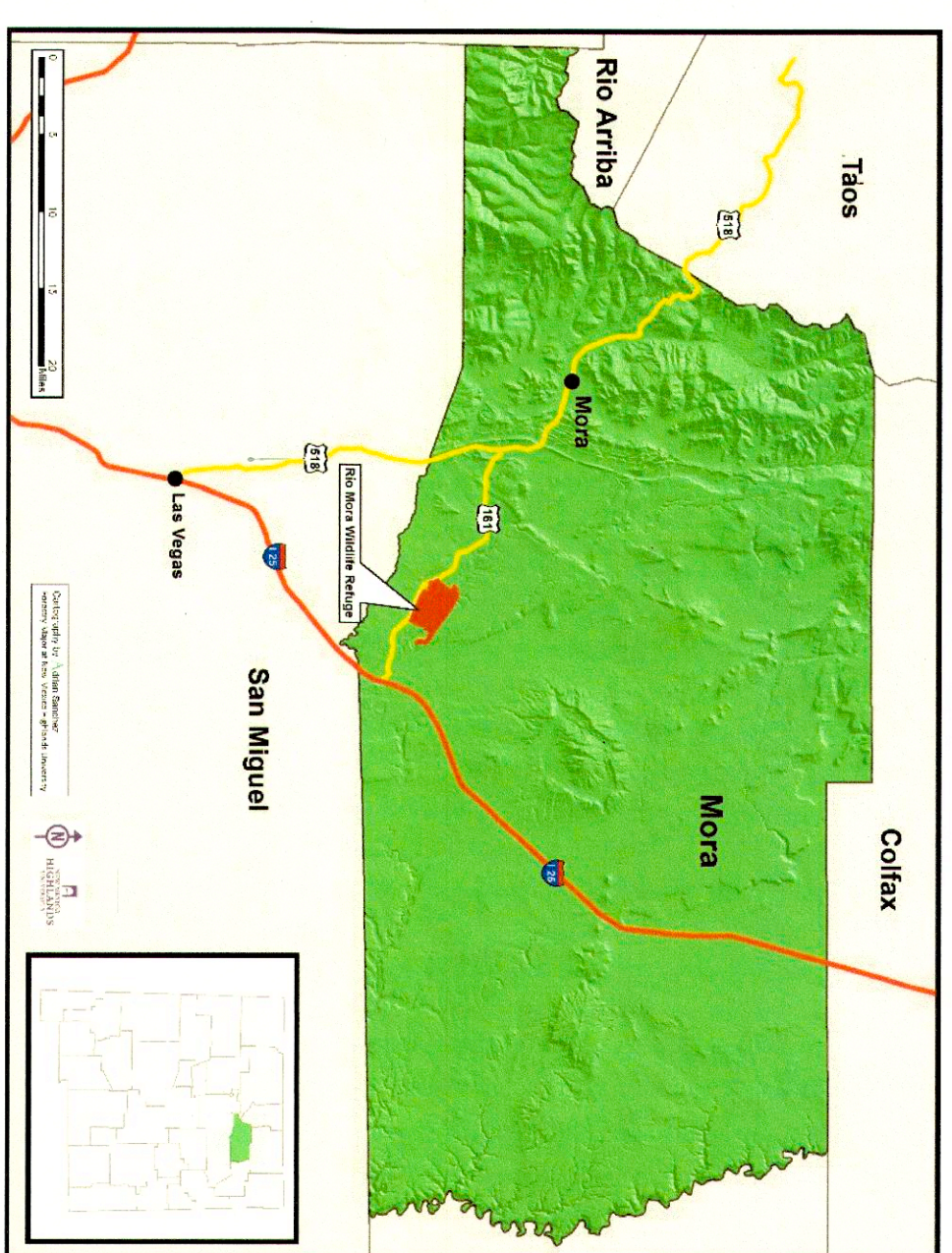


A MULTI-SCALE VISUALIZATION AND EXPLORATION OF THE MORA WATERSHED, NEW MEXICO

Joe Zebrowski, Patti Dappen, and Adrian Sanchez, New Mexico Highlands University

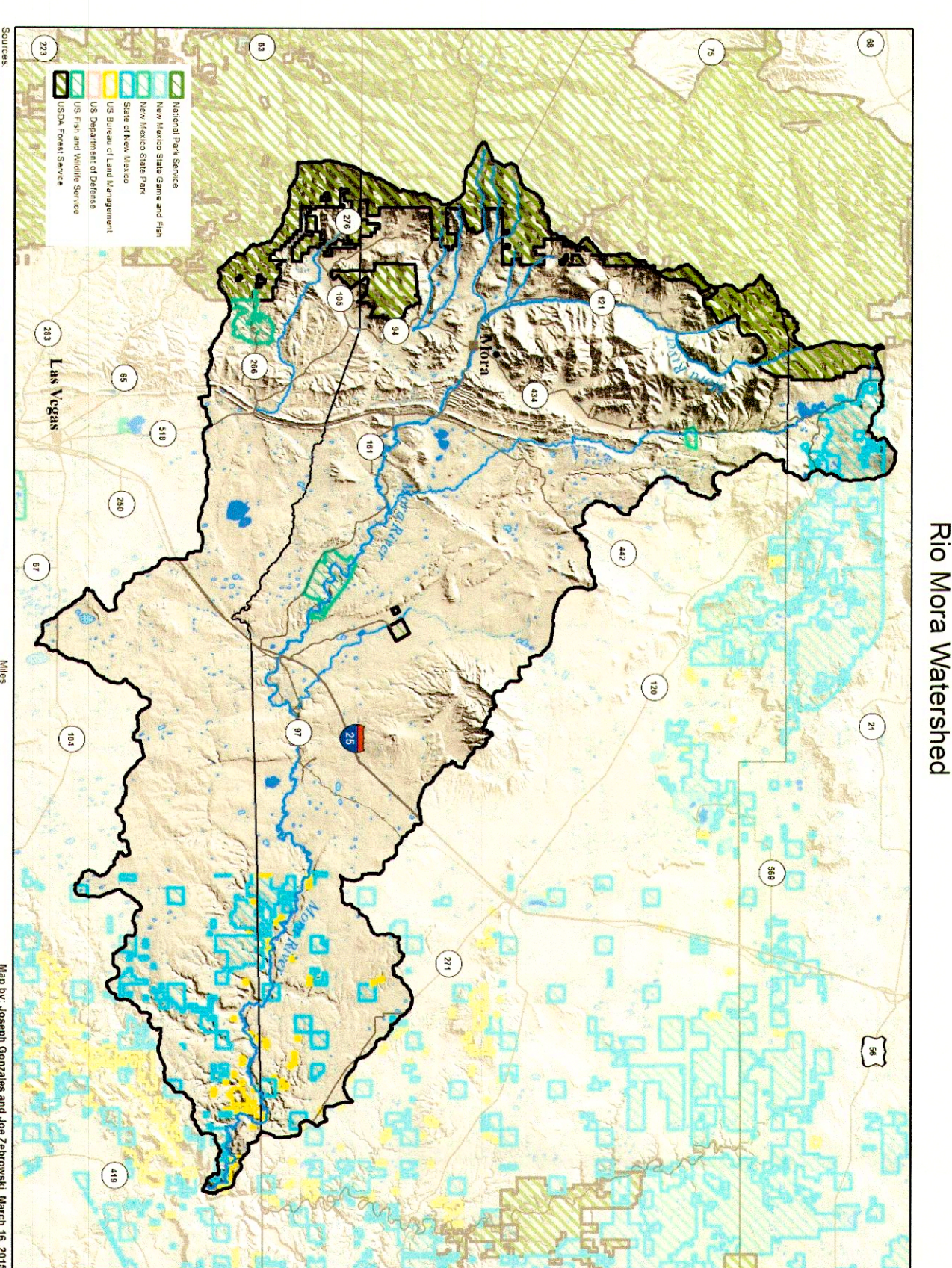


Beginning in the spring of 2015, a team of New Mexico Highlands University (NMHU) faculty and students began developing a series of curriculum modules to teach various practices for delineating watersheds, collecting field data, and exploring watershed features using desktop and online geographic information systems. This work was funded as part of New Mexico EPSCoR's Western Consortium, Watershed Analysis, Visualization, and Exploration (WC-WAVE). Undergraduate Visualization and Modeling Network (UVMN). In the first phase of the project, curriculum for delineating watersheds from 30-meter, 10-meter, and lidar-derived 0.3-meter resolution digital elevation models was developed. The Environmental Protection Agency's BASINS software is used. A users' guide for field data collection with Avenza's PDF Maps applications was also developed. A suite of camera equipment and accessories was obtained to help enhance field data collection using "gigapan" photography. In the continuation phase of the project, NMHU is developing an Introduction to Geographic Information Systems module. This module is being supported with exercises in using ESRI's ArcGIS Online platform to explore and create web maps, create Story Maps, and collect field data using ESRI's Collector for ArcGIS app. A unique aspect of this project was the establishment of a "co-learning" environment among students and faculty. Students were assigned to develop specific modules and were then expected to teach their faculty mentors what they had learned. Modules from the first phase of the project are already being used in various NMHU courses. Modules from the continuation phase are being piloted at NMHU this spring and will be incorporated in a course being conducted this summer at nearby Rio Mora National Wildlife Refuge by the Community College of Denver. The Denver Zoo at Rio Mora National Wildlife Refuge is also adopting the curriculum for use in various courses and workshops they will offer. All curriculum will be made available on the New Mexico Forest and Watershed Health Clearinghouse, alabouwaterheds.org.



