Study reveals need for better understanding of water use

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A new study of the Wabash River reveals a pressing need to better understand water use in America's rivers, with implications for drought-stricken regions of the country. Credit: Purdue University photo

A new study reveals a pressing need to better understand water use in America's rivers, with implications for drought-stricken regions of the country.

Findings from the study showed that virtually all of the water entering the Wabash River in Indiana during summer months is withdrawn and then returned to the waterway.

"In a nutshell, in the summertime we generally use what is equivalent to the entire volume of the Wabash River so that by the time the river reaches the confluence of the Ohio River, the water in the Wabash on average has been through one human engineered system, which includes wastewater treatment plants and power utilities," said Loring Nies, a professor in the Lyles School of Civil Engineering and in the Division of Environmental and Ecological Engineering at Purdue University. "The Wabash river basin, which encompasses most of the state of Indiana, is already at a tipping point of fully exploiting its water resources."

The research also has implications for other U.S. rivers, which undergo the same cycle of low rainfall during summer months.

"The amazing thing about this is that in Indiana we rarely have droughts, but we're still using the whole Wabash River," said Chad Jafvert, also a Purdue professor in the same programs.

Doctoral student Julia Wiener led the research. Findings are detailed in a paper appearing online this week in the journal *Science of the Total Environment*. The paper was authored by Wiener, Jafvert and Nies.

One hurdle in better understanding how much water is flowing into and out of America's waterways is the patchwork of data available from various agencies. No central clearinghouse exists for this type of information.

"State and federal agencies collect plenty of data, but it's not coordinated in a way that anybody who's managing water resources in a large basin like the whole Wabash River can easily combine and use," Wiener said.

"There needs to be a watershed-scale understanding that simultaneously keeps track of the volume of water flowing into the river and how much water is being extracted, and not just from the surface sources but from the groundwater sources as well. That way, we will be able to better understand the human-driven water cycle in our watersheds."

The Wabash River has peak flows in January, February and April. In August, September and October the river flow is at its lowest flow rate, a cycle seen in most U.S. rivers, Nies said.

"At the low-flow rates we are essentially using all of the water, which until this research nobody understood," he said. "Another way to put it is that we are essentially emptying the river out and then filling it back up continuously."

Based on the findings, the researchers have determined that suggestions of reusing wastewater for irrigation and other consumptive purposes may be detrimental to the river.

"Back in 2012 when we were having a drought in Indiana, people were looking at reusing wastewater for irrigating," Jafvert said. "Well, if you diverted wastewater to irrigation instead of letting it flow back into the river, then the river flow's going to get even lower. The point is, the river is not this immense untapped source of water that's available for us to use in times of stress. It's already being used."

A potential strategy could be to collect and store water during times of high flow.

"But where would you store it?" he said. "Reservoirs are expensive."

During low-flow periods, water flows into the river at a rate of 165 cubic meters per second, and people are withdrawing about 162 cubic meters

per second, according to data from gauging stations dotted along the river throughout the state.

Water being discharged into the river from power utilities during the summer accounts for most of the inflow - about 80 percent - with the remainder coming from sources such as municipal wastewater treatment facilities.

"This is not bad as long as the treatment plants are doing what they are supposed to be doing," Jafvert said.

For example, the treated wastewater is disinfected to remove any remaining pathogens. Power utilities use the water to cool power plants.

"We do a lot of unplanned water reuse because we discharge it at one point and then a city downstream withdraws it. So part of what they are withdrawing is treated wastewater," Jafvert said. "It's been in the river for maybe one or two days, but it still has that treated wastewater component."

During the driest months water enters the river from the surrounding aquifer, a natural subsurface source.

"So when you have two weeks of no rain in the summer, the river is still running because you've got groundwater going into it," Jafvert said. "But you also have pipe flow going into it from people, from wastewater treatment plants, from power utilities, and from other industries."

The findings have implications for water-challenged California, where residents have resisted calls to reuse treated wastewater that is now discharged to the Pacific Ocean.

"People are resistant to reusing water because they don't want to use

treated wastewater as their drinking water source, but in the Midwest we do it all the time. It's called a river system," Jafvert said.

The work is ongoing, and Wiener will extend the research into a larger watershed, possibly the Mississippi River system.

More information: The Assessment of Water Use and Reuse through Reported Data: a US Case Study, *Science of the Total Environment*, 2015.

Provided by Purdue University