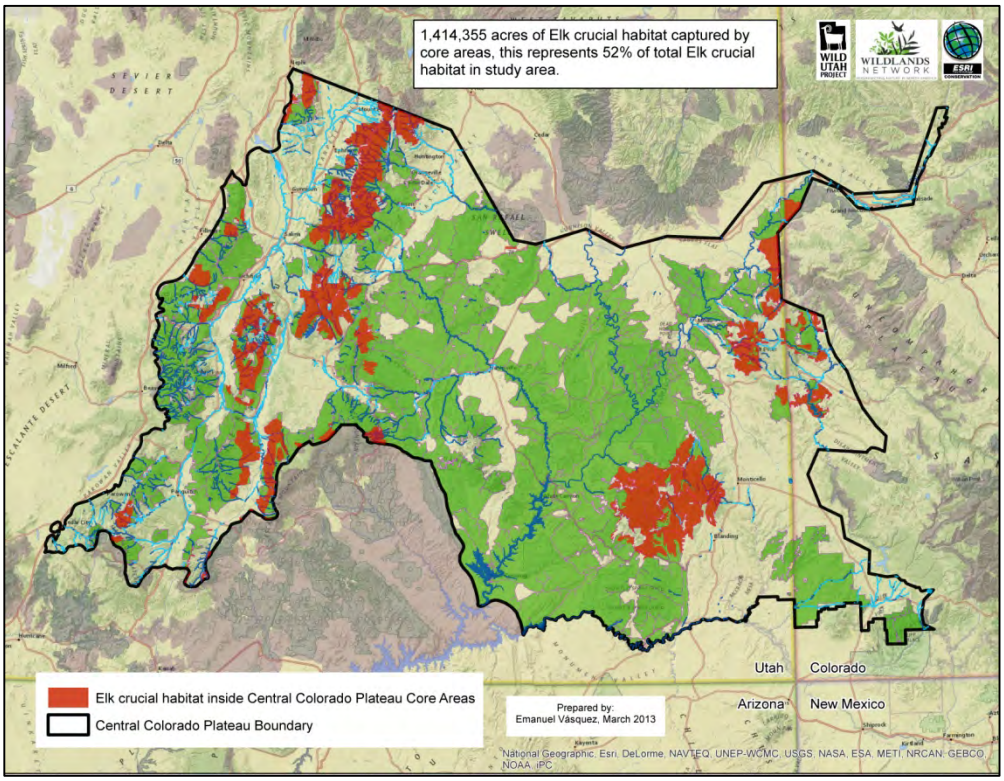
Map 9
TNC Portfolio of Conservation Sites



