Daniel Zavala Araiza [dz2675] GIS in Water Resources

STATUS REPORT: Colorado River Water Resources Vulnerability: Project for Hill Country Conservancy:

Objective

Development of a tool based on geographical information that is useful in determining which water resources are more vulnerable to development. In other words, which parts or parcels of land are more valuable in terms water management in order for conservancy efforts to focus on maintaining and preserving them. The area of interest for the project is the Colorado River Watershed within the Hill Country.

Background information: Water Resources Vulnerability

Based on geological and hydrological data, it is possible to classify different areas in order to determine both, ground and surface water vulnerability in terms of development and pollution. Hill Country Conservancy is interested in a tool that helps in the decision making of which areas of the watershed they should address and protect from unsustainable development. The vulnerability analysis helps determine which areas have more potential to being contaminated.

A water resource system can be evaluated in terms of reliability, resiliency and vulnerability (Hashimoto, et al, 1982). Reliability is a measurement of the possibility of the system to fail. Resiliency related to the ability of the system to recover from failure, while vulnerability refers to the consequences and effects that a failure would cause on the system. Speaking in a broader sense, these failures could include many types of impacts and stresses that are commonly part of water resources systems. In terms of land conservation and sustainability it is of great importance to develop an index that measures the magnitude of these effects.

In the case of ground water, one of the most used vulnerability mapping tools is the DRASTIC method (Aller, et al, 1985). In many cases, DRASTIC is not the best approach, with mixed results in many parts of United States. Another calibrated probability map was suggested by USGS (USGS, 1999), taking into account land use, soil drainage, and depth to water. Many other approaches have been followed in the creation of vulnerability maps, and they were taken into account in this particular analysis.

Methodology and Progress:

Determination of vulnerability divides into two main parts: ground water vulnerability and surface water vulnerability. Some of the parameters considered are shared in both calculations, and it is also important to analyze the coupled effect of both measurements in one same area, as a final result that derives in the decision making tool for Hill Ground Water Vulnerability the parameters taken into account are: Land use and land change information, or vegetation, soil drainage, cave density, soil thickness and slope. In the case of Surface Water vulnerability, the parameters taken into account are soil thickness, soil KSAT, slope, and vegetation. For each parameter a specific rating or points system was used in order to rank the level of vulnerability. Therefore, a value between 0 and 100 is assigned, where 0 is the least vulnerable and 100 is the most vulnerable. After all the parameters are evaluated a weighted sum is applied to determine the final vulnerability score. A first approach was to assign an equal weight to all the parameters involved, further analysis could try to assign different weights based on the theoretical importance of each of the parameters.

The reclassify tool from the spatial analyst from ArcGIS was really useful in translating the original information contained in the original dataset, to the ranking systems used for the vulnerability estimation. A good example of this process is what happens with the Land use land change data. This dataset was obtained from the USDA

Geospatial Data Gateway, and it comes in the form of a raster data set where the raster values represent different types of land (i.e. water, developed, vegetated). Based on a classification proposed by Hill Country Alliance, the original raster was reclassified in terms of vulnerability. For example, cells representing open water would be reclassified with a 100, being really vulnerable, and pastures would be reclassified with a zero, as being the least vulnerable. Figure 1 shows the reclassification from the original raster to the resulting parameter used for vulnerability calculation for the whole state of Texas.

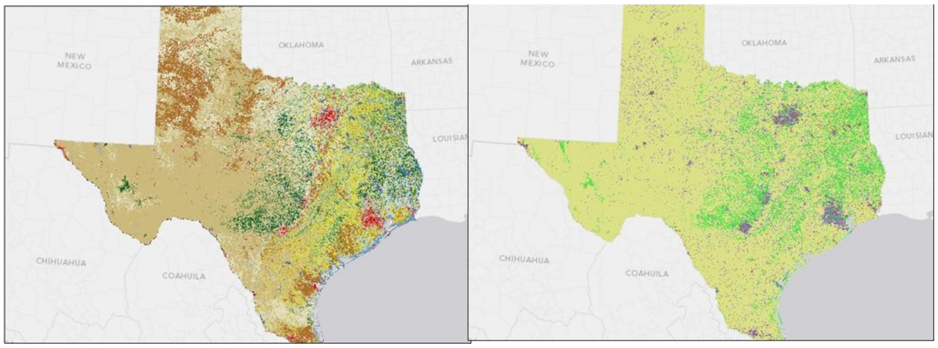

Figure 1 – Original Land Use raster dataset from Texas, and its reclassification to obtain the vegetation vulnerability parameter.

Further work:

Almost all datasets that are need for the analysis have been obtained, with the exception of soil drainage and cave density, which will be based in field measurements and will be provided by Hill Country Conservancy. Both, ground water and surface water vulnerability will be estimated by the equal weights method and subsequently different type of weighted methods will be applied to contrast possible outcomes. As a complimentary part of the project, if there is enough borehole data, using the capabilities of ArcHydro ground water, it would be interesting to develop 2D cross sections of the interested watershed to support the vulnerability analysis.

References:

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