

APPENDIX I

Digital procedures for locating springs on Cibola National Forest Land

In the springtime of 2012 this procedure was developed by Rebecca Frus and Chad Bryant, University of New Mexico. Several ARCGIS layers were collected from federal resources to identify all official springs (named or unnamed) within the Cibola National Forest, Mountain Districts. In general there were many duplicates between the different ARCGIS resources. The assumptions to eliminate duplicates and have the most correct names and locations would be prioritized as follows; 1) The most recent date of visit 2) lowest elevation and if these were not available then 3) ARCGIS material from the NSFS would be used due because they are the land managers for the areas being researched.

Below is a description of the ARCGIS layers that were used and the process that was taken to determine spring locations within Cibola National Forest

1. Cibola USFS land boundaries determined using GIS layer
 - i. Surface_Ownership_Cibola GIS layer from Cibola Forest Hydrologist, Livia Crowley
2. Three digital resources used to locate springs within Cibola land boundaries
 - a. An initial total of 707 springs were found
 1. USFS_Cibola_Spring layer (total of 136 spring)
 - a. Only used Spring Well Development
 - b. Deleted unnamed and "spring" only named
 - c. Reduce CF_ID duplicates to one point, using the latest dates (Rev_date) for the coordinate
 - i. Considered <null> in Rev-date as no date
 2. GNIS_Cibola_Spring layer (total of 375 springs)
 - a. Only Spring Features
 3. NHD_Cibola_Spring layer (total of 196 springs)
 - a. Only used Named Features
 - i. Deleted <null> data
3. Identify and delete duplicates within the three digital resources
 - a. Start with most recent data set (USFS Cibola Springs layer)
 - i. Create a 200 meter buffer radius around USFS Cibola Springs
 1. Any USFS, NHD or GNIS springs within the 200 meter buffer zone are considered duplicates
 - a. Duplicates are deleted
 - i. The data layer with the most recent data is accepted as the current spring location
 - ii. If no date is reported, the lowest elevation is saved as the current spring location from the Digital Elevation Model (DEM)
 - b. Continue this same procedure with all other datasets one at a time
 - i. Create a 200 meter buffer radius around remaining NHD Springs

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1. Any USFS, NHD or GNIS springs within the 200 meter buffer zone are considered duplicates and deleted using already described protocol
 - ii. Create a 200 meter buffer radius around remaining GNIS Springs
 1. Any USFS, NHD or GNIS springs within the 200 meter buffer zone are considered duplicates and deleted using already described protocol
4. After duplications were deleted there was a total of 308 springs within the Cibola National Forest land boundaries
 - a. USFS Springs Layer (total of 101 springs)
 - b. GNIS Springs Layer (total 99)
 - c. NHD Cibola Layer (total 108)

Comparing quadrangle topographic map spring locations and Digital spring location protocol

During the spring/summer 2012 the digital protocol was being developed at the same time field work was being completed. There were several sites in the Sandia and Zuni Mountains that were visited during this field work. Site coordinates were based on measurements taken from topographic quadrangle maps. Comparison of topographic map locations and digital locations was undertaken to identify if there were duplicates.

1. Cross comparing of previously visited spring sites
 - d. Some sites from the topographic maps were cross referenced to digital protocol
 - i. Any duplicates were deleted and springs were considered visited
 - ii. Any sites that were not in the digital protocol were included in the total spring sites tables and the source was listed as TOPO.