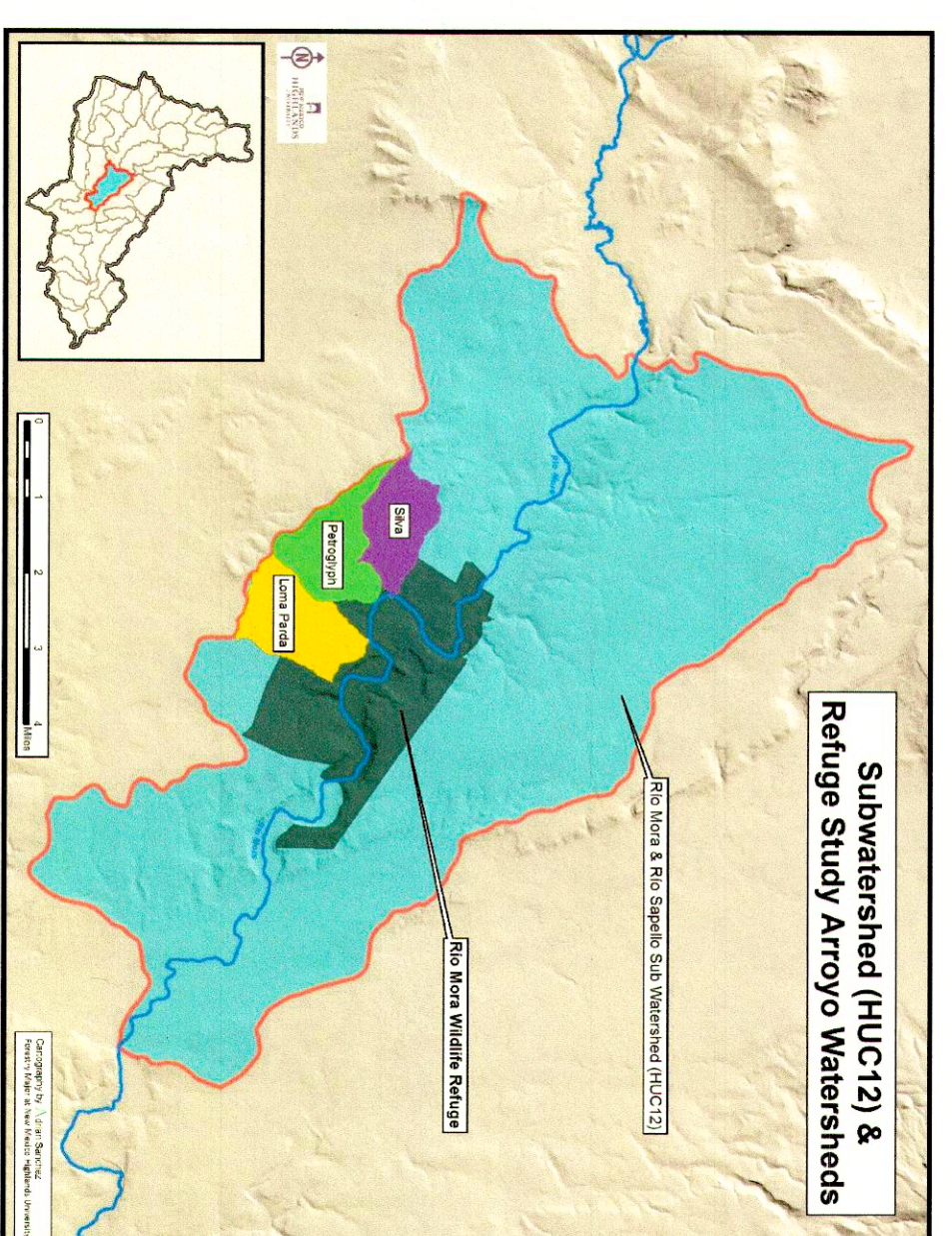
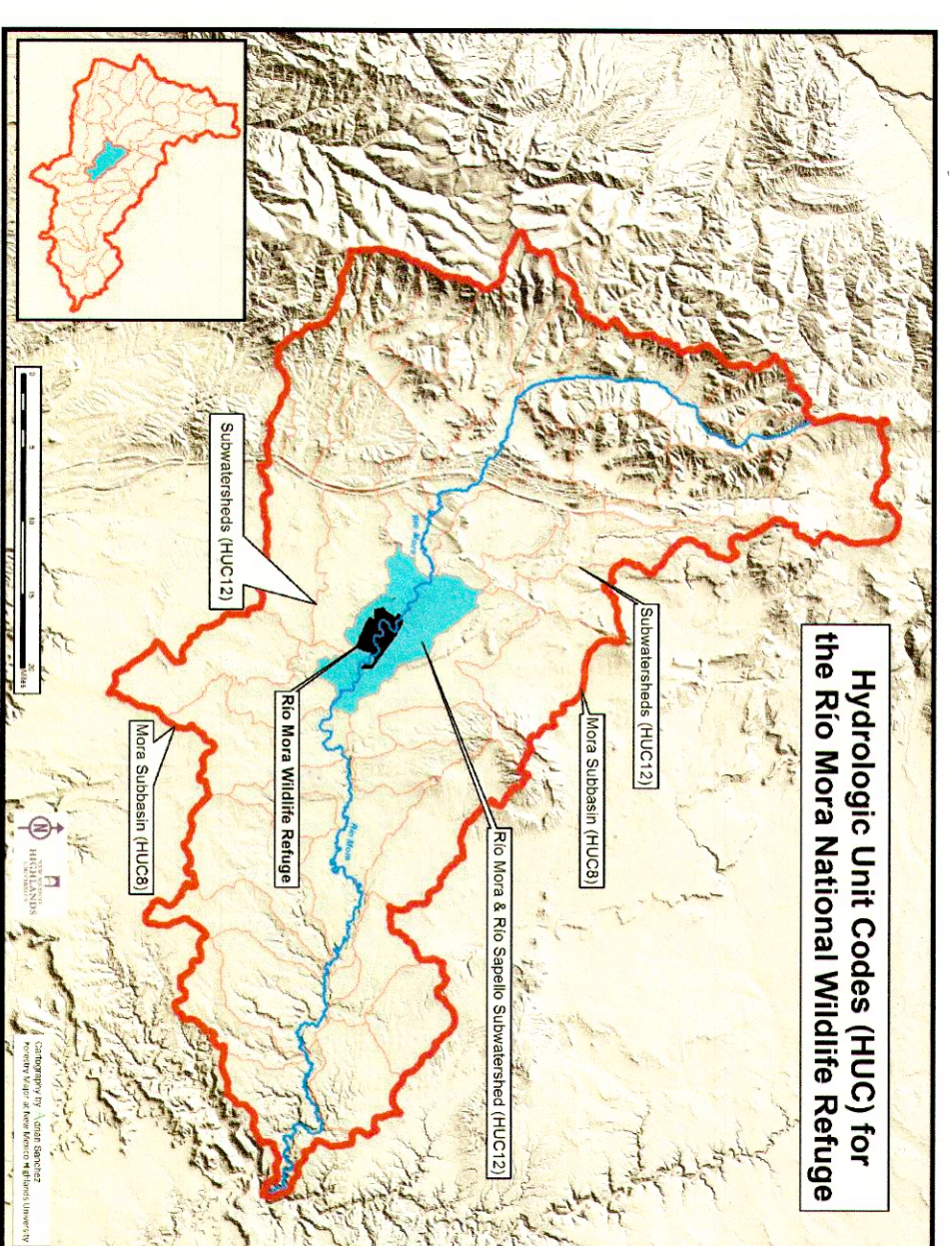
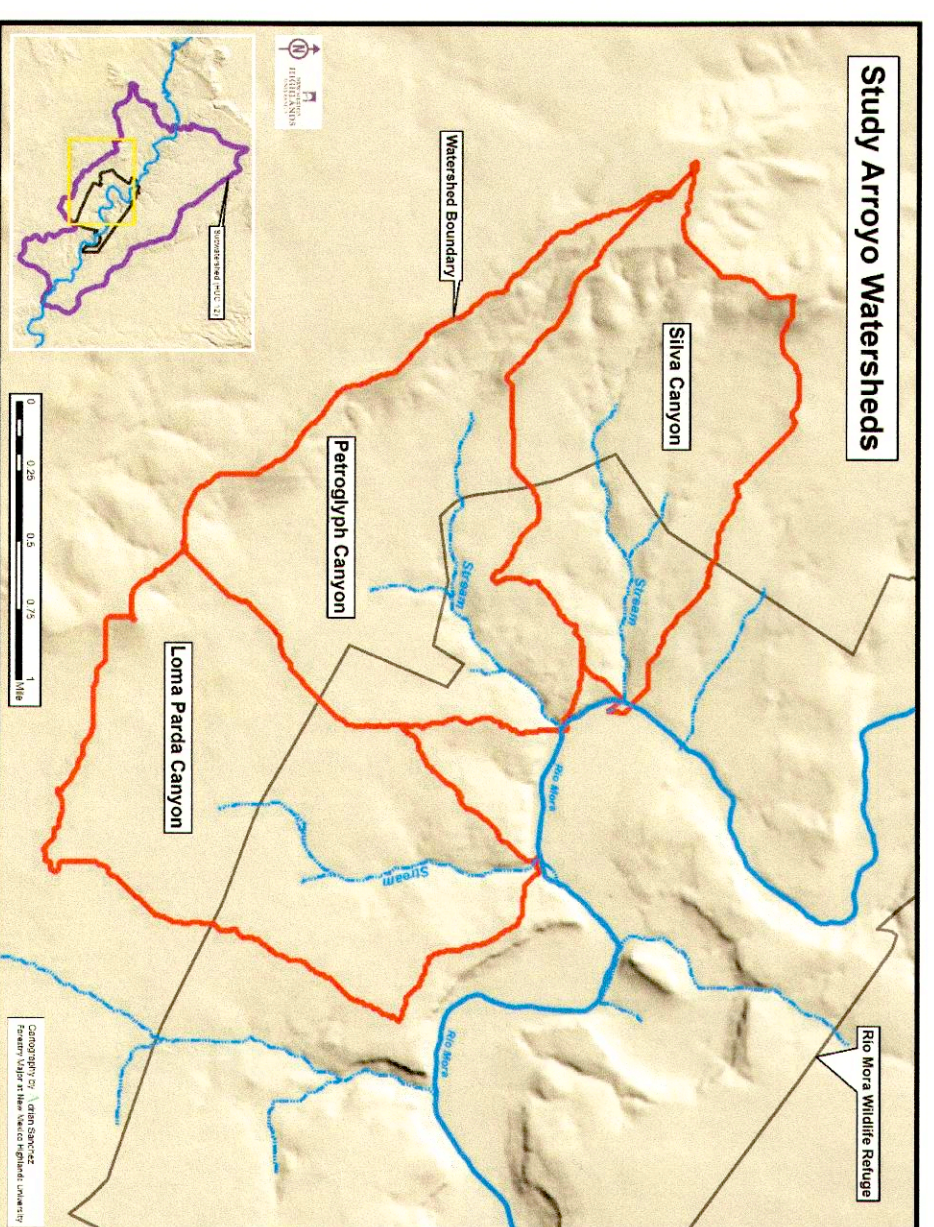
Setting

At over 1,000,000 acres, the Rio Mora watershed encompasses a diverse mosaic of land cover, plant and animal habitats, geologic provinces, and human communities. Land management is governed by a complex array of private and public entities ranging from very small private farms and residential properties to extensive private ranches and state and federal land holdings. Families going back many generations to the early 19th century have strong ties to the land and are fierce advocates for its proper stewardship.