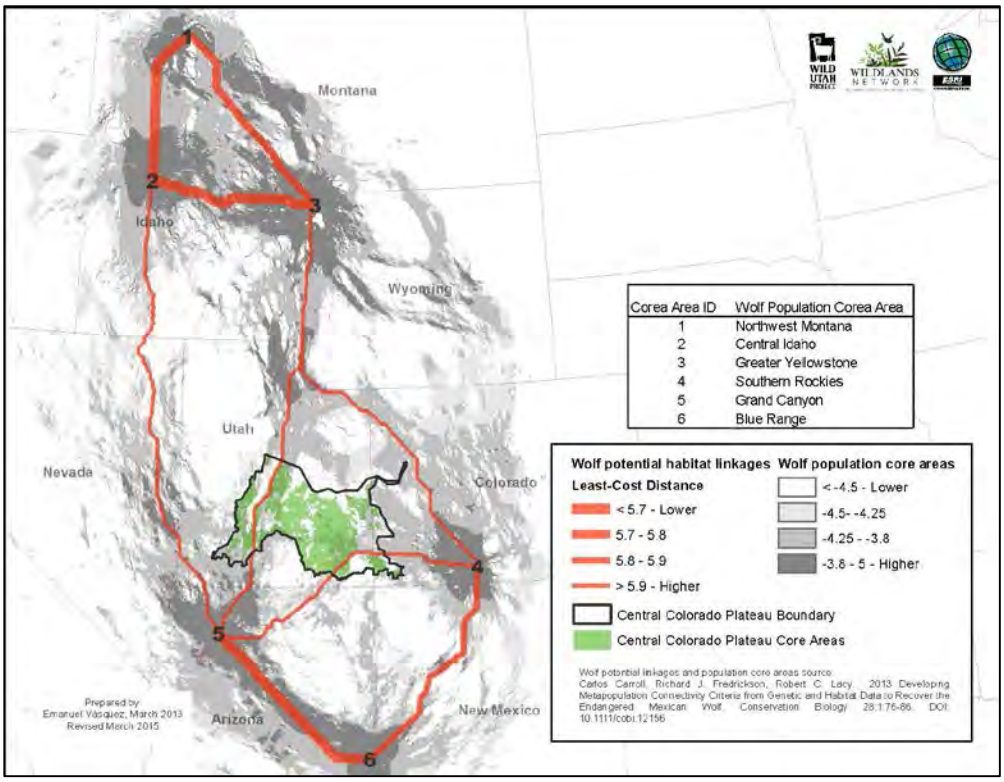
Map 10
Elk Crucial Habitat



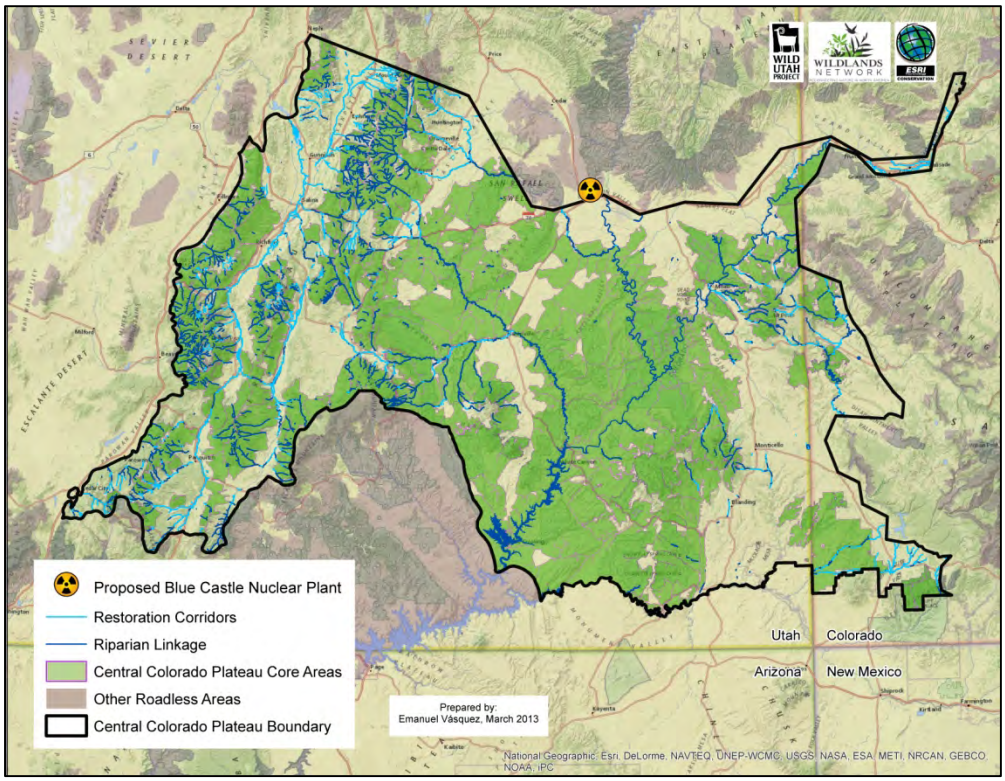
Map 11
Elk Crucial Habitat Captured by Core Areas



