

POWER OF **R&D** NEWSLETTER

— **CONNECTING THE DOTS.
TO INNOVATION**

As America's civil works infrastructure ages, managers need innovative solutions to replace parts that have been in service nearly a century. Often, these original components were fabricated using trial and manufacturing methods that are costly, burdensome and time-consuming to replace.

— **AN ARM FOR AN ARM**

3D printing accelerates infrastructure innovation

A lot of our research has gone into investigating the best parameters to produce some of the methods we want to minimize any defects that would affect strength or fatigue. We have to validate the mechanical performance of those parts and ensure they are as good as or better than parts we already have in this at least 20- or 30-year-old metals that were previous



U.S. ARMY



US Army Corps
of Engineers

FIELD NOTES

MAJOR GENERAL MARK C. QUANDER

GREAT LAKES AND OHIO RIVER DIVISION



In the face of rapidly escalating costs for the repair and replacement of aging infrastructure, coupled with an urgent need to bolster resilience against climatic extremes, the U.S. Army Corps of Engineers (USACE) finds itself at a pivotal juncture in its nearly 250-year storied history. Today, the call for innovative solutions is louder and more critical than ever before.

It is with immense pride that I reflect on a groundbreaking project undertaken by the Detroit District in collaboration with the U.S. Army Engineer Research and Development Center (ERDC) and our industry partner, Lincoln Electric. This initiative, which leveraged state-of-the-art additive manufacturing techniques, resulted in the fabrication of a monumental 12-foot-long, 6,000-pound metal part for the ship arrestor system at Poe Lock. This achievement marks the creation of the largest U.S. infrastructure component ever produced by a 3D printer.

When routine maintenance unearthed cracks in the arrestor lever arm, a component with six decades of service, the urgency of replacement was undeniable. Traditional manufacturing methods suggested an 18-month wait—a delay untenable considering Poe Lock’s crucial role in our national economy. The stakes could not have been higher, with nearly 90 percent of the U.S. high-strength steel pivotal for manufacturing passing through Poe Lock. The potential economic implications of a protracted closure were simply unacceptable.

Embracing innovation and propelled by the bold vision of our Detroit District engineers and the profound expertise of ERDC in additive manufacturing, the team delivered the new part in an astonishing 12 weeks. This ensured the uninterrupted operation of Poe Lock, showcasing our commitment to pioneering solutions that not only extend the lifespan but also enhance the resilience of America’s critical infrastructure.

This venture exemplifies how USACE is spearheading innovative approaches across the board. From deploying robotic platforms for improved inspections and utilizing digital twins for continuous structural health monitoring, to implementing advanced security measures to safeguard our facilities, we are at the forefront of enhancing the robustness of our nation’s infrastructure.

Innovation is the bedrock of our future. As we continue to face and overcome the nation’s most formidable engineering challenges, I am confident in our collective ingenuity and our unwavering commitment to pushing boundaries. Our resolve is to not just meet the demands of our time but to set new benchmarks for performance, safety, efficiency and resilience.

Through our actions, we are forging a stronger future.

Essays!

MG Mark C. Quander
Commanding General
Great Lakes and Ohio River Division

**“INNOVATION IS
THE BEDROCK OF
OUR FUTURE.”**



NAVIGATE

Vintage History, Cutting-Edge Future: Additive manufacturing can transform infrastructure rehabilitation.....	page 6
Innovation at Work	page 8
Predicting the Spread: IRAMI informs decision makers during infectious outbreak.....	page 10
RAPID Defense: Military base camp technology now being applied to shield facilities.....	page 12
Under Pressure: Levee Screening Tool aims to mitigate dangerous flood events.....	page 14
Team Effort: R&D teams join response to Francis Scott Key Bridge collapse.....	page 16
USACE R&D Strategy: Top 10 R&D Priorities.....	page 16

- Eddie Belk, director of the U.S. Army Corps of Engineers Civil Works program, delivers remarks during the final day of RD24, a workshop hosted at ERDC that focused on ongoing research and development initiatives and transitioning R&D back to districts and divisions. During his remarks, Belk mentioned the R&D efforts that were playing a critical role in the response to March's tragic shipping accident in Baltimore that resulted in six deaths and the collapse of the Francis Scott Key Bridge. *(Photo by Marty Kittrell, ERDC)*



**US Army Corps
of Engineers®**

Our mission is to deliver vital engineering solutions, in collaboration with our partners, to secure our nation, energize our economy, and reduce disaster risk.

