ARIZONA LAND AND WATER TRUST

Landscape-level Conservation Planning for Wildlife under a Changing Climate

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THE UNIVERSITY OF ARIZONA

Arizona Land and Water Trust

Mission:

Founded in 1978, Arizona Land and Water Trust is committed to protecting southern Arizona's rural heritage of working farms and ranches, wildlife habitat, and the water resources that sustain them.

Arizona Land and Water Trust

Land trusts are 501(c)(3) nonprofit organizations that work with willing landowners, stakeholders, and the community to conserve land and water by entering into private voluntary conservation agreements.

Today there are 1,700 land trusts with only 308 Nationally Accredited.

Arizona Land and Water Trust

- Conservation Internship/GIS Practicum

  (July 2013- April 2014)
- Strategic Goals 2014-2016
- 1. Protect 10,000 acres of high priority lands

“Focus efforts on high priority areas that meet as many as possible of the land protection criteria in order to leverage the Trust’s protection efforts.”

Designing Landscapes for Wildlife and People into the Future

- Update the identification of key priority areas based on new analyses and available data
- Highlight areas that provide diverse ecosystem services, climate change resilient landscapes, and water

o Regarding climate change – ensure space and protect refugia for species to adapt to more intense and unstable climate regimes

Designing Landscapes for Wildlife and People into the Future

Space= Large unfragmented landscapes or landscape connectivity (non-human disturbed) within defined regions

Refugia= Where species may find suitable habitat (micro-conditions) and persist through this period of rapid climate change and instability

Designing Landscapes for Wildlife and People into the Future

Landscape Linkages: In this case, space for facilitated movement to "refugia" habitat within region or large-scale movement to new suitable habitat across regions

Adaptation: Behavioral changes, and rapid or longer-term evolutionary response to adjust to changing conditions

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- Current Debate in Landscape Conservation Planning for Biodiversity Conservation under Climate Change. Literature full of points of view, but notable is:

*Species pop. viability depends on,

<u>habitat area & quality</u> vs.

<u>connectivity, spatial arrangement, & structural properties of the linkages</u>

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Our focus area for conservation analysis was set to the Gila Watershed in Arizona

- Began by looking at various landscape condition models: goal identify large unfragmented landscapes (i.e., "Wildland Blocks")

1) Arizona Game & Fish Dept. (HabiMap)

2) NatureServe-Non-profit conservation sci. org.

3) University of Arizona, Dr. Ryan Perkl's project for AZGFD, *Arizona Landscape Integrity and Connectivity Assessment*

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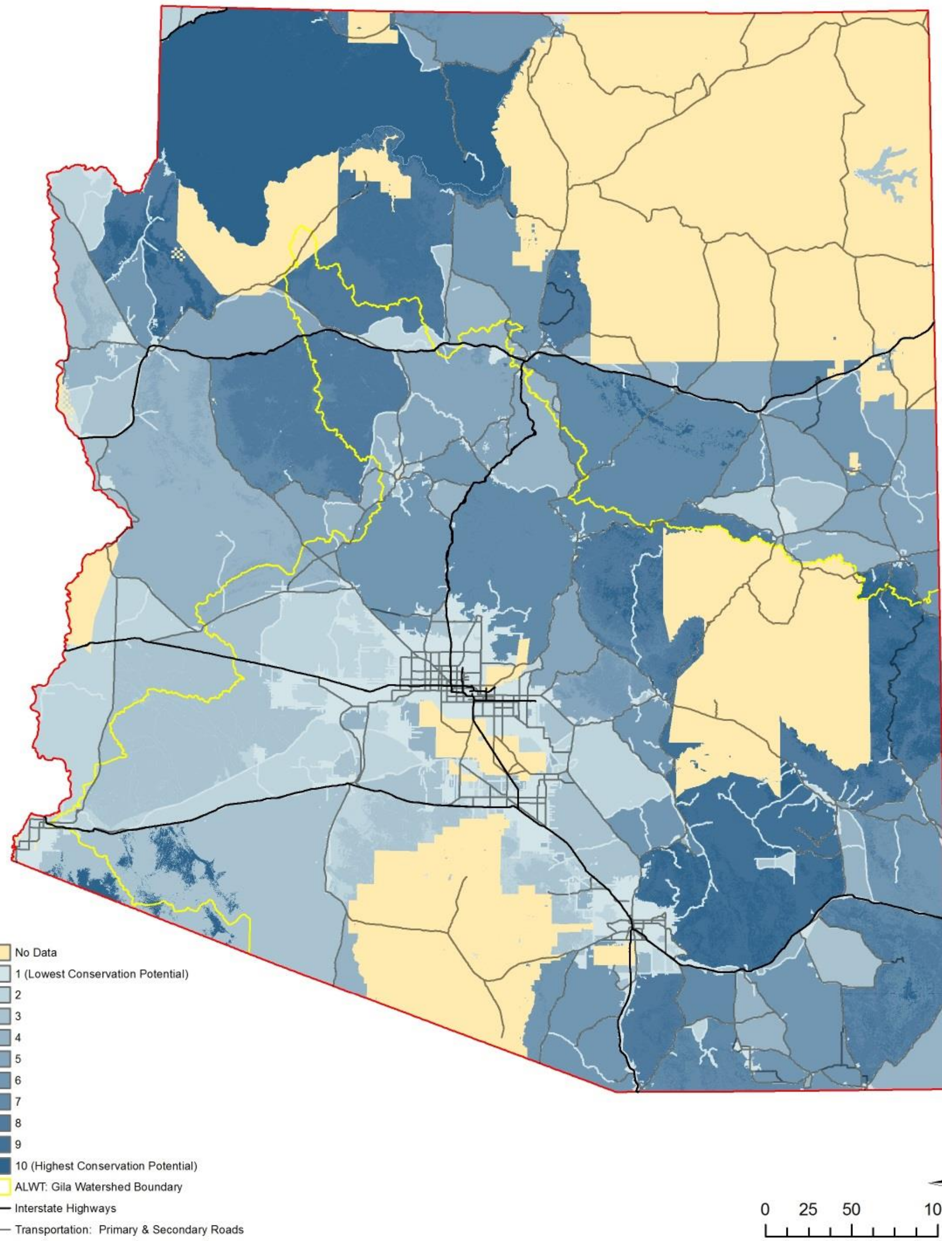
Arizona Game & Fish Department: Unfragmented Areas Model



