



## Should Water Quality Management be Integrated with Land Use Planning?

Based on the research of Xinhao Wang, *University of Cincinnati* (xinhao.wang@uc.edu)

Traditionally land use planning and water quality management are separate activities with independent goals. Land use planning seeks to maximize the use of land and minimize negative health and welfare consequences for the citizens of a given jurisdiction. Water quality management focuses on the environment with a goal of maintaining and improving water quality, often by reacting to threats and contaminations. Unlike the jurisdictional focus of land use planning, water quality management must often be regional in scope to address the myriad of possible contaminants. Both types of planning use some of the same approaches, including developing criteria for designating land and water uses, regulating activities, and using long-term plans to guide development.

Wang argues for the integration of these two types of planning by demonstrating the damage that high impact urban areas have on water quality. In his study, Wang found that water above and below wastewater treatment plants was not significantly different in quality. In contrast, the water below high impact urban areas (e.g. areas with industrial uses), was poor quality, according to both chemical and biological indicators. In his interpretation of the data, Wang discusses how sewage treatment has improved over time and rather than focusing on isolated pollution points like the wastewater plants, the water quality manager may need to consider the broader impact of urban land use.

Wang's study, conducted in a watershed adjacent to the growing Dayton and Cincinnati

metropolitan areas, has numerous management and policy implications for both planners and policymakers:

1. Land use planning needs to recognize regional issues such as water quality and adapt its goals to meet not only the local need for maximizing use of the land, but also the regional need for a healthy ecosystem.
2. Water quality managers and land use planners need to collectively have the resources to acquire data on both land use and water quality as part of the development of new plans.
3. Environmental impacts on water need to be studied not only where single sources affect the water, such as the treatment plants, but also where less contained land uses such as urban areas may cumulatively affect water quality.
4. Water quality managers need sufficient resources to measure water quality using multiple indicators, such as the conventional physical and chemical indicators and more up to date biological assessments.
5. Policymakers need to consider the value of regulating not only specific sources of pollution like the treatment plants, as is presently done, but also more generalized sources of pollution such as the higher impact urban areas.
6. Policymakers need to weigh the benefits and consequences of human utilization of land, including a loss of species diversity in the watersheds as a result of urban impacts.

## Should Water Quality Management be Integrated with Land Use Planning? Research Methods and Findings

Wang studied the Little Miami River watershed, an area dominated by cropland and pasture (71%), followed by wooded areas (22.8%), and urban land (4.2%). The urban counties included in the study are rapidly growing, with 15-25% growth rates in the study years (1990 – 1997). The watershed is biologically diverse with fish, mussels, macroinvertebrates and algae. Past studies of this area have found decreasing levels of water pollution over time, but the watershed continues to have more pollution than it has capacity to assimilate.

The study used multiple types of data from the U.S. and Ohio Environmental Protection Agencies to assess water quality and land usage:

- Water chemistry data, a traditional source of information for assessing water quality;
- Biological data including habitat, fish, and macroinvertebrate data, used to assess water quality. Research has shown that increased pollution results in water that is less capable of supporting a biologically balanced and adaptive ecosystem;
- Data specific to pollution from the wastewater treatment plants; and
- Data on the discharges into the water from industrial facilities and toxic release sites to measure the affect of high impact urban areas.

To test the hypothesis that water quality decreased below wastewater treatment plants, water quality was measured upstream and downstream from the plants. Only one of the three measures of water quality demonstrated a statistically

significant decrease in water quality downstream from the plants, implying that the plants may not be significantly degrading water quality. The results align with the significant improvements in treatment practices found in previous studies.

A spatial analysis of urban land use and water quality identified various pollution sources concentrated in the urban areas. Two water quality measures demonstrated significantly lower quality water in the higher human impact areas, implying that these urban areas are negatively affecting water quality. The analysis also showed that as the intensity of human activities increased in a given area, the water quality across multiple measures decreased.

In addition to the findings regarding human impact on water quality, the author also notes the importance of studying water quality using multiple measures. The complexity of water quality issues requires that a variety of indicators be used to reflect the different aspects of the water body and the ways in which it can be affected by many multiple factors. For example, using the more recently developed biological indicators allows for an understanding of the affect of pollution on such things as species diversity.

Overall, the methods and analysis of Wang's study highlights one central message: *maintaining economically and ecologically healthy habitats requires collaboration between land use planning and water quality management.*

Based on: Wang, X. 2001. Integrating water-quality management and land-use planning in a watershed context. *Journal of Environmental Management*, 61: 25-36.