VINTAGE HISTORY CUTTING-EDGE FUTURE



Dr. Zack McClelland
Research Mechanical Engineer
U.S. Army Engineer Research
and Development Center

As America's civil works infrastructure facilities age, managers need innovative solutions to repair and replace the individual parts that keep them functioning. Often, these original components were fabricated using vintage material and manufacturing methods, making them costly, burdensome and time-consuming to replace.

Responding to this need, USACE is employing cutting-edge additive manufacturing techniques to produce these parts faster and at a lower cost while maintaining, and often improving, their properties.

In early March, the USACE Detroit District installed the largest U.S. civil works infrastructure component produced by a 3D printer – a 12-foot-long,

6,000-pound metal part for the ship arrestor system on the Poe Lock, one of the two active locks on the Soo Locks facility. Building on years of research performed by ERDC, the part was manufactured in 12 weeks, compared to a projected 18-month lead time for conventional manufacturing.

The part was installed, tested and commissioned during the Soo Locks' winter maintenance cycle, replacing a 60-year-old lever arm that had begun to show cracks. The rapid repair ensured normal operations at Poe Lock, a major transit point for domestic iron ore.

To read the full story, visit:
<https://www.erdcl.usace.army.mil/Media/News-Stories/Article/3726876/infrastructure-innovation-new-poe-lock-arrestor-arm-is-the-largest-us-civil-wor/>

**Additive
manufacturing
can transform
infrastructure
rehabilitation**



“THE POE LOCK ARRESTOR ARM REALLY SHOWS WHAT CAN BE DONE WITH THE TECHNOLOGY IN TERMS OF COMPLEX DESIGNS, AND IT SIGNALS A PARADIGM SHIFT IN HOW LARGE PARTS CAN BE MANUFACTURED.”

DR. ZACK MCCLELLAND

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**Poe Lock arrestor arm is the
LARGEST U.S. CIVIL WORKS
INFRASTRUCTURE COMPONENT
produced by 3D printer**

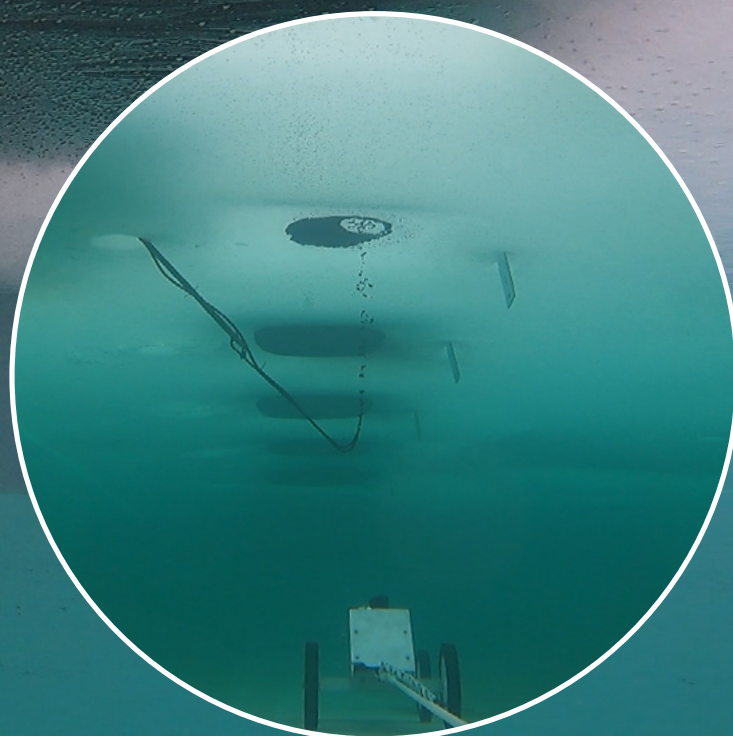
Helping fish navigate Alabama locks and dams • Teams from ERDC and the Mobile District captured and identified species of fish passing through the Claiborne and Millers Ferry locks and dams in Alabama. The work is part of an effort to gather baseline data on the relative number of species that are successfully making their way through the locks and dams. The Mobile District is in the process of designing new fish passage structures at both facilities, and the data collected in this study will be used to compare them once the bypass structures are constructed. During two days in February, netting above and below each miter gate documented 15 different freshwater fish species.