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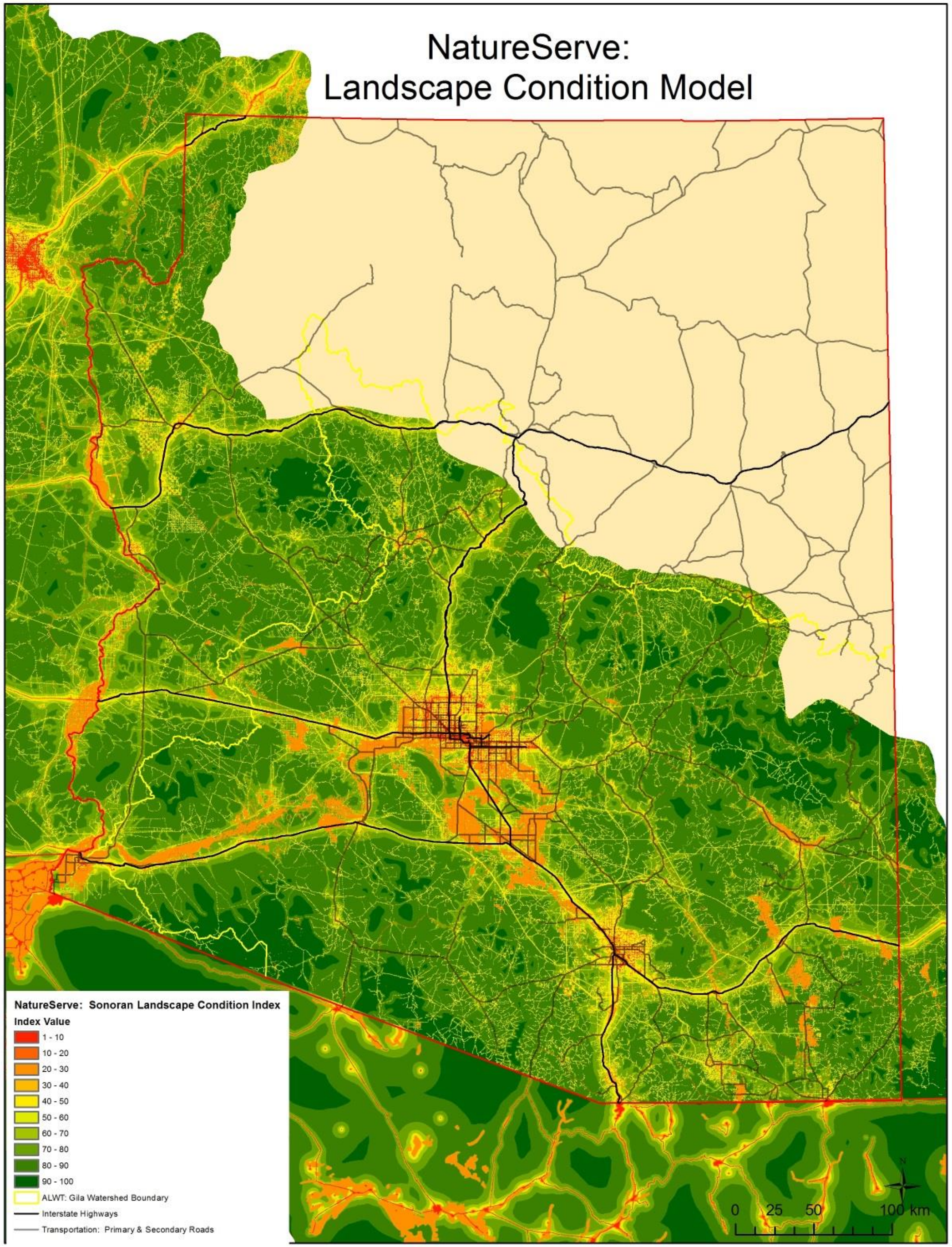

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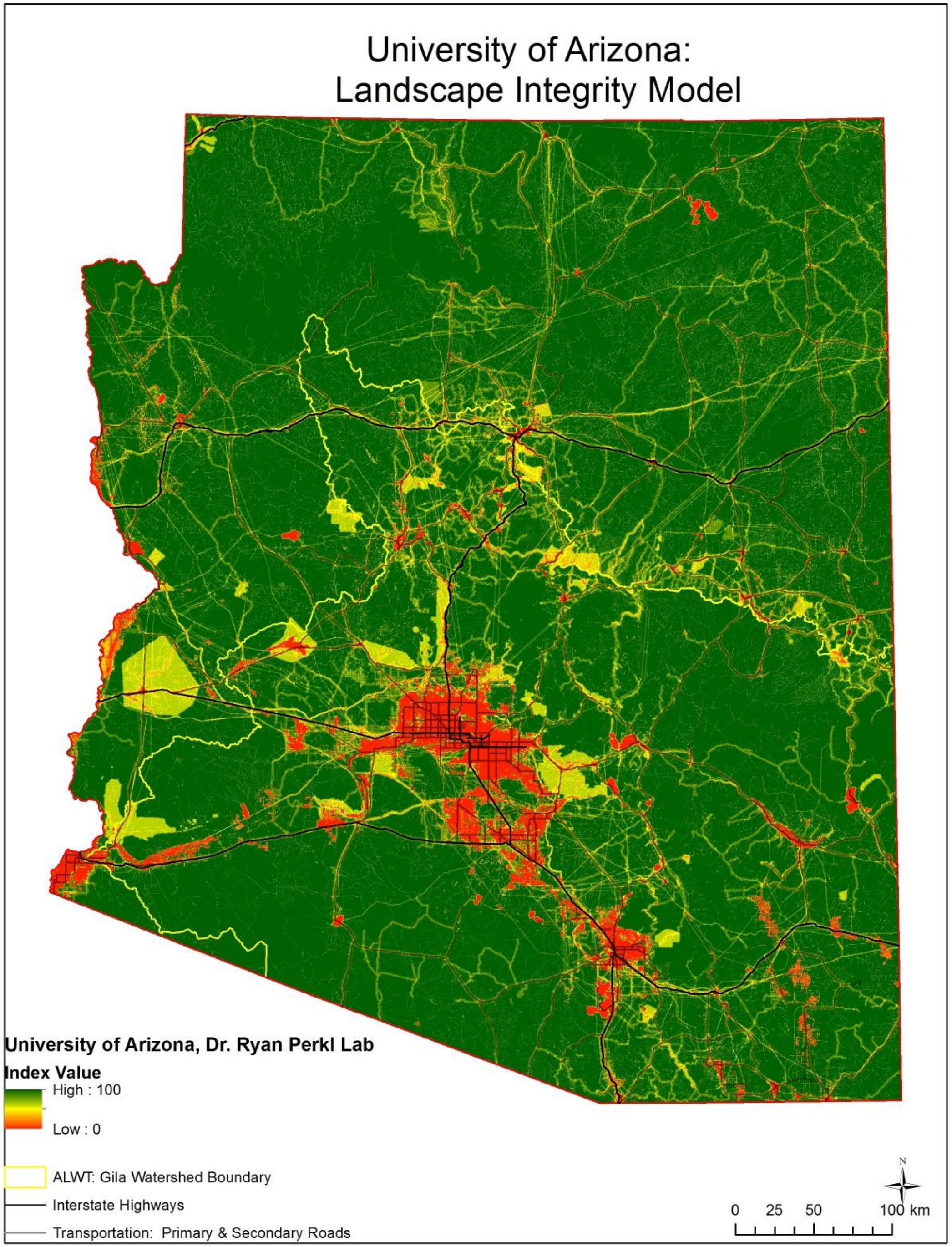
- Perkl's UA Model:
- Landscape Integrity = (the inverse of) "Human Footprint"
- Combine geographic data of <u>human infrastructure and alteration</u> throughout the state (variety of spatial data, e.g., roads, airports, energy sites, mines, impervious surface, housing density, etc. n=19 factors)
- Model based on proximity & density for human factors
- Max. distance threshold of impact determined from literature and experts team (generalized to impacts to terrestrial, hydrological, and atmospheric systems)