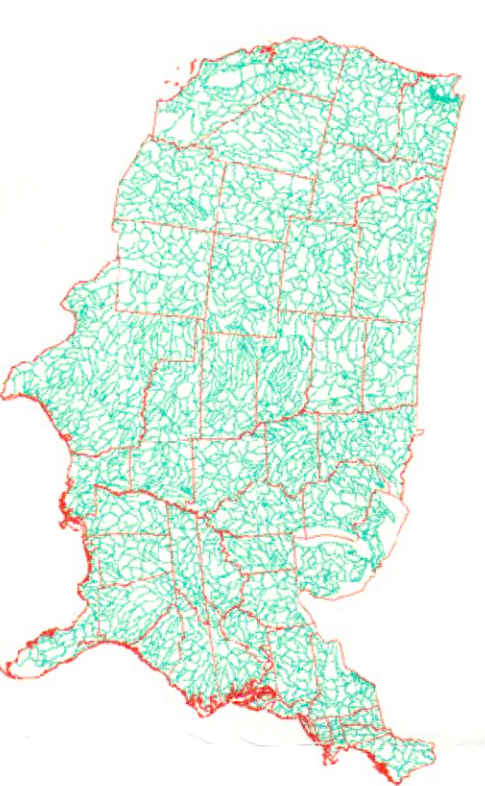


Project Areas

Visualizations of at three scales were developed: 1) the entire Rio Mora watershed (HUC 8), 2) the Rio Mora and Sapello sub-watershed HUC 12 watersheds in the center of the Rio Mora watershed, and 3) a set of arroyos located on the Rio Mora National Wildlife Refuge in the Rio Mora and Sapello sub-watershed. These three scales are reflective of the landscape at which varying levels of management occur. Restoration of highly eroded watersheds is a major activity in the Rio Mora watershed. Techniques involve the strategic placement of large rocks and riparian vegetation along river banks to help slow the flow of water, along adjacent lands to saturate and the water table to rise. Similar techniques using one rock dams and other small structures are used in side drainages to improve the hydrologic and ecologic function of these area.

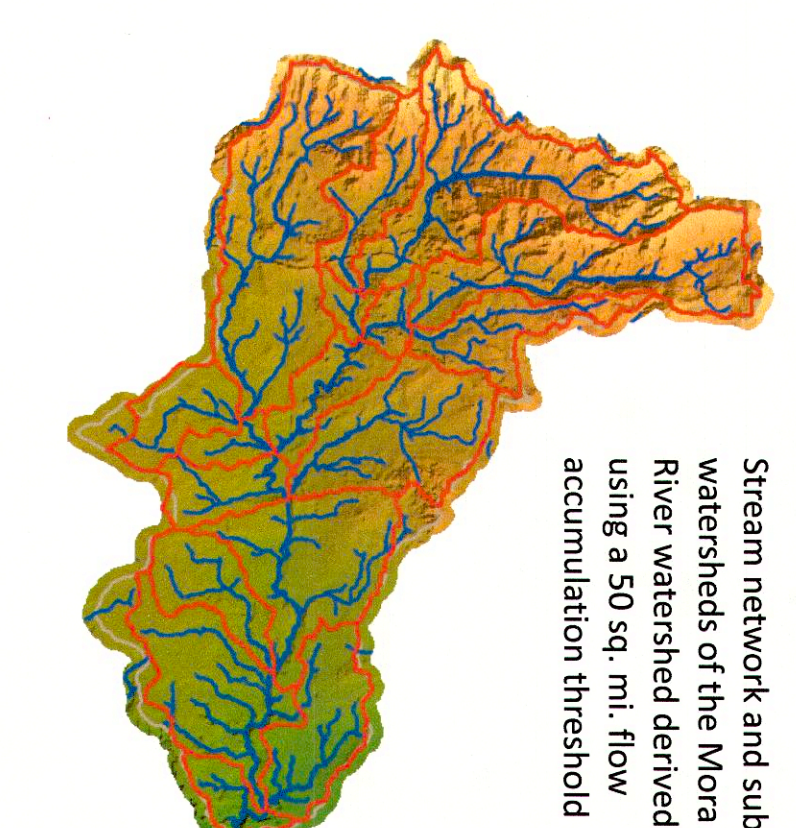
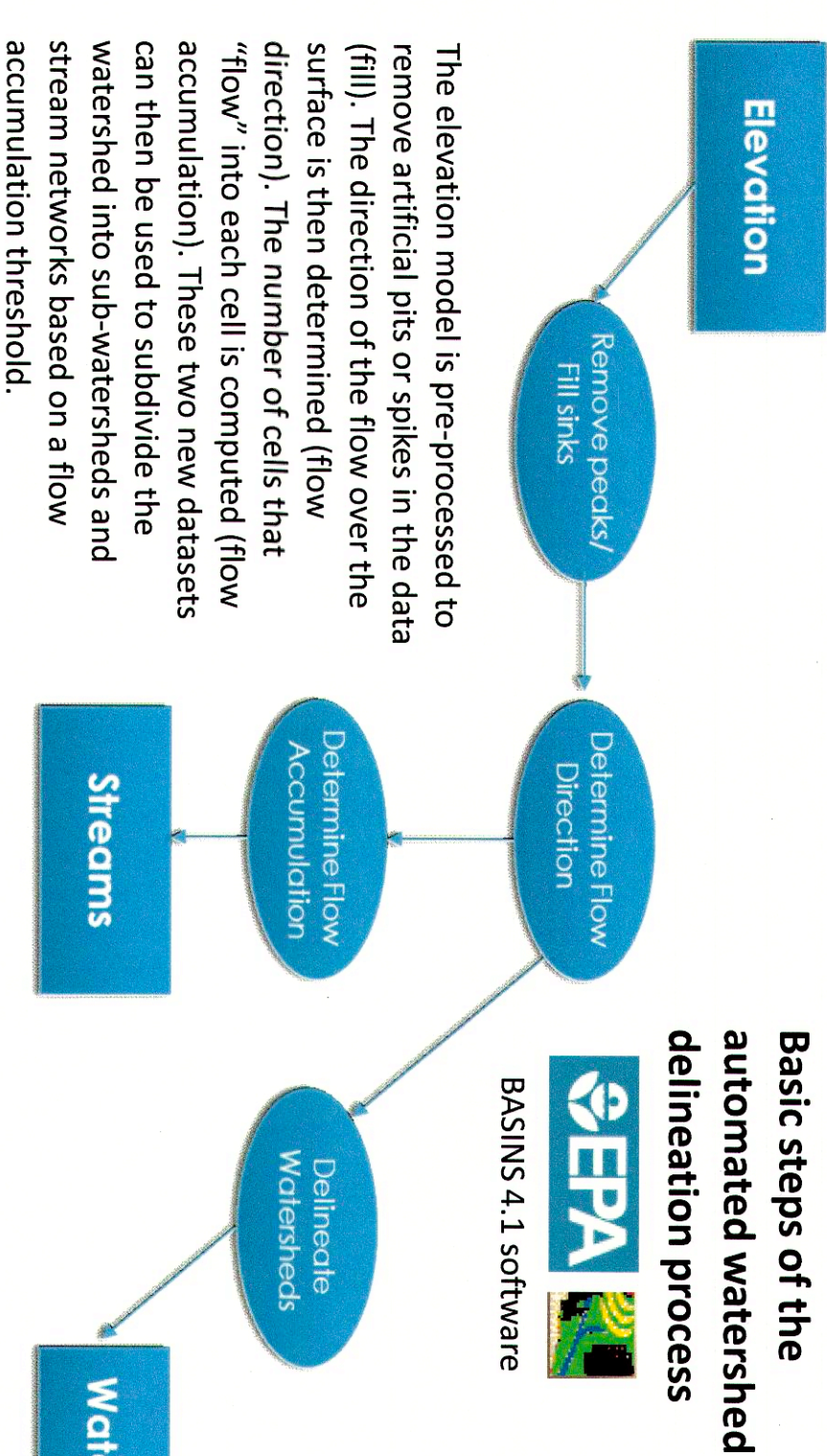