New methods successful in addressing cracked infrastructure • ERDC-developed techniques are helping deploy fiber-reinforced polymers (FRP) to repair and in some cases strengthen infrastructure components that have developed fatigue cracks. Recently, engineers applied FRPs to repair an upstream sector gear at Cheatham Lock and Dam in Tennessee. The application of the materials decreased the crack opening and increased the cross-section strength, reducing the stress and avoiding the potential for the crack to grow. These materials have also now been used to mitigate corrosion's impact on infrastructure components. A method like the one used at Cheatham Lock is being applied to areas of extreme corrosion, helping recover the strength of steel I-beams on the miter gates experiencing as much as 30-percent corrosion.

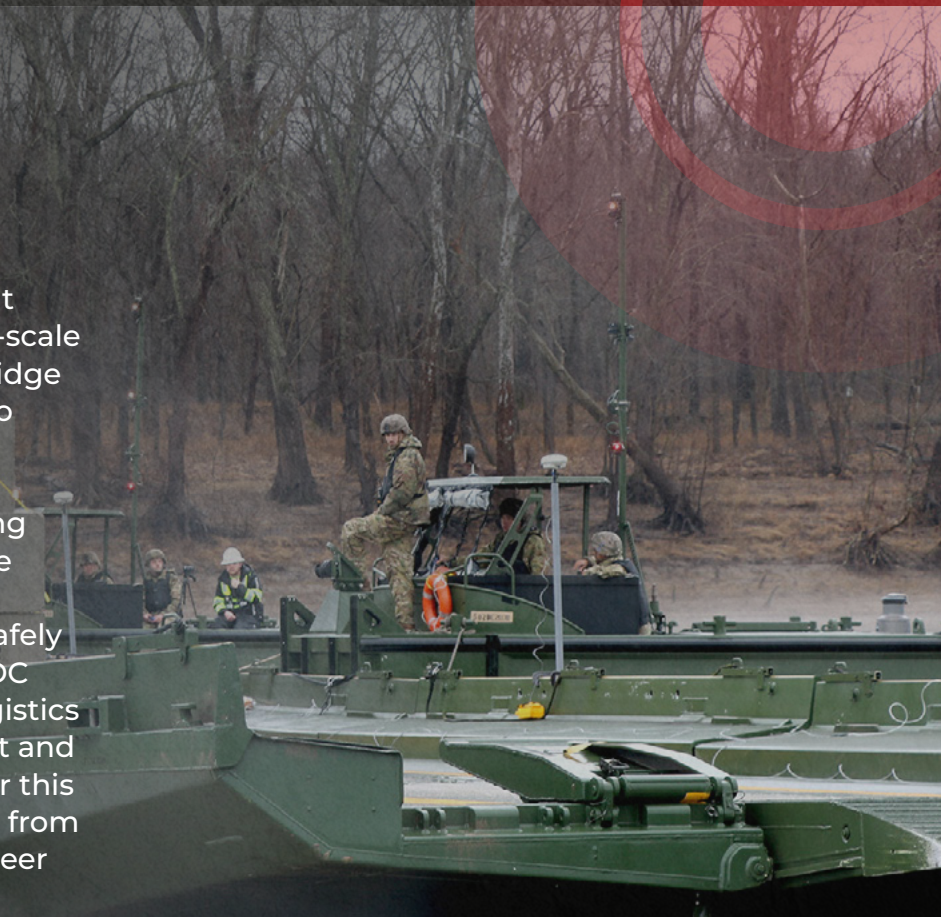
Detecting oil spills in the Arctic •

Leveraging the unique capabilities at its Cold Regions Research and Engineering Laboratory (CRREL), ERDC is evaluating the effectiveness of sensors to help detect possible oil spills in the Arctic. Researchers created an experimental ice sheet, and then injected crude oil in various amounts into ice cavities for assessment. This test, which used a remotely operated vehicle with various oil detection sensors, simulated an oil spill in the Arctic, where visual identification can be difficult. The evaluated sensor technology showed potential in detecting and quantifying oil under the ice sheets, offering a possible solution for future recovery efforts.



Engineers conduct successful test of Improved Ribbon Bridge •

Under extreme conditions, ERDC and combat engineers conducted a successful full-scale evaluation of the Improved Ribbon Bridge (IRB) for rafting operations on the Ohio River. The IRB is designed to function in two main configurations, bridging and rafting, providing wet-gap-crossing