University of Arizona:
Landscape Integrity Model
University of Arizona, Dr. Ryan Perkl Lab
Index Value
High : 100
Low : 0
ALWT: Gila Watershed Boundary
Interstate Highways
Transportation: Primary & Secondary Roads
0 25 50 100 km
N

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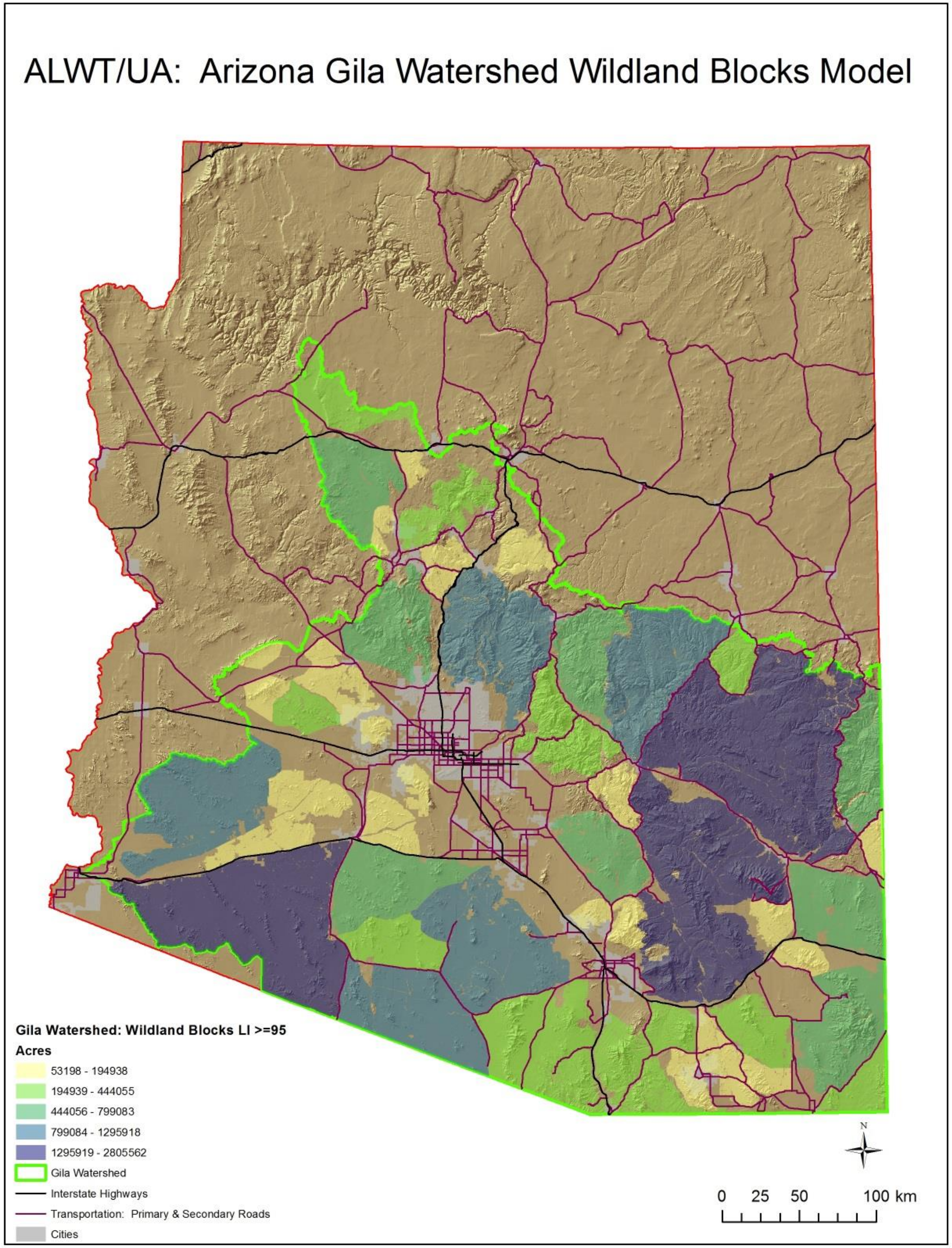
- We chose LI Scores 95 and greater to avoid minor dirt roads/jeep trails influencing contiguity of primarily unfragmented "Wildland Blocks"
- We started with blocks 150,000 acres and larger, and then added additional "Wildland Blocks" of 50,000-150,000 acre size within our Gila Watershed focus area
- We modified our "Wildland Blocks" to encompass adjacent smaller "LI95 blocks" of varying sizes, if less traveled roads were the only division between adjacent "Wildland Blocks" of LI score $\geq$ 95



N = 64
Wildland Blocks

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- "Wildland Blocks" have on-the-ground value
- New concept to many, and not easily explained to those outside the conservation field
- Hard to engage citizens around conservation for a Wildland Block within a common geography
- I decided to evaluate watersheds that were roughly were the same size as our Wildland Block model, and these are the USGS mapped Hydrologic Unit Code 8 watersheds.

