New Tool Identifies the Value of Floodplain Preservation and Restoration

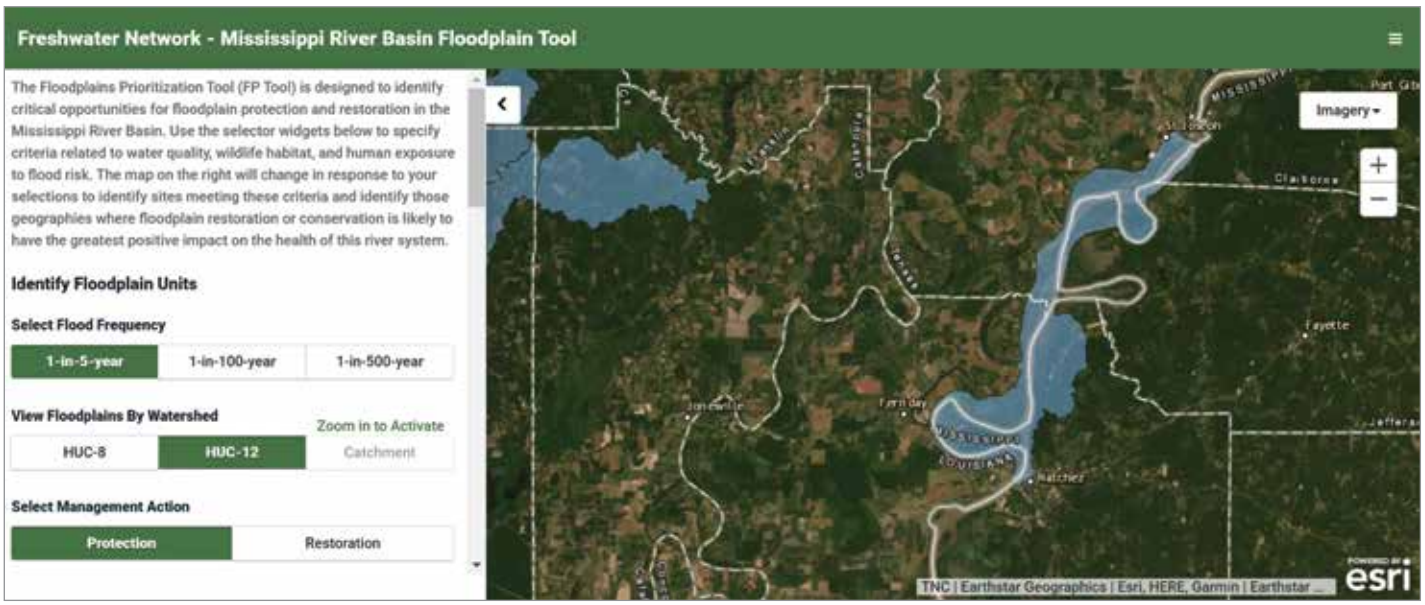
By Jay Harrod

As planners, land trusts, and government officials look for ways to protect communities from flooding and safeguard water supplies, they're increasingly looking to natural solutions, like protecting or restoring floodplains. But in places as vast as the Mississippi River basin, which floodplains are most valuable? Which places—if protected or restored—will provide the best defense for communities given the money spent?

Thanks to the sophisticated use of GIS, a solution is now available. Developed by The Nature Conservancy (TNC) and partners using Esri's ArcGIS, the Floodplain Prioritization Tool (FP Tool) can help communities throughout much of the Mississippi River basin decide where and how best to use limited financial resources to protect or restore floodplains.

"Protecting and restoring floodplains help reduce flooding and avoid damages from further development of flood-prone lands, while providing improved habitat for fish and wildlife and offering people improved water quality and recreational opportunities," said Kris Johnson, who led development of the tool. Johnson is the TNC deputy director of agriculture for North America.

"We wanted to provide a science-based tool that can help decision-makers—like *[those in]* federal, state, and local governments; county planners; land trusts; and businesses—optimize their protection and restoration investments and minimize the impacts of



development," Johnson added. "The FP Tool does just that. It's designed to help guide investments and assess trade-offs related to different goals, like water quality, wildlife habitat, and estimated flood damages."

Handling a Lot of Data

Developing the FP Tool relied on refining a huge amount of data from government agencies and natural resource organizations. The University of Iowa; the University of Bristol in the United Kingdom; and Fathom, a flood risk analysis company also based in the United Kingdom; provided data for the tool that had been previously unavailable to the public.