capabilities for mechanized forces. The test's objective was to determine the conditions under which the IRB can safely raft the Abrams M1A2 SEPv3 tank. ERDC provided subject-matter expertise, logistics coordination, instrumentation support and a surrogate tank specially designed for this test. Support was provided by soldiers from the 20th Engineer Brigade/19th Engineer Battalion/502nd Multi-Role Bridging Company, which deployed seven bays of the IRB and the vessels used to carry out rafting of the bridge.



PREDICTING THE SPREAD

IRAMI informs decision makers during infectious outbreak

A cross-laboratory team of ERDC researchers has launched a new project that seeks to revolutionize the way military bases prepare for and combat respiratory infections, with the potential to help public health across the globe.

The Infection Risk Assessment on Military Installations (IRAMI) project aims to quantify the spread of infections and evaluate their impact on military personnel. By estimating the time, intensity and overall duration of a respiratory infection outbreak, the tool will allow leaders to make informed choices regarding mitigation policies. It is also expected to be able to predict the number of personnel present at work each day during an infectious outbreak.

Initially demonstrated on COVID-19, IRAMI can be used to predict the spread of flu, RSV and other infectious diseases.

The U.S. Army's Fort Huachuca in Arizona will serve as the pilot site for the project. Data from the pilot will be used to build models for barracks, as well as common public environments like gyms, shopping plazas, restaurants and cafeterias.



Dr. Sergey Vecherin
Research Physicist
U.S. Army Engineer Research
and Development Center

**“THE APPLICATION OF
THIS METHODOLOGY IS
NOT LIMITED TO MILITARY
INSTALLATIONS, AS IT
CAN BE ADAPTED TO
ANY WORKPLACE
FACING THE RISK OF
PERSON-TO-PERSON
INFECTION SPREAD.”**