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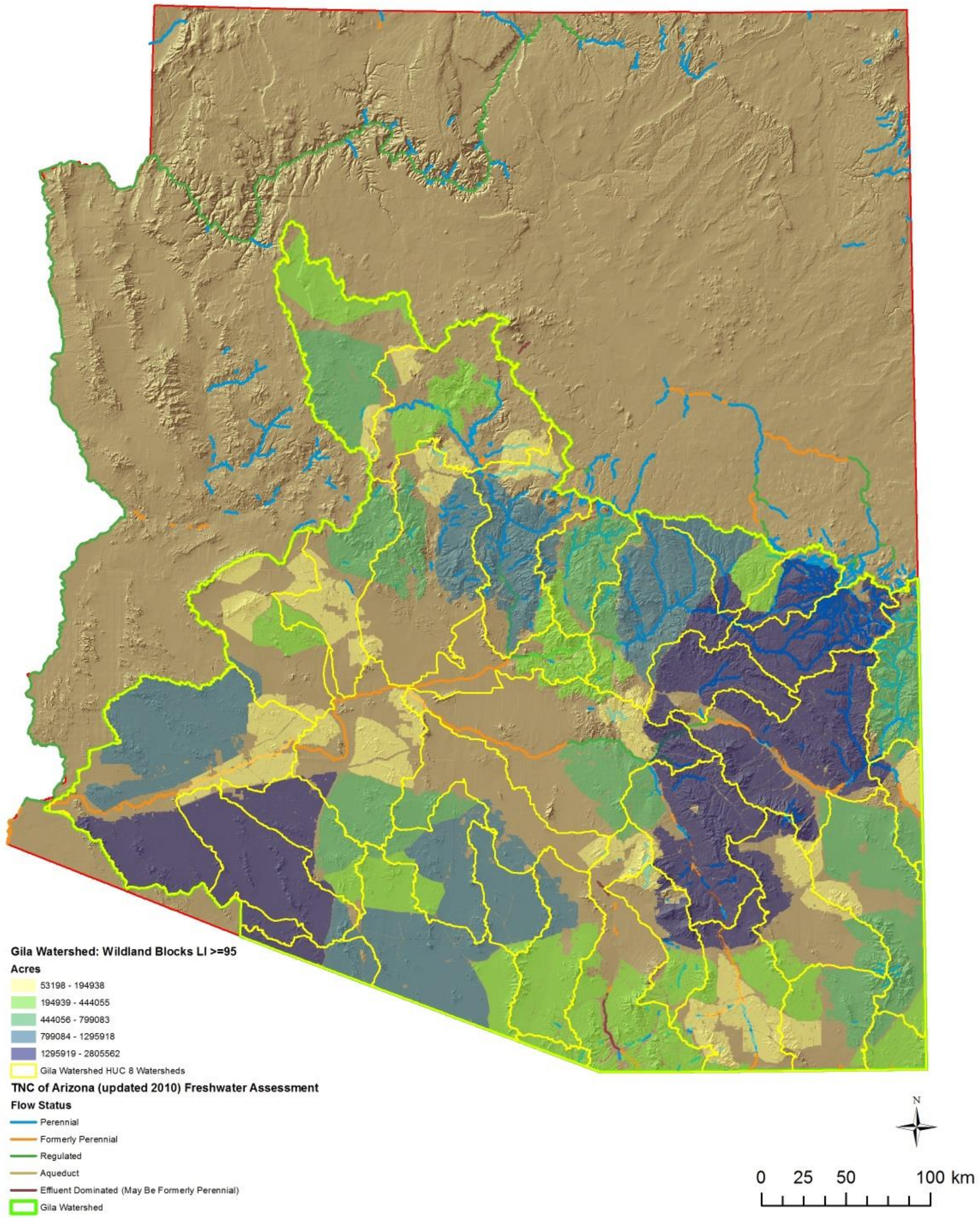
AZ Gila Watershed, Wildland Blocks to HUC 8 Watershed, Transition Analysis



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- Next, I evaluated the HUC 8 watersheds within the Gila Watershed by Topographic Roughness Index (TRI).
- TRI is one of the primary guiding factors to landscape assessment for climate change adaptation to wildlife (especially at large scales)


Chrissy Kondrat-Smith

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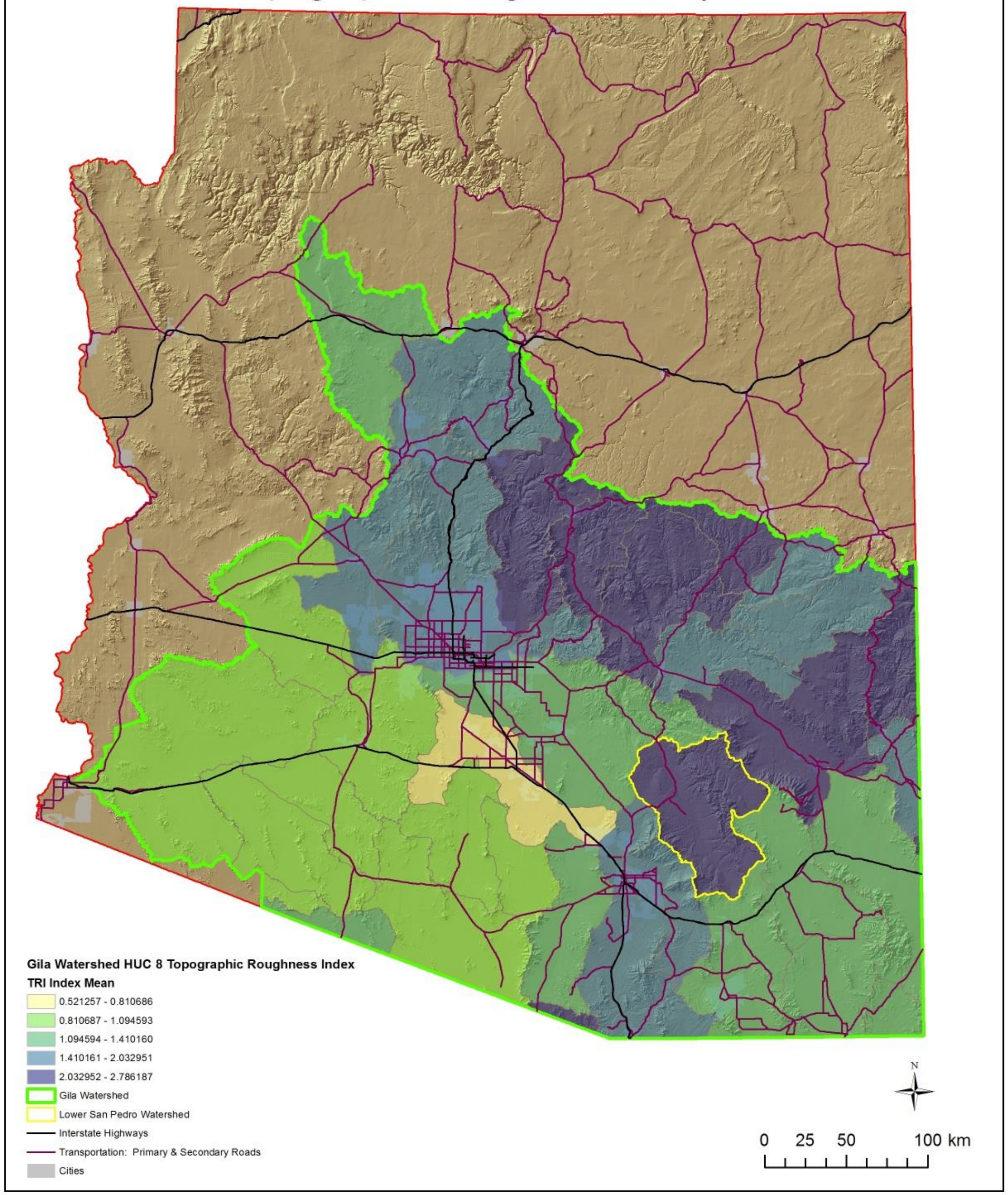
TRI assesses:

- Overall terrain diversity or ruggedness
- Index to diversity of micro-terrain (potentially also soil, vegetation, wetness)
- Potential conditions suitable for facilitating small-scale species movements, and behavioral and/or evolutionary adaptation to changing climate conditions
- Very rough terrain within sub-basins, correspondance to shadier and cooler micro-conditions, such as within canyons

Arizona Gila Watershed, HUC 8 Watershed, Topographic Roughness Analysis



Climate Adaptation Analysis at the Watershed Level: Focused to the Lower San Pedro Watershed with Sub-basins (HUC 12) defining my Analysis Unit

Analysis Relies on a DEM, Springs & Perennial Waters layers

Heat Load Index (HLI): Provide an index to potential "refugia" (micro-climates) from climate change. Accounts for aspect, steepness of slope, and latitude, thus southwest aspects are warmest (steeper slopes have higher values) and northeast aspects are coolest

Topographic Roughness Index (TRI): The average elevation change between any point (30m pixel) on a grid and its surrounding area (8 neighboring pixels), thus measuring ruggedness of terrain

Spring & Seep Abundance (SA): Percentage of all springs in the watershed

Elevation Range-Maximum (ER): The maximum elevation range span of the sub-basin

Perennial Waters (PW): The Nature Conservancy Freshwater Assessment 2010 GIS layer.


Matt Griffiths

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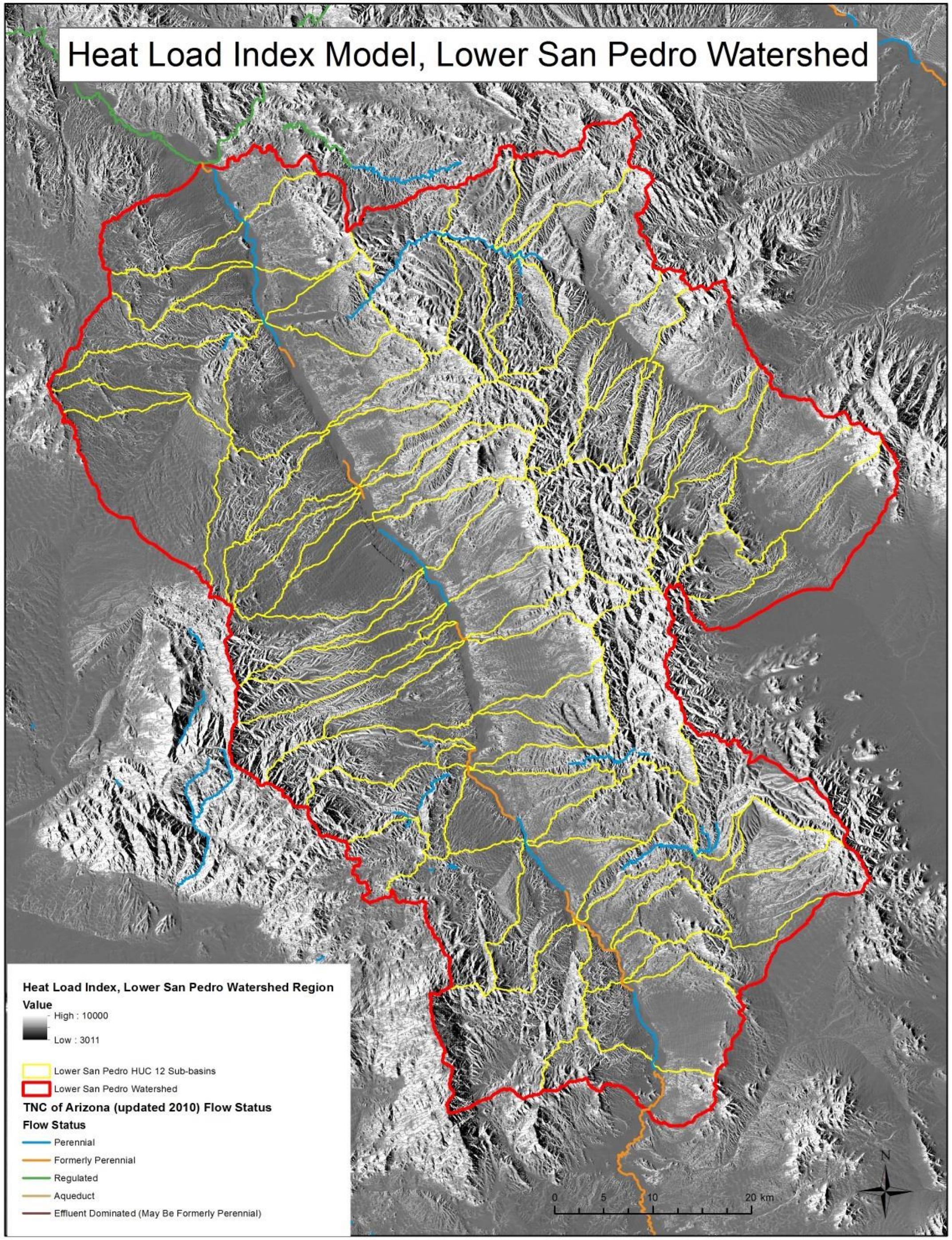
Development of a Climate Adaptation Rule Set for analysis of Sub-basin Watersheds for Conservation:

- Six-step process for prioritization, focused on selecting the top tiers of landscape factors through statistical analysis Natural Breaks (Jenks)
- Focused primarily on a “resilience” approach to adaptation, by <u>prioritizing select landscape factors</u>, and <u>achieving landscape connectivity</u>, along mtn. ranges, with perennial waters, and cross-valley spanning low to high elevation


Heat Load Index Model, Lower San Pedro Watershed
Heat Load Index, Lower San Pedro Watershed Region
Value
High : 10000
Low : 3011
Lower San Pedro HUC 12 Sub-basins
Lower San Pedro Watershed
TNC of Arizona (updated 2010) Flow Status
Flow Status
Perennial
Formerly Perennial
Regulated
Aqueduct
Effluent Dominated (May Be Formerly Perennial)
0 5 10 20 km
N