ArcGIS Desktop was essential in creating the tool, said Eugene Yacobson, a conservation information manager for TNC. "The FP Tool analysis included more than 15 data layers and covers a study area that spans approximately 23 percent of the continental US," he said. "Analyzing that data was carried out primarily using features within Esri's ArcGIS Desktop." Yacobson explained that the tool has multiple modes including three flood frequencies and two management actions. This meant that each data layer needed to be processed multiple times with small variations in workflow, so scripting and automation were essential for carrying out the process efficiently and keeping the process both well documented and replicable.

The integration of ArcGIS with the Python programming language via the ArcPy module made this simple. Complex table manipulations could be carried out in Python, those tables joined to spatial layers, and the layers fed directly into tools in ArcGIS. "Python integration also made it possible to do multiprocessing to take advantage of multiple CPU cores to rapidly crunch through 30-meter-resolution floodplain raster layers stretching from North Dakota to Louisiana and eastern Colorado to northwest Pennsylvania," said Yacobson.

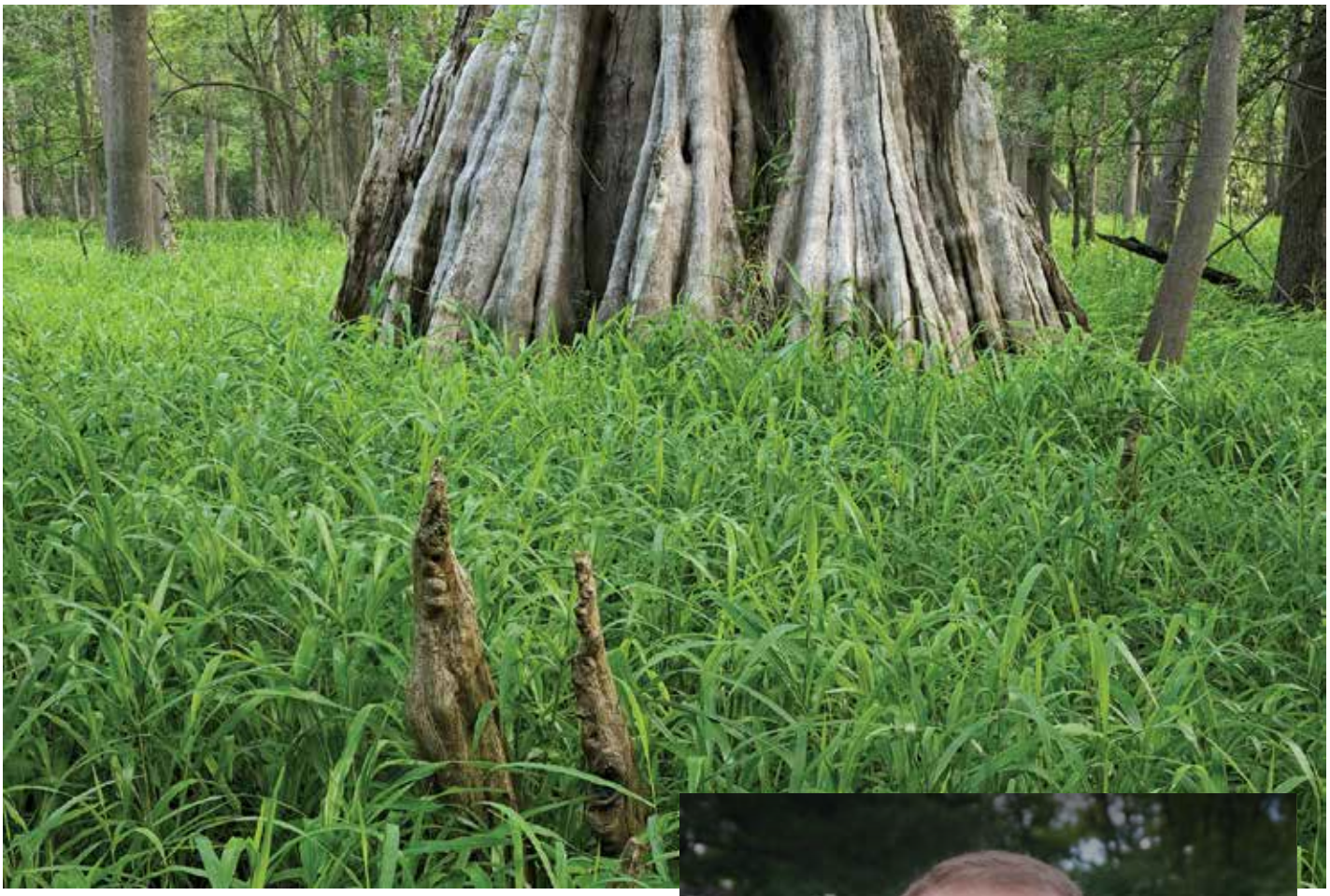
The project's other goal involved producing a tool that could be employed by a wide range of online users. TNC senior web developer Casey Schneebeck used ArcGIS API for JavaScript to build an online presence for the tool that's easy to navigate and can direct users to practical, tangible solutions for communities. Although the tool was initially built for the Mississippi River basin, it could potentially be used across the continental United States.