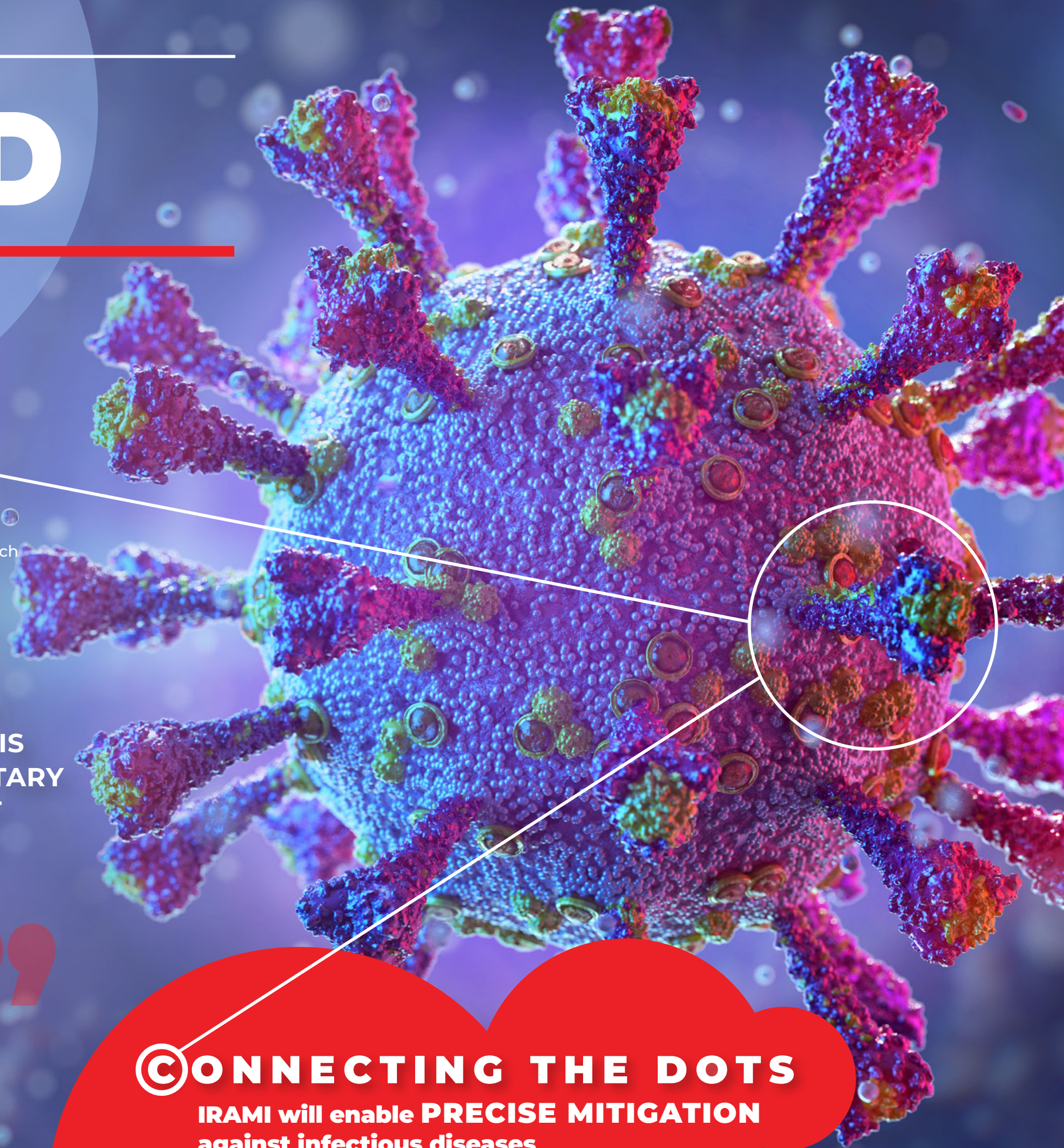
DR. SERGEY VECHERIN

To read the full story, visit:

<https://www.erdcd.usace.army.mil/Media/News-Stories/Article/3694076/erdcd-research-aims-to-model-combat-respiratory-infections/>

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**IRAMI will enable PRECISE MITIGATION
against infectious diseases**



RAPID DEFENSE

“THIS TYPE OF INNOVATION CAN ENHANCE SECURITY
AT USACE FACILITIES AND MASS GATHERING EVENTS.”