The United States is divided and subdivided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, -regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system. <http://water.usgs.gov/GIS/HUC.html>

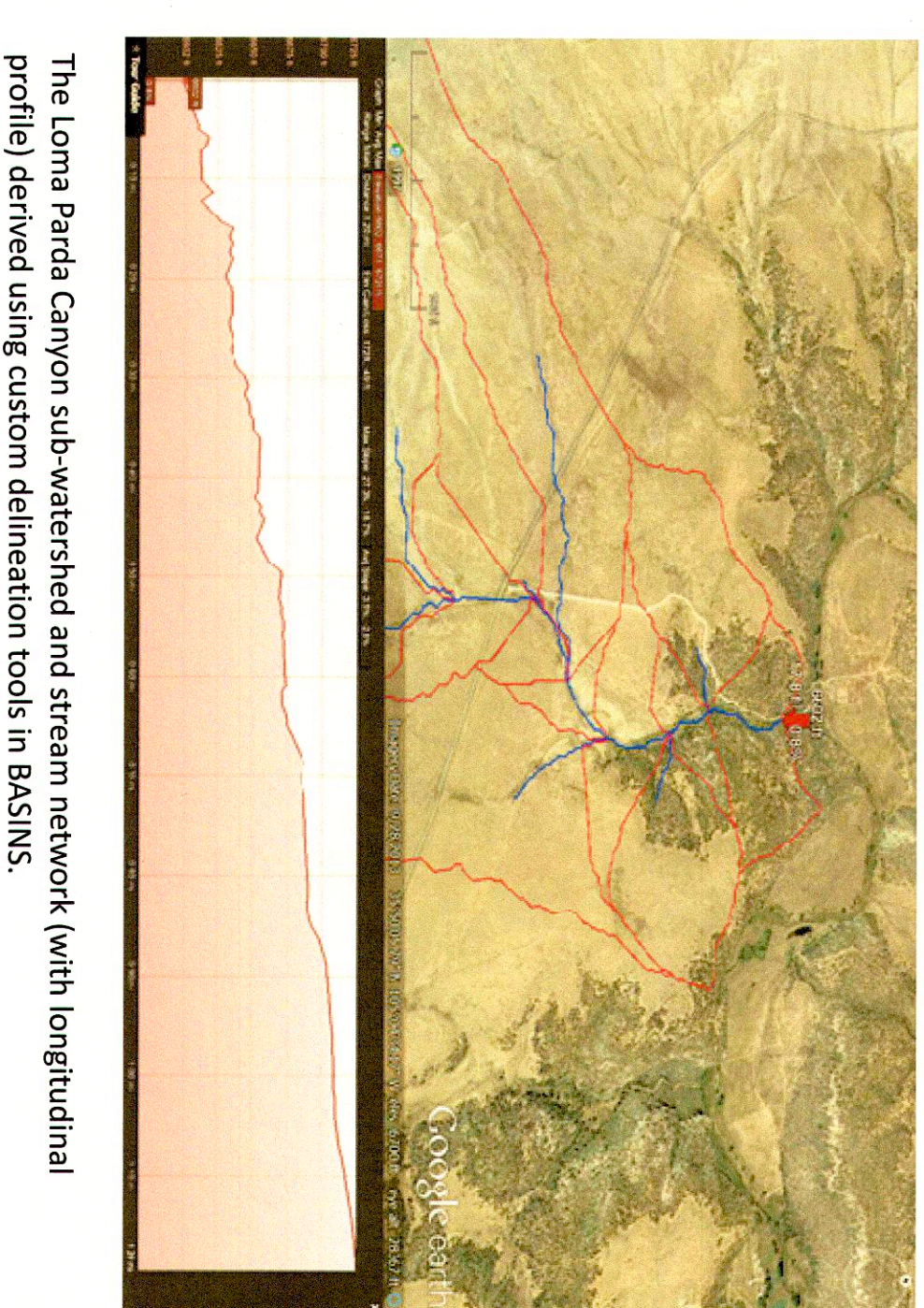


8 digit HUCs (Cataloging Units) of the continental United States

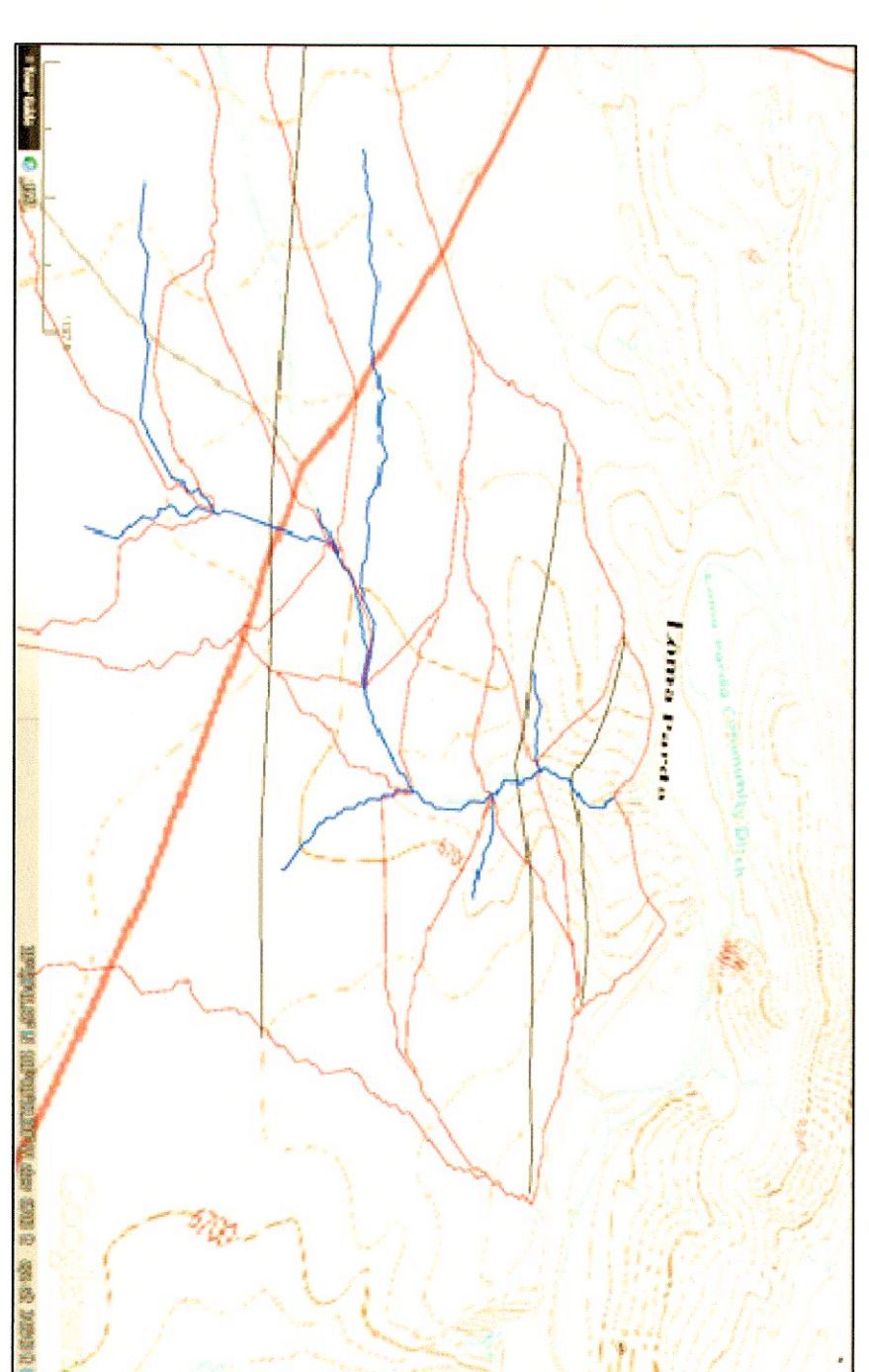
Lessons and lab exercises were developed that illustrate techniques for delineating watersheds and drainages using topographic maps