Supporting Research & Technology through the Rappahannock SmartRiver Initiative

RIVERE Ecological Center | Updated November 20, 2026

The RIVERE Ecological Center, a 501(c)(3) non-profit organization, will create a world class ecological center designed in form and function to offer a vibrant coworking collaboration space that brings together researchers, educators and tech companies with a shared focus on enhancing water quality monitoring and environmental education through technology. The Rappahannock SmartRiver Initiative will serve as a focal point for collaboration.

Recent advances in wireless sensors and communication technologies have led to the emergence of next generation water quality monitoring systems that are changing the ways in which bodies of water can be monitored and managed (Adu-Manu et al., 2017; Burke & Allenby, 2013; Chen et al., 2018; Dong et al., 2015). Over the past fifteen years, many examples of wireless sensor networks used for water quality monitoring have been developed throughout the world (Dong et al., 2015; Adu-Manu et al., 2017). The Intelligent River© system on the Savannah River in South Carolina (White et al., 2010) is of particular interest to the mid-Atlantic. RIVERE is reaching out to the Intelligent River© staff at Clemson University's Restoration Institute in Charleston, SC to discuss opportunities to tour the project and seek opportunities for collaboration.

RIVERE will support water research involving emerging sensor technology, applied machine learning and predictive modeling by bringing the SmartRiver Initiative to the Rappahannock River in Virginia. RIVERE envisions making the Rappahannock Virginia's first complete SmartRiver through strategic placement of wireless sensors from its headwaters to the Chesapeake Bay. The development of a smart wireless sensor network throughout the length of the Rappahannock will enable much-needed proactive monitoring, mitigation and planning measures as projected population growth and development upstream place increased pressure on the river. The Rappahannock SmartRiver Initiative can also support and complement the growing network of technology-based, precision conservation initiatives in the Chesapeake Bay watershed (Burke & Allenby, 2013).

The Rappahannock SmartRiver Initiative will combine an automated wireless sensor network with applied machine learning to collect real-time data on chemical, biological and physical aspects of the river, and transmit those data through a centralized server to be processed, stored, and made available online. This SmartRiver network will enable real-time monitoring of water quality to detect changes over time, identify existing or emerging water quality issues, and enable rapid mitigation responses. A long-term 'big dataset' resulting

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from the SmartRiver Initiative can be used to support predictive modeling of water availability and the effects of weather or climate-based events on the watershed, and help inform regional, national, and global freshwater challenges.

RIVERE will support research efforts to acquire, deploy and test emerging technologies associated with Smart Cities (Trindade et al., 2017) to the Rappahannock SmartRiver, and will accomplish this through key partnerships. First, RIVERE will help water researchers develop, pilot and test new wireless sensor network initiatives through a collaboration with the Virginia Innovation Partnership Corporation (VIPC) and its Virginia Smart Community Testbed initiative in Stafford County. VIPC created the Testbed in Stafford to test new technologies in a real-world setting to drive faster innovation. RIVERE will complement Smart Stafford's Integrated Water Management initiative by engaging water researchers with the Testbed and helping to pilot and test SmartRiver sensor technologies by (a) determining if there are available sensors or sensors that can be developed to collect desired data, (b) deploying sensors, (c) bringing data from sensors into the cloud, and (d) making data available in an online dashboard. Second, RIVERE has aligned with Friends of the Rappahannock's (FOR) to support their educational mission and seek their expertise on suitable sensor locations along the Rappahannock. RIVERE is currently developing collaborative partnerships with technology-based companies and research laboratories to develop immersive learning experiences that integrate virtual and augmented reality into educational and public outreach focused on the Rappahannock River. A key outcome for the Rappahannock SmartRiver Initiative overall will be to align with Fredericksburg's objective to become an employment epicenter for science and technology R&D. RIVERE aims to make Greater Fredericksburg the "go-to" region for academic researchers and high-tech companies interested in developing, manufacturing, and deploying emerging sensor technologies to enhance water quality monitoring.

To guide the development and implementation of the Rappahannock SmartRiver Initiative, RIVERE has assembled a team of experts to serve on our Research Advisory Board. This board includes representatives from Virginia Cooperative Extension, Virginia Tech, Chesapeake Bay Foundation, U.S. Geological Survey Next Generation Water Observing System, Friends of the Rappahannock, Rappahannock River Basin Commission, the University of Mary Washington, and Virginia Innovation Partnership Corporation.

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