MATT HOSSLEY



Matt Hossley
Mathematician
U.S. Army Engineer Research
and Development Center



Bowen Woodson
Research Civil Engineer
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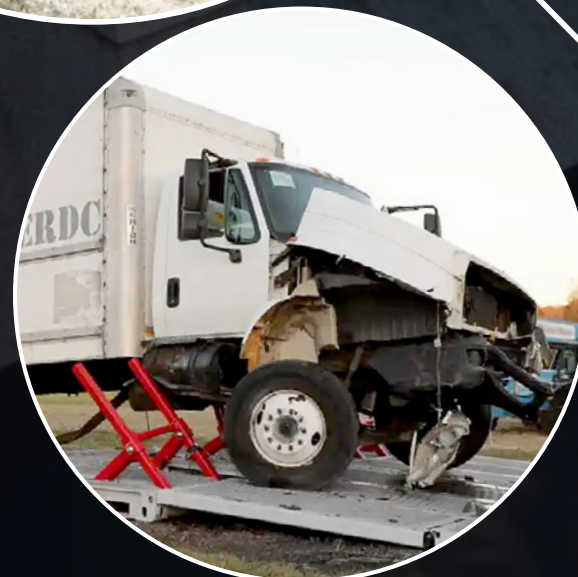
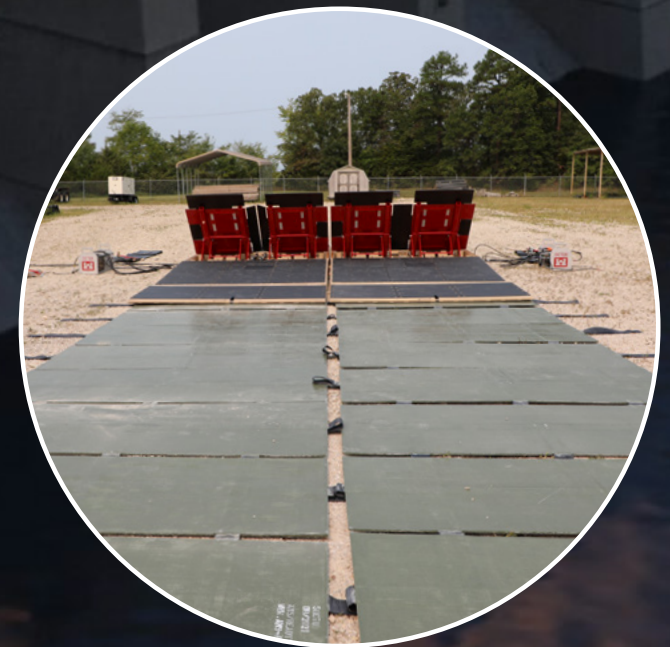
Military base camp technology now being applied to shield facilities

Soft targets and crowded spaces are major safety concerns for law enforcement and federal agencies. As terrorists and extremist groups turn to less sophisticated methods to inflict harm, the use of vehicles in these types of attacks has shown the potential for catastrophic damages to USACE projects.

In response, USACE researchers developed DETER (Deployable Expedient Traffic Entry Regulator), an active vehicle barrier that serves as an expedient access control solution to protect critical assets from vehicular attack.

Initial research into protecting deployed forces at base camps led to the development of a design and validated capability to stop a ramming vehicle. The Department of Homeland Security is currently funding the evaluation of DETER in urban environments.

The innovative and versatile barrier provides rapid protection in multiple scenarios, making it a valuable system to enhance the security at USACE facilities and mass gatherings. Moving forward, the team is working to develop guidance for soft asset protection and to provide incremental design improvements to the system.



CONNECTING THE DOTS
DETER PROTECTS SOFT ASSETS
from vehicular threats

To read the full story, visit:

<https://www.erdc.usace.army.mil/Media/News-Stories/Article/3759535/protecting-dam-facilities-with-innovative-new-technology/>

Levee Screening Tool aims to mitigate dangerous flood events



Jason Needham
Lead Consequence Specialist
USACE Risk Management Center

A newly developed technology will help USACE better understand the conditions of its levees and their associated flood risks.

The Levee Screening Tool (LST) 2 is a web-based application that quantifies risk estimates based on the likelihood of flood loading, expected performance of the levee under those loads and the potential consequences of a levee breach or overtopping.