and digital elevation models. These exercises include techniques for visualizing and summarizing properties of watersheds such as longitudinal profiles, cross sections, and land cover. Additional exercises covering the basics of geographic information systems and the use of online and webapps are being developed.



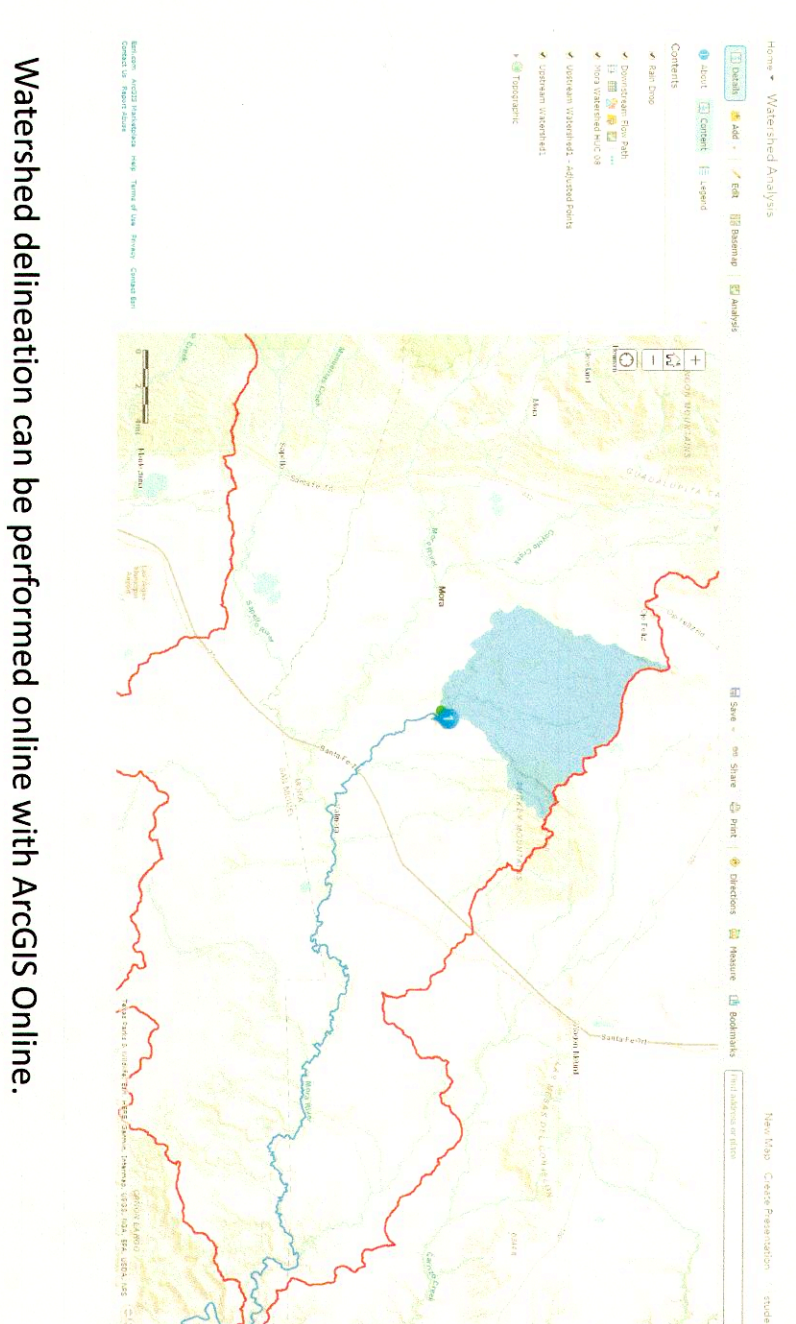
Stream network and sub-watersheds of the Mora River watershed derived using a 50 sq. mi. flow accumulation threshold