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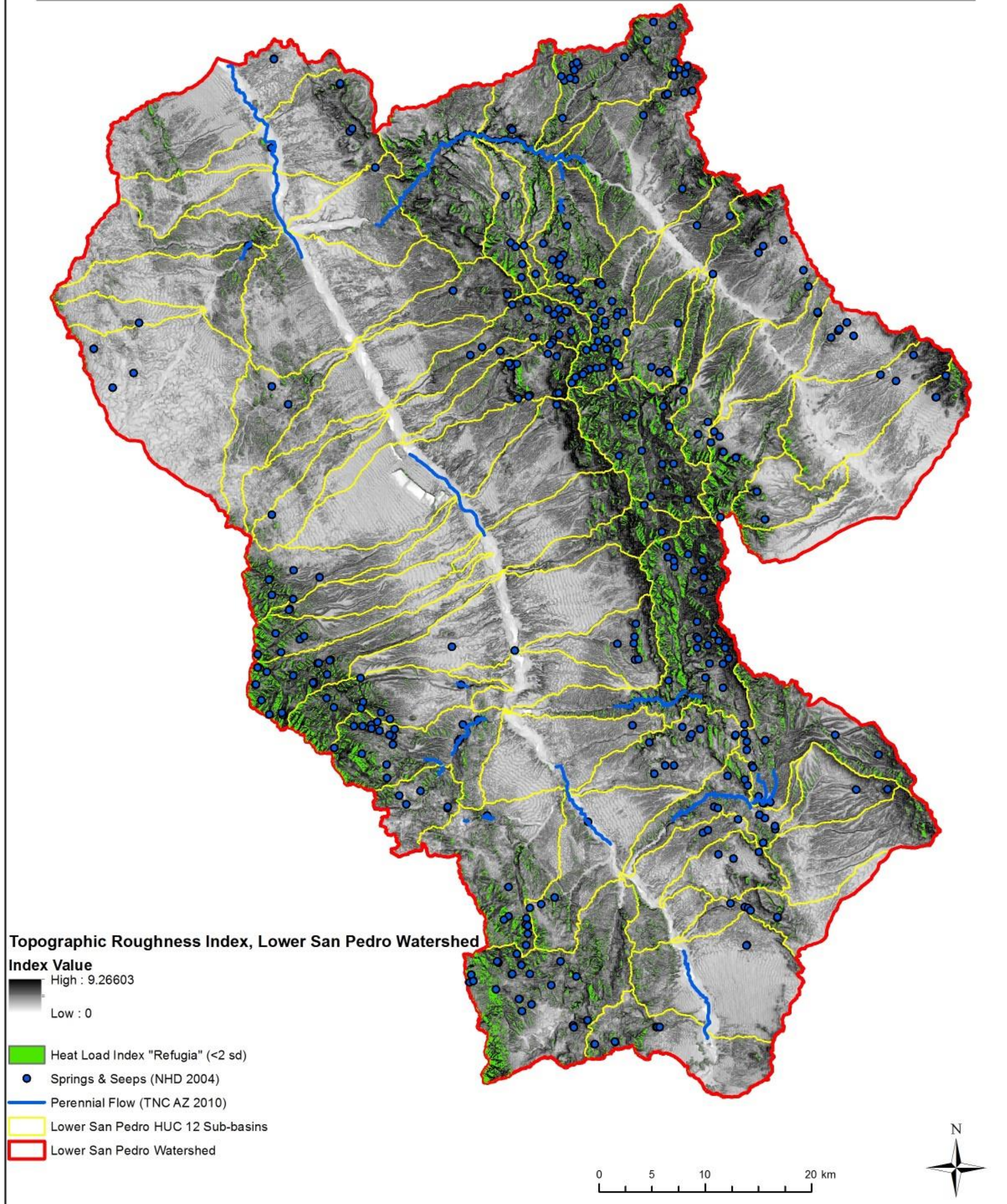
Topographic Roughness + "Refugia" + Springs + Waters, Lower San Pedro Watershed