The new tool builds upon the LST 1 by incorporating state-of-the-art hydraulic modeling from the Hydrologic Engineering Center's River Analysis System. This provides more accurate estimates of flood depths, velocities and arrival times should a levee breach occur, giving levee owners an efficient and effective way to prevent fatalities and reduce economic risks.

LST 2 has been used to analyze USACE levees, and the team hopes to soon expand its use to other levees. In addition, its data can be used to assist emergency managers to improve warning and evacuation plans.

The effort has also spurred development of the Dam Safety Tool, which can be used by federal, state and local agencies to quickly assess risks associated with underperforming dams and inform investment decisions.

To read the full story, visit:
<https://www.erdc.usace.army.mil/Media/News-Stories/Article/3759559/analyzing-levees-to-save-lives/>

HAZARDS

What are the hazards and how likely are they to occur?

PERFORMANCE

How will the levee perform in the face of these hazards?

CONSEQUENCE

What is in harm's way?
How susceptible to harm are they?
How much harm is caused?



RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)

LEVEE RISK IS A FUNCTION OF HAZARDS, PERFORMANCE AND CONSEQUENCES

“INFORMATION GAINED THROUGH THE SCREENING PROCESS CAN BE USED BY LOCAL EMERGENCY MANAGERS TO IMPROVE WARNING AND EVACUATION PLANS IN CASE OF LEVEE BREACH OR OVERTOPPING.”

JASON NEEDHAM

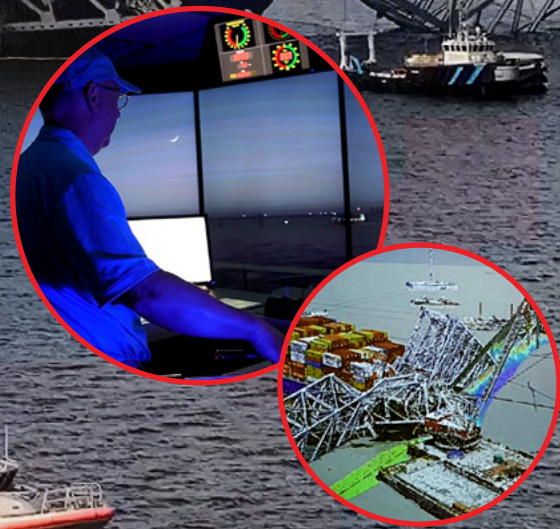
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**Better understanding flood risk will help planners
PREVENT FATALITIES AND
REDUCE ECONOMIC RISKS**

TEAM EFFORT

R&D teams join response to Francis Scott Key Bridge collapse

Multiple ERDC teams provided expertise in response to the Francis Scott Key Bridge collapse. Research structural engineers and certified bridge inspectors collaborated with North Atlantic Division structural engineers to determine the total weight and volume of steel and concrete for each of the collapsed bridge spans and piers – supporting debris removal decisions. Meanwhile, ERDC's expertise in point cloud mesh modeling helped process raw sonar data of the collapsed bridge to enable viewing in ArcGISPro to aid analysis. And ERDC's Ship/Tow Simulator allowed pilots from the region to test how well a variety of ship types would be able to operate within a limited access channel at the accident site that would reopen the port to some commercial vessel traffic.



USACE R&D STRATEGY

Below are the current Top 10 USACE R&D Priorities to address the nation's toughest challenges with multi-disciplinary solutions. These strategies lay the foundation for a bold, new era of USACE R&D.

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Mitigate & Adapt
to Climate Change



Win Future Wars



Modernize Our
Nation's Infrastructure



Support Resilient
Communities



Enable Smart &
Resilient Installations



Ensure Environmental
Sustainability and Resilience



Secure Reliable
Installation Energy



Revolutionize and
Accelerate Decision Making



Improve Cyber and
Physical Security



Protect and Defend
the Arctic



SCAN FOR
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