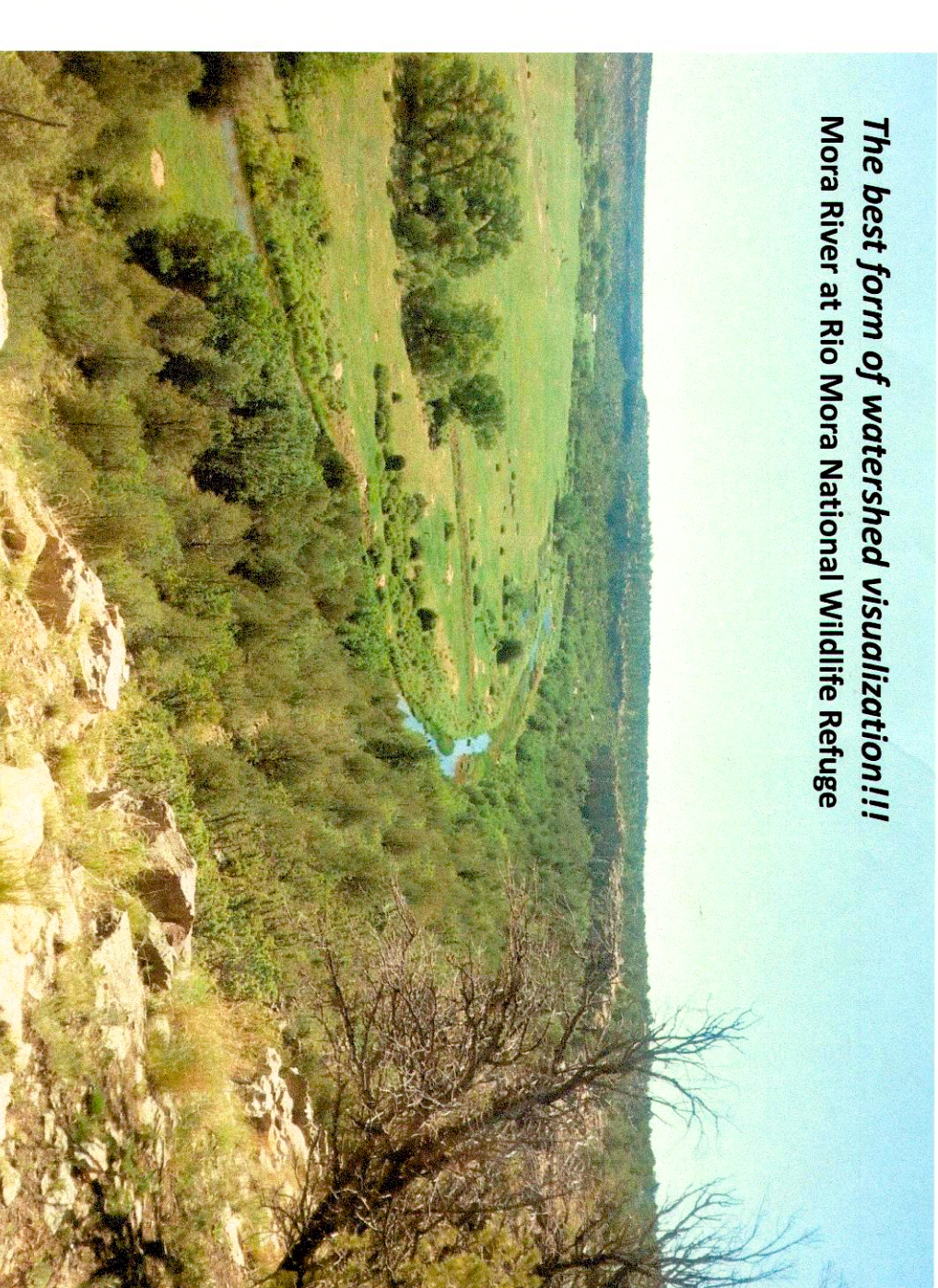
The Loma Parada Canyon sub-watershed and stream network (with longitudinal profile) derived using custom delineation tools in BASINS.



USGS US Topo map draped over terrain in Google Earth



Watershed delineation can be performed online with ArcGIS Online.



The best form of watershed visualization!! Mora River at Rio Mora National Wildlife Refuge



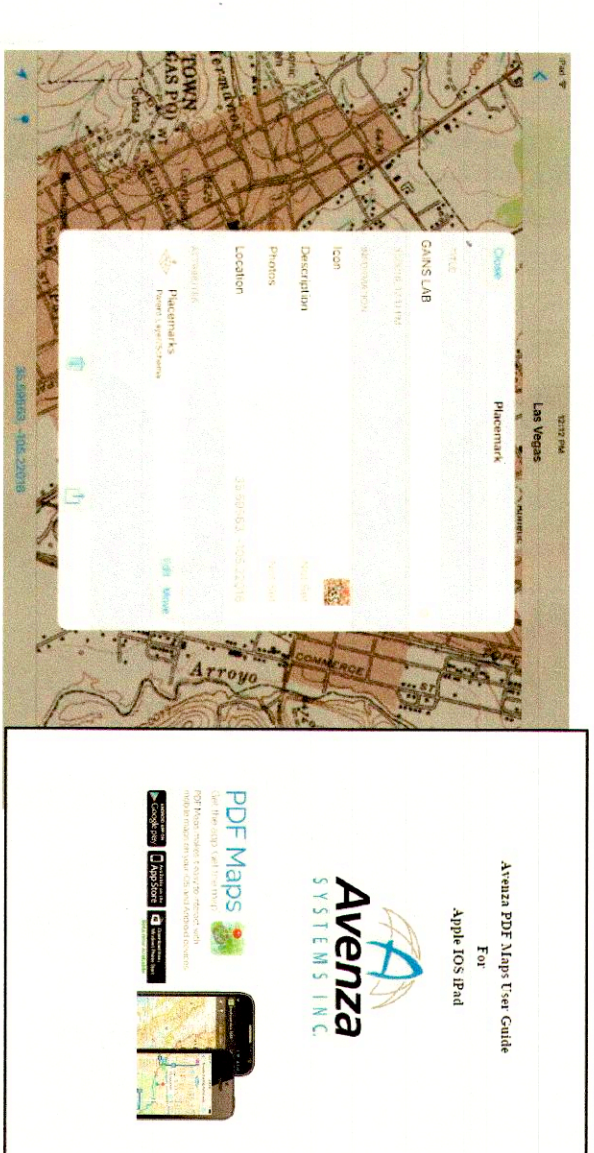
Gigapan Photography

Gigapan panoramic photography equipment was purchased using UVMN funds and UVMN team members began training on its use. NMHU researchers have expressed great interest in this form of photography as an aid to document conditions at field monitoring sites.

