Executive Summary

The objective of this study was to develop a watershed based plan for the Upper Gila Watershed that includes a characterization and classification of the watershed features. This watershed based plan identifies areas that are susceptible to water quality problems and nonpoint pollution sources that need to be controlled, and management measures that should be implemented to improve water quality throughout the watershed.

The first part of the project focused on watershed characterization identifying physical, biological and social characteristics of the Upper Gila Watershed from publicly available information. ArcGIS (Environmental Systems Research Institute, Inc.) software was used to construct a spatial database including topography, land cover, soil types and characteristics, geology, vegetation, hydrologic features, and population characteristics.

After developing the geographic information system (GIS) spatial database, watershed classifications were performed to identify important resources and rank 10-digit HUC (hydrologic unit code) subwatershed areas based on likelihood of nonpoint source pollutant contribution to stream water quality degradation. A HUC is a means of subdividing watersheds into successively smaller hydrologic units of surface water drainage features.

To achieve the objective of developing a watershed classification, a fuzzy logic knowledge-based methodology was applied to integrate the various spatial and non-spatial data types. Fuzzy logic is an approach to handle vagueness or uncertainty, and has been characterized as a method by which to quantify common sense. This methodology has been selected as the basis by which subwatershed areas and stream reaches were prioritized for proposed implementation of Best Management Practices to assure load reductions of constituents of concern.

The water quality results reported in Arizona's Integrated 305(b) Assessment and 303(d) Listing Report (ADEQ, 2003), and EPA’s (U.S. Environmental Protection Agency) revisions of Arizona's final 2004 303d List for water quality results were reviewed and summarized for each monitored stream reach in the Upper Gila Watershed. Based on exceedances of water quality standards in each reach and the designated use classification system, each stream reach was classified as extreme, high, medium or low risk of impairment. Each subwatershed was then ranked using a scale of 0-1 based on the stream reach condition in each 10-digit HUC and downstream reach condition.

Subwatershed classification ranking data were then created based on calculated parameters for each of the water quality constituent groups and by simulating hydrologic response using the GIS data. For each constituent group several parameters were calculated in each subwatershed and a fuzzy membership value (FMV) was developed in order to assign a
ranked value (0-1) to each 10-digit HUC subwatershed. The FMV for each parameter and the ranked water quality assessment data were combined, and each subwatershed was ranked and categorized as either low or high risk for nonpoint source pollution problems.

The Revised Universal Soil Loss Equation (RUSLE) model (USDA, 1997) was used to estimate sediment yield due to land use or land use change. The Soil and Water Assessment Tool (SWAT) hydrologic model (Arnold et al., 1994) within the Automated Geospatial Watershed Assessment Tool (AGWA) (Burns et al., 2004) was also applied to simulate sediment yield and runoff for each 10-digit HUC subwatershed area.

Unique Waters of the state, mapped wilderness areas and preserves, riparian areas, and critical habitat for endangered species were used to identify important Natural Resource Areas (NRA) at the scale of 10-digit HUC subwatersheds in the Upper Gila Watershed. These were then used to recommend management actions specific to the conditions in each NRA.

Best Management Practices for each subwatershed were proposed based on the watershed assessment data and available ADEQ Total Maximum Daily Load (TMDL) reports. This section of the document includes general watershed management methods, recommended strategies for addressing existing impairment in the watershed, stream channel and riparian restoration, and proposed education programs.

As a result of this study, the primary sources for nonpoint source pollutant concerns in the Upper Gila Watershed were identified as abandoned mine sites, new development and increased urbanization, and new road construction. Apache Creek-Upper Gila River, Yuma Wash-Upper Gila River, Centerfire Creek-San Francisco River, Mule Creek-San Francisco River, Chase Creek-San Francisco River, and Stockton Wash subwatersheds are prioritized as high risk areas from nonpoint source pollutants (metals, sediment or organic constituents).

References:


Burns, I.S., S. Scott, L. Levick, M. Hernandez, D.C. Goodrich, S.N. Miller, D.J.
Assessment (AGWA) - A GIS-based Hydrologic Modeling Tool:
Documentation and User Manual Version 1.4, from
http://www.tucson.ars.ag.gov/agwa/

with the Revised Universal Soil Loss Equation (RUSLE). United States
Department of Agriculture, Agriculture Handbook No. 703. Washington D.C.