Evaluation of the effects of population growth on mountain watershed water quality

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Degradation of water quality has become a key environmental issue over the past forty years in the United States. While there has been great progress in cases where the sources of the degradation could be clearly identified (point sources), the effect of non-point sources, particularly those associated with population increases, has proven more difficult to identify and quantify. Regulation of non-point sources is based on the total maximum daily loading (TMDL) concept developed by the USEPA. This concept sets the overall limit for solutes in a surface source and divides liability among all the identified watershed stakeholders. Implementation of the concept will require that all the potential sources of the solute be identified and that all potential responsible parties be apportioned their appropriate share of the total loading.

The mountain ranges of the western US consist of numerous small watersheds that serve as the ultimate source for most surface and ground water in the western half of the continent. The processes that effect water quality can be examined in much greater detail in small watersheds than the more typical regional studies. The major objective of this study is to evaluate the impact of population growth on the water quality in a specific mountain watershed and then extrapolate those results to a larger area, specifically Colorado. We have chosen one typical Jefferson County watershed (Turkey Creek) where population has more than doubled in the past twenty-five and numerous studies provide much more detailed data that is usually available. The data for the period 1975 to 2000 for the TDS of surface discharge from the watershed has increased by a factor of as much as three over the twenty-five year interval. In contrast to the surface discharge, the groundwater average TDS has not increased. Thus, overall water quality as measured by total dissolved solids (TDS) is being significantly impacted by population increases in mountain watersheds, while local users remain relatively unaffected. Our interpretation of the detailed data available for this watershed indicates that:

1. The degradation of water quality is more likely related to the increases in local populations and residential by-products rather than the increases in the associated infrastructure such as roads.
2. Systematic analysis and correlation of geological, hydrochemical, hydrological, infrastructure and land use data helped identify and quantify the influence of various potential sources of impact (e.g. septic tank effluent, transportation corridors, construction activities, agricultural and livestock activities, etc.).

Using the insights gained from this study, we can make a systematic evaluation of the changes in stream water chemistry for the state of Colorado using the National Water-Quality Assessment (NAWQA), NWIS and EPA STORET databases. Correlation of the systematic state-wide temporal changes in water quality are compared to population changes in the source watersheds and using the insights gained from the single watershed study, we extrapolate the probable future impacts of growth on water quality for other watersheds that do not have the detailed data available in the Turkey Creek watershed.