Thanks to Dr. Donna Depierre, Idaho State University and the NM EPSCoR team for assistance in procuring and learning how to use this equipment.

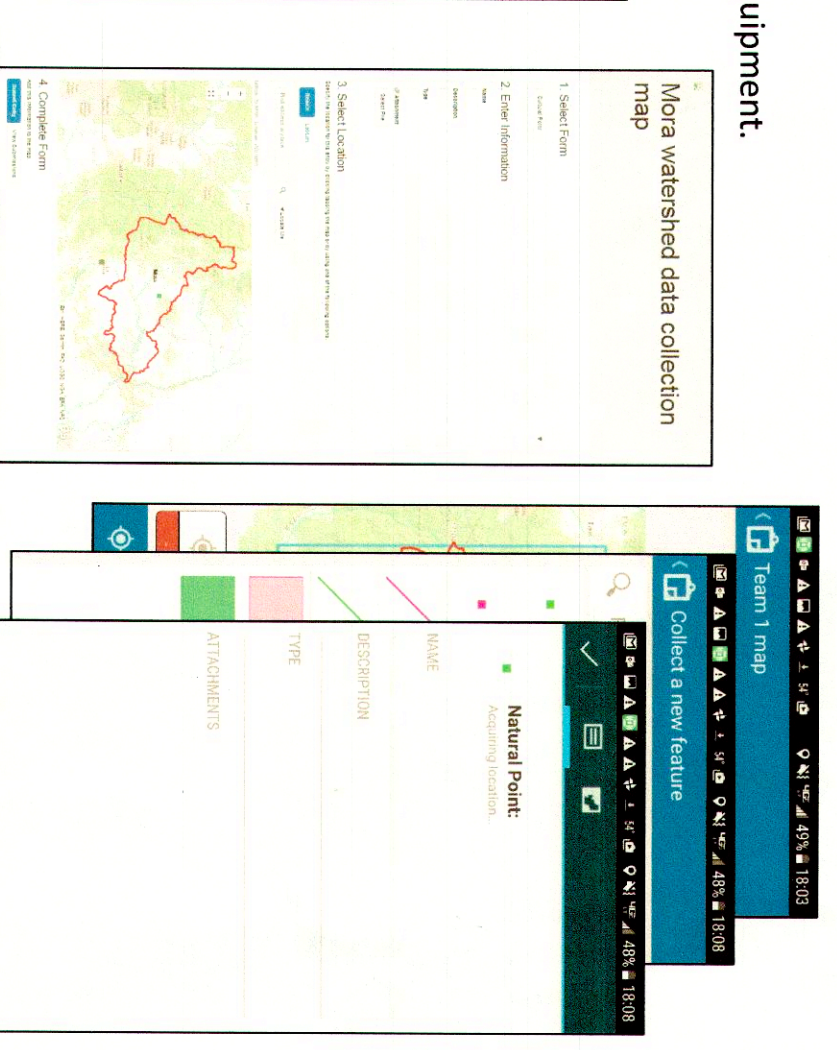


Watershed Delineation lab presentation to NMHU students (hydrology students and faculty)



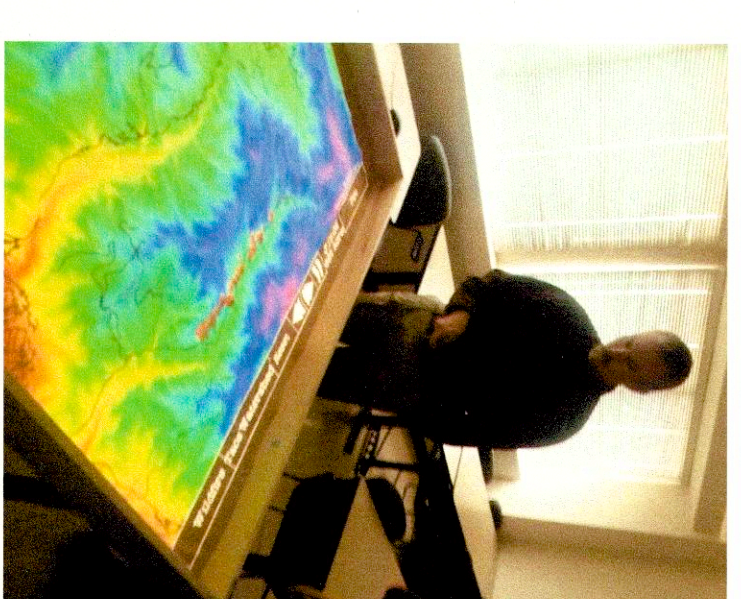
Avenza PDF Maps Users Guide

Mapping apps for mobile devices are increasingly used for field data collection. There are many free or low-cost apps available, including Avenza. There are many free or low-cost apps available, including Avenza. There are many free or low-cost apps available, including Avenza.



ESRI ArcGIS Online Apps

ESRI web mapping apps are a part of the ArcGIS "platform". They include a variety of crowd-sourcing and field data collection utilities. In this manner, the ArcGIS Online apps can be used for data collection in the field. They can be used on a smartphone or tablet.



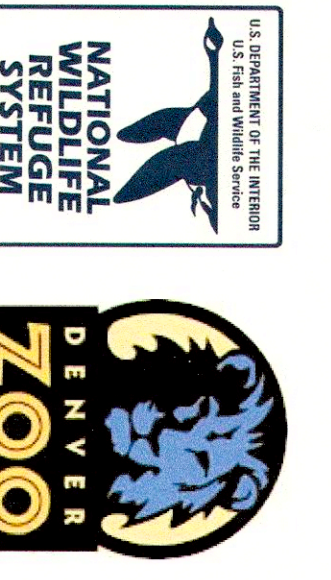
Simtable™ visualization demonstration. NMHU is working with the vendor to include stream network and watershed boundary overlays for visualization of fire and hydrologic process.

Key Successes

- Developed lessons and Avenza PDF Maps user guide.
- Incorporated lessons and exercises into courses.
- Developing Gigapan photo collection field guide.
- Web mapping and Watershed delineation and characterization techniques are being incorporated into an increasing number of undergraduate and graduate research projects.

Implementation

- Course lessons/labs for various NRM courses
- Watershed Delineation and Terrain Profiling with Topographic Maps - 100% complete
- Automated Watershed Delineation - 100% complete
- GIS Data Download, Preparation, and Summarization - 100% complete
- Watershed Visualization in Google Earth - 100% complete
- Introduction to GIS Lesson - 100% Complete
- Exploring the Mora Watershed with Arc GIS Online Exercise - 95% Complete
- ArcGIS Online Story Map Exercise - 60% Complete
- ArcGIS Online Webapp Exercises - 45% Complete



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