The Need for More Solutions

"In the past, you might have portions of large, thousand-acre-plus floodplains that flooded every 25 or 30 years," said Colin Wellenkamp, director of the Mississippi River Cities and Towns

↑ Flooding like this in Peoria, Illinois, and other communities in the United States costs taxpayers billions in damages. The Floodplain Prioritization Tool can help planners select sites where nature can help reduce flood risks and safeguard water quality while providing wildlife habitat. Copyrighted photo provided courtesy of Jay Harrod/The Nature Conservancy.

← The Floodplain Prioritization Tool is most useful when applied in partnership with local planners and stakeholders. The FP Tool is currently helping inform a collaborative floodplain management plan for Missouri's Lower Meramec River.



↑ Kris Johnson, the TNC deputy director of agriculture for North America, led the development of the Floodplain Prioritization Tool to aid in protecting and restoring floodplains and help reduce flooding. Copyrighted photo provided courtesy of The Nature Conservancy.

Initiative, an association of mayors from cities along the Mississippi River corridor. "Now we're seeing entire floodplains flood more often, and they're inundated with water for months at a time. If we have to go through many more years like 2019, natural assets like floodplains will be the only way we'll be able to deal with the impacts of flooding, which are becoming worse."

With more frequent and more intense floods, floodplains can provide communities with efficient and effective solutions. Flood protection, water filtration, wildlife habitat, and other services supplied by floodplains have dollar values, according to Wellenkamp. "The Floodplain Prioritization Tool can help us guide protection or restoration investments or better understand the impacts of the development choices we make." Wellenkamp also believes the science-based reports that the tool generates can help communities when applying for federal, state, or county grants aimed at reducing flood risks or improving water quality or wildlife habitat.

A new study by TNC and its partners attempted to determine which floodplain strategy would cost American taxpayers more. Based on current projections, should undeveloped areas that are likely to flood in the coming decades be protected now, or should development be allowed to proceed and the subsequent flood damages to be paid for when they inevitably occur?

The study, "A benefit-cost analysis of floodplain land acquisition for US flood damage reduction," was published in the December 9, 2019, issue of *Nature Sustainability*. It identified more than 104,000 square miles—an area roughly the size of Colorado—located in 100-year floodplains where conservation would be an economically sound way to avoid future flood damage.

> "The Floodplain Prioritization Tool can help us guide protection or restoration investments or better understand the impacts of the development choices we make."

"For just over 21,000 square miles of this area, the benefits are at least five times the cost, meaning that a dollar invested in floodplain protection today returns at least five dollars in savings from avoided flood damages in the future," said Johnson.

See the Floodplain Prioritization Tool at https://bit.ly/2R1U6ij. For more information, contact Jay Harrod at jharrod@tnc.org.

Acknowledgments

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About the Author

Jay Harrod is the associate director of marketing for The Nature Conservancy. Based in central Arkansas, Harrod serves as TNC's communications lead for the organization's Natural Climate Solutions-Adaptation strategies, among other programs.

← Every dollar spent toward protecting or restoring floodplains like this one in Louisiana can provide at least $5 in savings from avoided flood damages in the future, according to a recent study by TNC and its partners. Copyrighted photo provided courtesy of Byron Jorjorian.

↓ Through pop-ups, the Floodplain Prioritization Tool (FP Tool) makes a wealth of information on the extent and impact of floods on communities throughout much of the Mississippi River basin.