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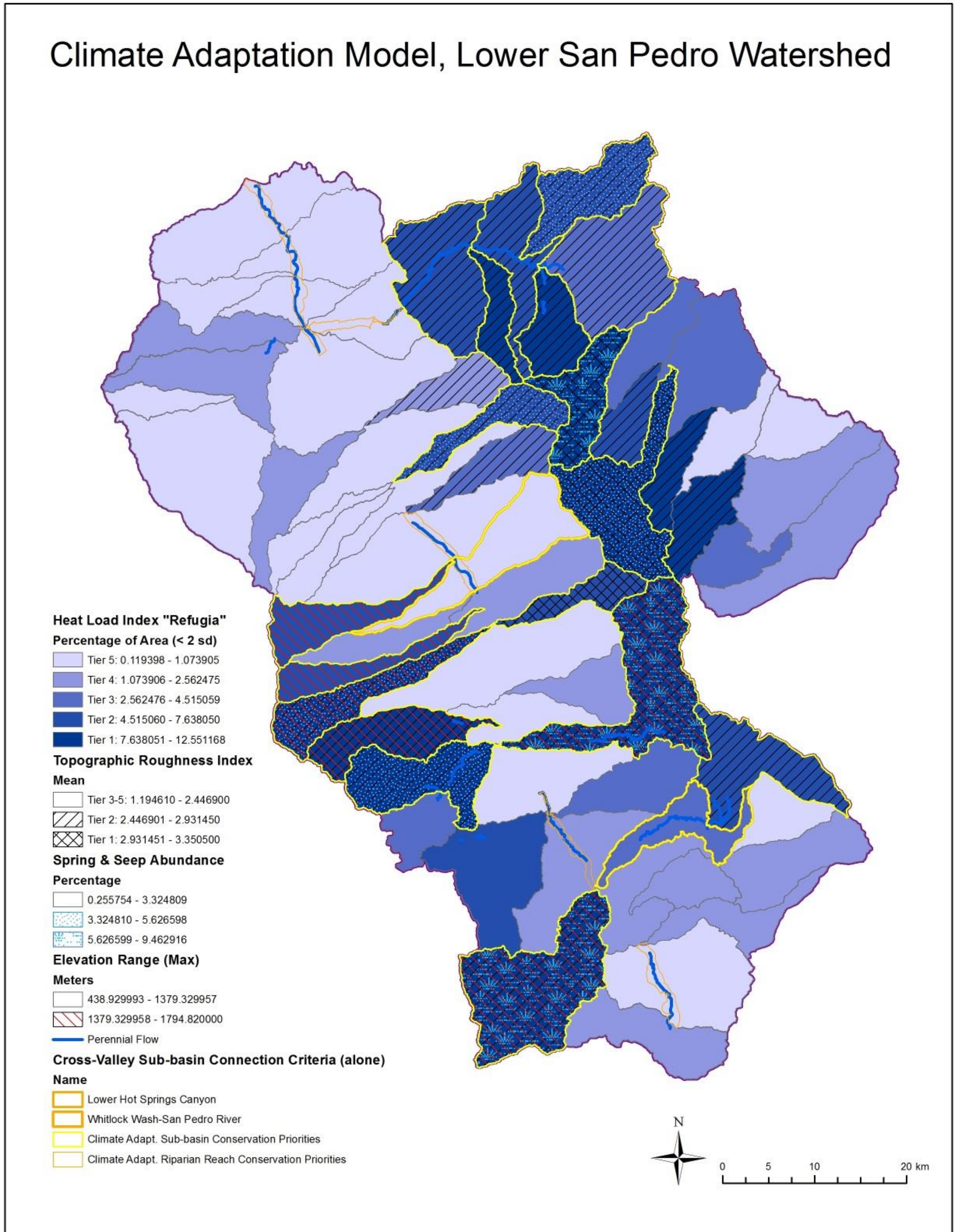
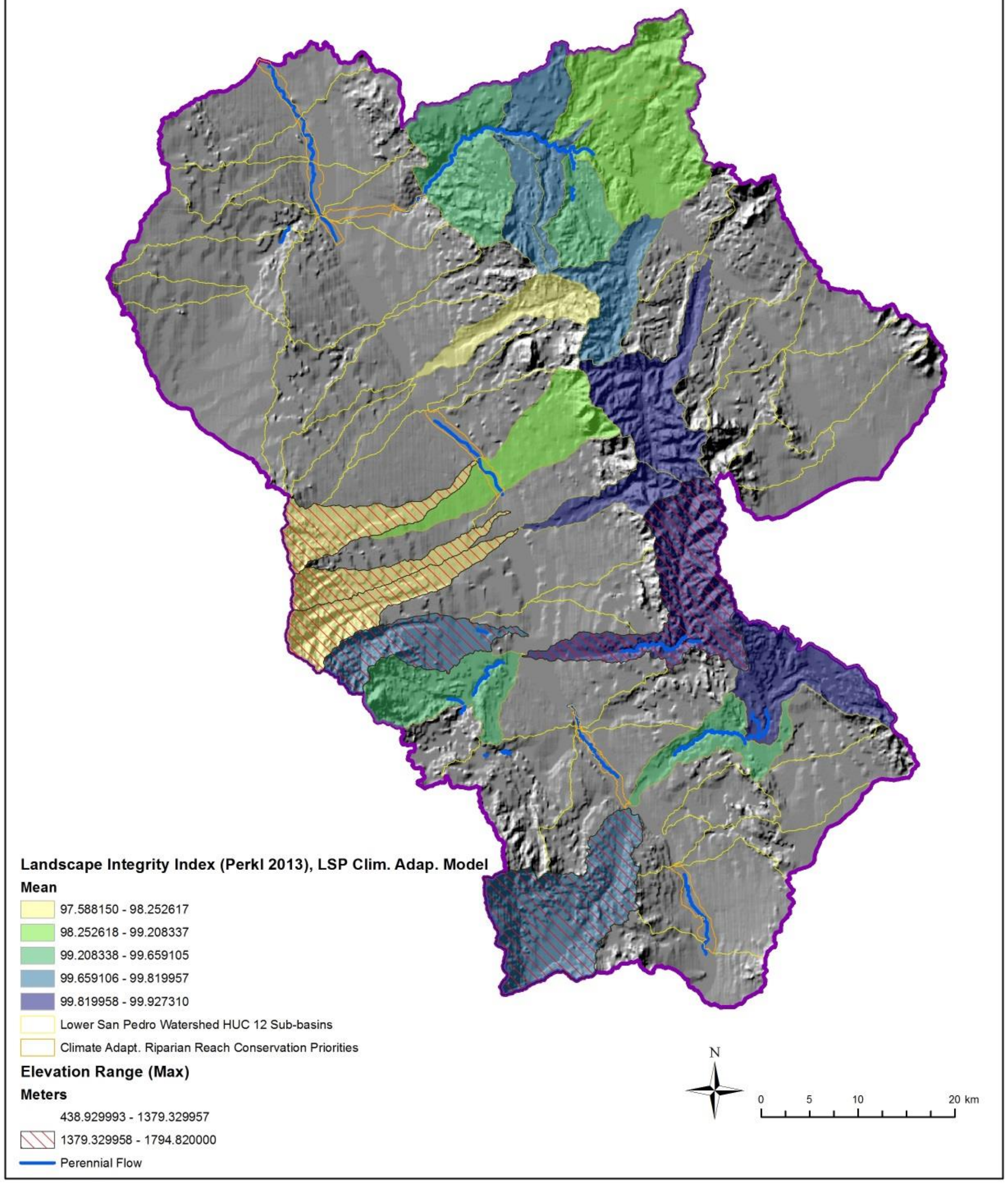
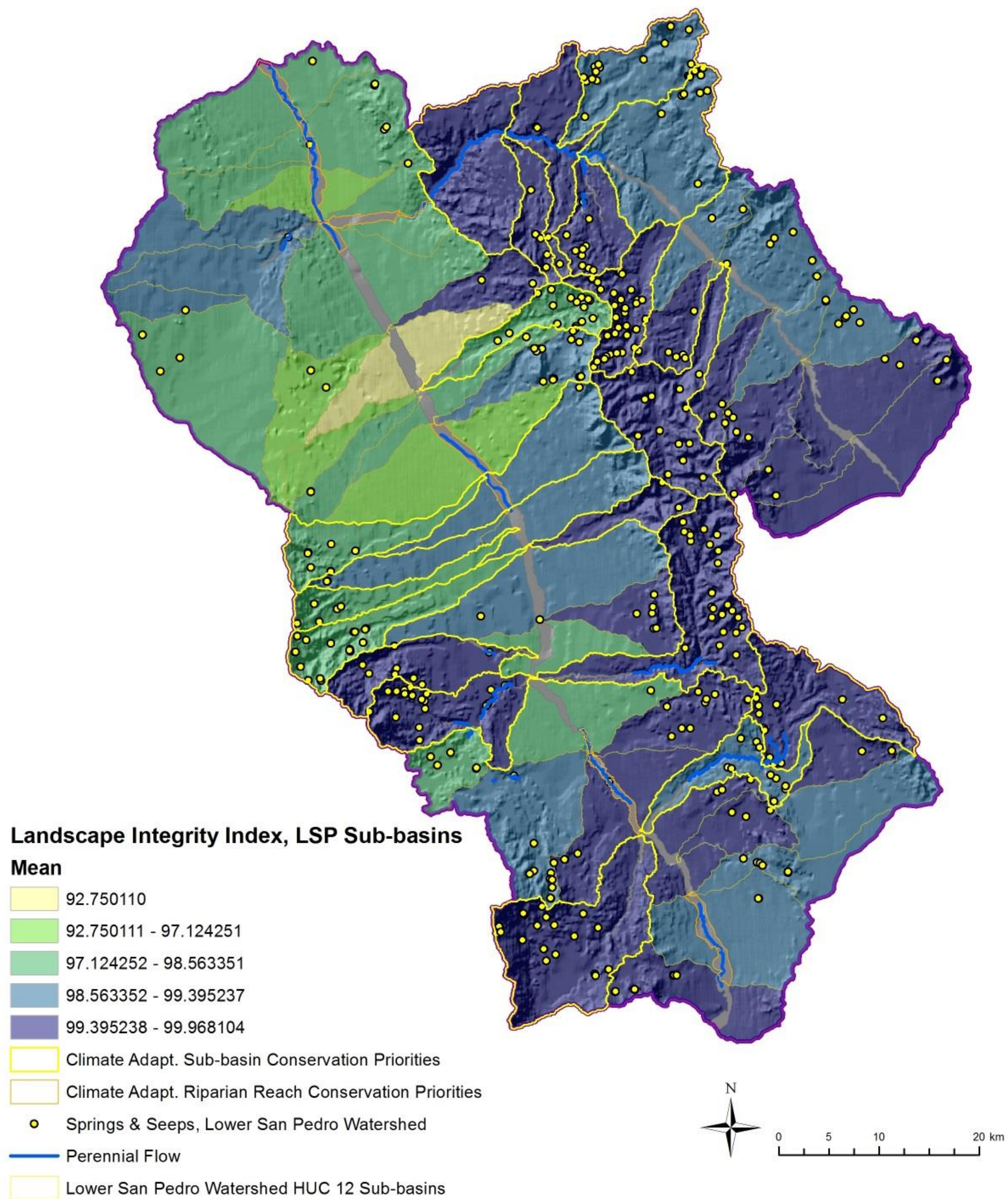


