CASE STUDY The Importance of Long-term Flow Monitoring in the Pomperaug River Watershed

by Marc J. Taylor
Chair, Pomperaug River Watershed Coalition
www.pomperaug.org

ACKNOWLEDGMENTS

David Bjerklie, Virginia de Lima, Jeff Starn and Elizabeth Ahearn of the USGS Connecticut Water Science Center http://ct.water.usgs.gov/ provided provisional data, figures used in this article and/or helpful advice in preparing it. More information about the MesoHABSIM model can be found at www.neihp.org.

Details concerning the Pomperaug Watershed Management Plan and a link to the USGS gage on the Pomperaug are available at www.pomperaug.org.

The U.S. Geological Survey (USGS) gaging station on the Pomperaug River has been recording flows (discharge) on the river continuously since 1932. The Pomperaug River Watershed Coalition (PRWC) and our scientific collaborators depend on real-time and historical discharge measurements from this station for many purposes, including the creation of a watershed management plan based on computer models.

The Watershed. The Pomperaug is a 90 square mile sub-basin of the Housatonic River in western Connecticut. Tributaries arising in the surrounding uplands join an eight mile-long main stem that traverses the length of the Pomperaug Valley to join the Housatonic River on its way to Long Island Sound. The Pomperaug is a beautiful natural resource with undeveloped flood plains, a well-preserved riparian corridor and a long tradition of exceptional recreational fishing. There is a small impoundment in a headwater tributary, and there are four wastewater treatment plants that discharge to the river.

The Aquifer. The Pomperaug aquifer, formed by the deposition of porous sediments dating to the melting of the last glacier, underlies the river at the valley's base. Groundwater from the aquifer is the source of the river's flow when rainfall is at low levels. As explored earlier in this issue, the river and the aquifer are dynamically connected. Three public water systems draw water from wells sunk into the aquifer very near the river. Two of these systems send quantities of water out of the basin.

Land Use. Over the past 70 years farms (and irrigation) have given way to forests and low-density housing. Now the region is becoming suburbanized. More impervious surface is impacting areas that used to allow precipitation to recharge the groundwater, and surface runoff is increasing. Demand for public water supplied by the aquifer has accelerated.

To deal with these threats, the PRWC initiated a group of computer modeling studies using discharge information from the gaging station and other inputs. The projects are intended to provide quantitative information to assist decision makers in their land use and water resource determinations.

Hydrologic Modeling. The models employed by the USGS (PRMS and MODFLOW) provide a quantitative understanding of how water enters, moves through and leaves the basin under varying conditions of weather, land use and pumping from the aquifer or river. Multiple simulations can be run. The model can predict consequences of various types of development at different locations in the watershed. One scenario, for example, predicts how discharge would change under drought conditions when water is pumped maximally to out-of-basin towns.

Flow Habitat Model. The Northeast Instream Habitat Program MesoHABSIM model (University of Massachusetts, Principal Investigator Dr. Piotr Parasiewicz) quantifies habitat availability in the Pomperaug River system for a target fish population under different flow conditions measured at the gaging station. (The suitability of habitat for the target fish community is used as a surrogate for the river's overall environmental health.) This model will be used to generate ideal flow regimens that would sustain fish habitat at desirable levels through the seasons. Our management plan will combine information from both models.

Other Studies. The PRWC is looking at water quality, transport of sediments, dilution of treated wastewater, chemical contamination and the fate of drug

metabolites reaching the environment. Reliable discharge data play an important role in all these undertakings.

Groundwater. By the time flows decrease to about 10 cubic feet per second (cfs) at the gaging station, many of the upland tributaries have run dry. At about 6 cfs, as occurs during the growing season without rain, all flow arises from the aquifer (base flow). These lowest flow times pose the greatest threat to fish and other species. The rates, timing and locations of pumping and where that water goes (especially whether in or out of basin) become crucial variables determining groundwater availability and base flow. Luckily, it may be possible to control these variables.

Long-term Data. Having long-term measurements of these lowest flows permits analysis of base flow trends over the period of record. Figure 1 represents base flow discharge values over 72 years. (Base flow is approximated by the flows that are equaled or exceeded 99% of the time.) The PRWC will continue to monitor these very low flows as important indicators of groundwater management in the watershed. The simulation in Figure 2 demonstrates that lower flows are more likely to occur with increasing land development. In this simulation water use was held constant; increased pumping would have further decreased the aquifer's contribution to base flow.

Figure 2

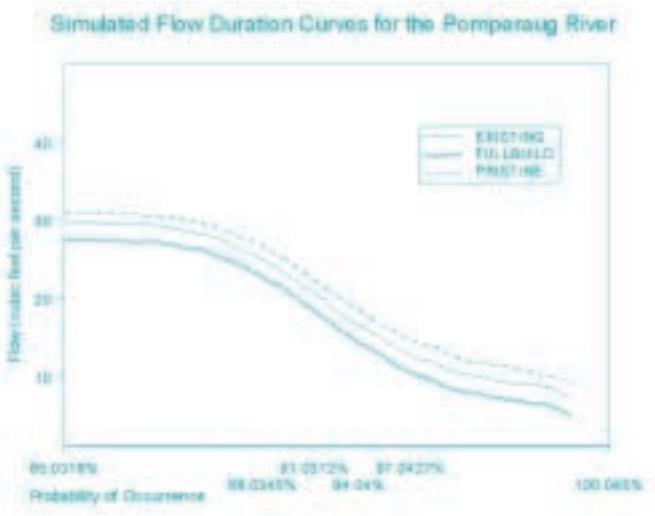
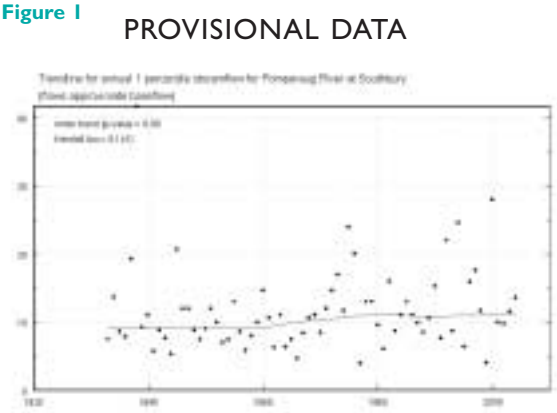


Figure 1



Lessons We Are Learning.

1) Long-term gaging station information is essential to understanding water issues and land use trends in our watershed.

2) The lowest flows (base flows) are particularly useful reflections of overall land use and water management practices.

3) Quantitative models can assist decision-making.

4) Ecologically desirable flow regimens can be developed and can be used for allocation decisions.

5) Testing our predictions against actual data over time will establish the validity and utility of our models.

6) Advocacy and relationship building are as important as ever.

7) While models are helpful, they are not for everyone. They are resource intensive.

8) The USGS and our academic collaborators are indispensable partners for this kind of work.