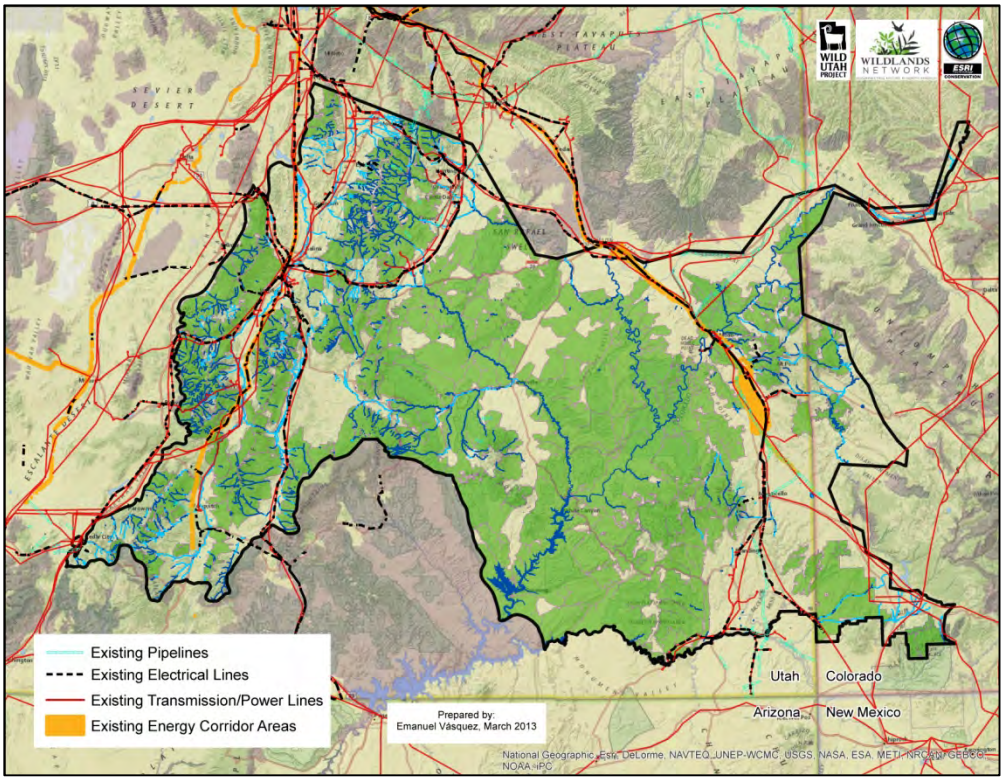
Map 12
Wolf Potential Linkages and Population Areas



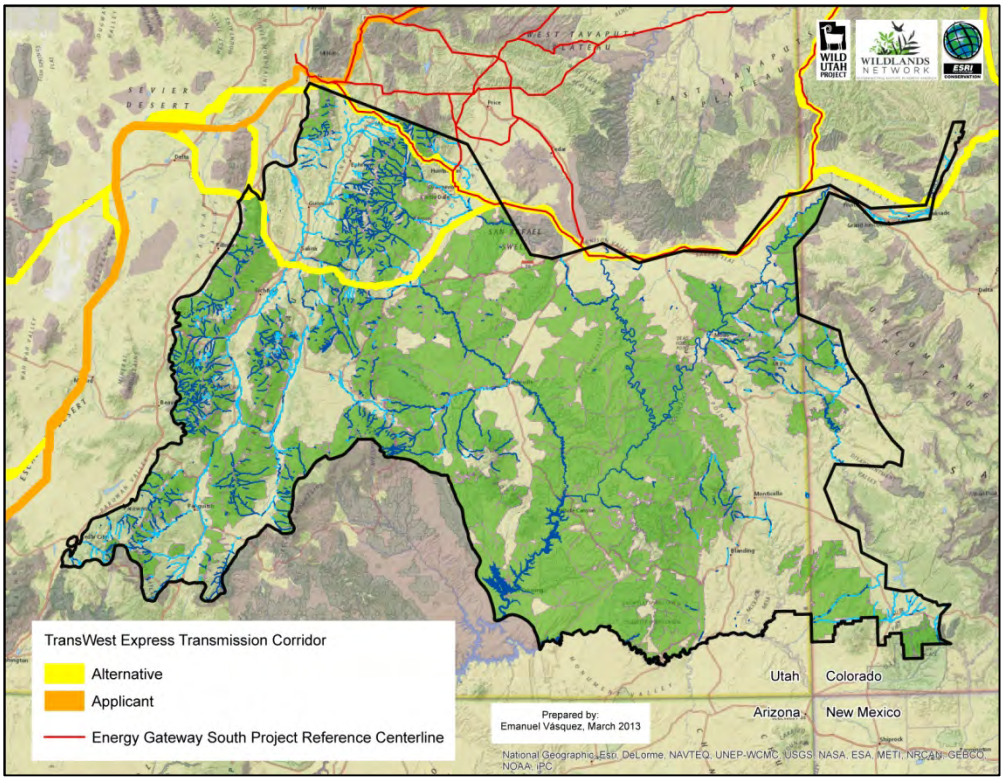
Map 13
Proposed Blue Castle Nuclear Plant Location



Map 14
Existing Transmission Lines/Utility Corridors



Map 15
Future Transmission Lines



Map 16
Proposed Renewable Energy Zones