Climate Adaptation Model with Landscape Integrity, Lower San Pedro Watershed



Watershed Landscape Integrity with Climate Adapt. Model, Lower San Pedro Watershed



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These are the conservation focus areas as related to watershed sub-basins with high value to wildlife adaptation potential under changing climate conditions

How might this help the Trust?

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- Outreach (hosting landowner workshops in the region, introducing conservation easements, water lease agreements)
- Property analysis at the landscape-level when landowner inquiries “come in through the door” to the Trust
- Conservation planning and for grant funding applications addressing strategic climate adaptation conservation projects

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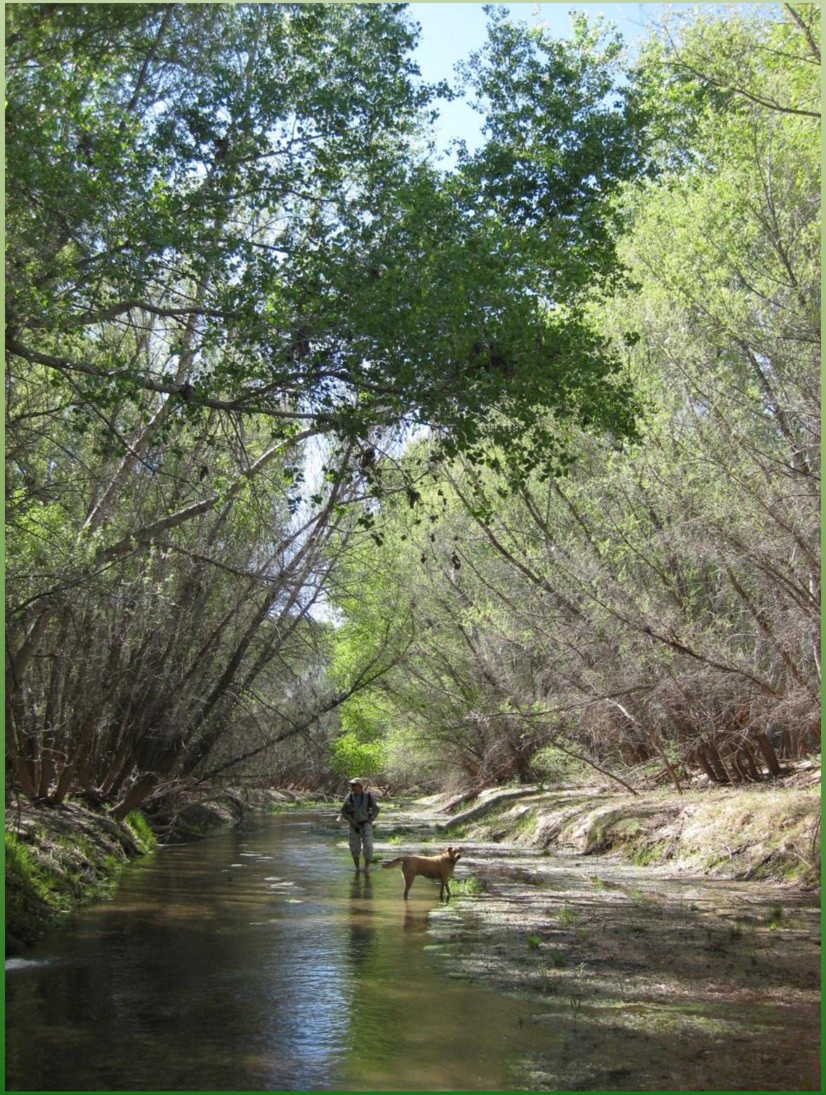
Any questions?

Thank you!



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Developed a Climate Adaptation Rule Set for analysis of Sub-basin Watersheds for Conservation:

1) Perform statistical analysis, select the top two tiers (from Natural Breaks Jenks) of (low) heat load index (HLI) and (high) topographic roughness index (TRI) from all sub-basins;
2) Keep those sub-basins that have the highest (top 2 tiers) of spring abundance (SA) or the highest tier for topographic elevation range (ER);

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Rule Set:

3) Additionally, keep those sub-basins selected that have perennial water within their boundaries or who connect with perennial water;
4) Additionally, keep those sub-basins that provide cross-landscape connectivity, i.e., either across the valley or along the spine of a mountain range. Design for paired sub-basins meeting the HLI and TRI requirements that provide for this connectivity;

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Rule Set:

5) Add (any) sub-basins with water that facilitate cross-valley connections to previously selected sub-basins (HLI+TRI+SA or HLI+TRI+ER);
6) Finally, add valley bottom perennial reaches.