US Army Corps of Engineers®

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

R&D: THE POWER OF ERDC

For nearly a century, the U.S. Army Engineer Research and Development Center (ERDC) has been at the forefront of tackling our nation's toughest engineering challenges, providing innovative solutions in the areas of civil works and military engineering, and offsetting the negative effects of climate change.

From its earliest days of hydrology experiments along the Mississippi River in 1929, ERDC's R&D has grown, along with its buildings and capabilities. Today, ERDC's facilities, combined with its people, have created one of the world's premier R&D organizations supporting the delivery of projects and programs for federal, state and local agencies as well as private, academic and international partners.

ERDC's ongoing R&D, aligned with the U.S. Army Corps of Engineers (USACE) R&D portfolios, allows key investments to be targeted to strategic areas that can benefit multiple interests.

ERDC's R&D enhances USACE's ability to execute its Civil Works (CW) missions to support commercial navigation, manage ecosystems and reduce flood risk, while our research in Installations and Operational Environments (IOE) is improving the reliability, efficiency and effectiveness of military infrastructure and on the battlefield. ERDC conducts scientific R&D to improve all aspects of mission planning, preparation, execution and sustainment, including innovations to protect the Warfighter.

Sustained, multiyear support for ERDC R&D is critical to institutionalize successes and magnify benefits, enabling the nation to take a proactive approach to meeting the complex challenges of both today and tomorrow.

ERDC: IT ALL STARTS HERE

Throughout our history, which began as the Waterways Experiment Station in 1929, we have confronted some of our nation's greatest scientific and engineering challenges.

As the U.S. Army Engineer Research and Development Center, we stand at the leading edge of R&D, discovering, developing and delivering solutions that make the world safer and better every day. This is not only our mission, but also our calling.

In leveraging world-class facilities and capabilities, combined with our people and their expertise, ERDC is shaping the engineering and science solutions of today and building a foundation of excellence to meet the demands of tomorrow.

Recently, USACE unveiled its Research and Development Strategy, outlining 10 areas where vital R&D solutions are needed. "This Strategy takes a new programmatic approach to R&D, elevating R&D's role within USACE as we increase our value to the nation," Lt. Gen. Scott Spellmon, 55th Chief of Engineers and USACE Commanding General, said in the strategy's release.

This comprehensive strategy serves as a reminder of how valuable our work is, the difference it can make, and the positive impact we can have on the lives of people around the world.

We are an organization that thrives when confronted with challenges, and never before in our history has our nation and world faced so many challenges at once.

While I am proud to serve as ERDC's director, my greatest pride comes from working with and alongside so many great people at a time when great solutions are needed. Our people are the key to our success today and tomorrow and are the true Power of ERDC.

Today, we are entering a bold, new era for R&D.

DAVID W. PITTMAN, PE, PhD, SES
Chief Scientist and Director of R&D, U.S. Army Corps of Engineers
Director, U.S. Army Engineer Research and Development Center

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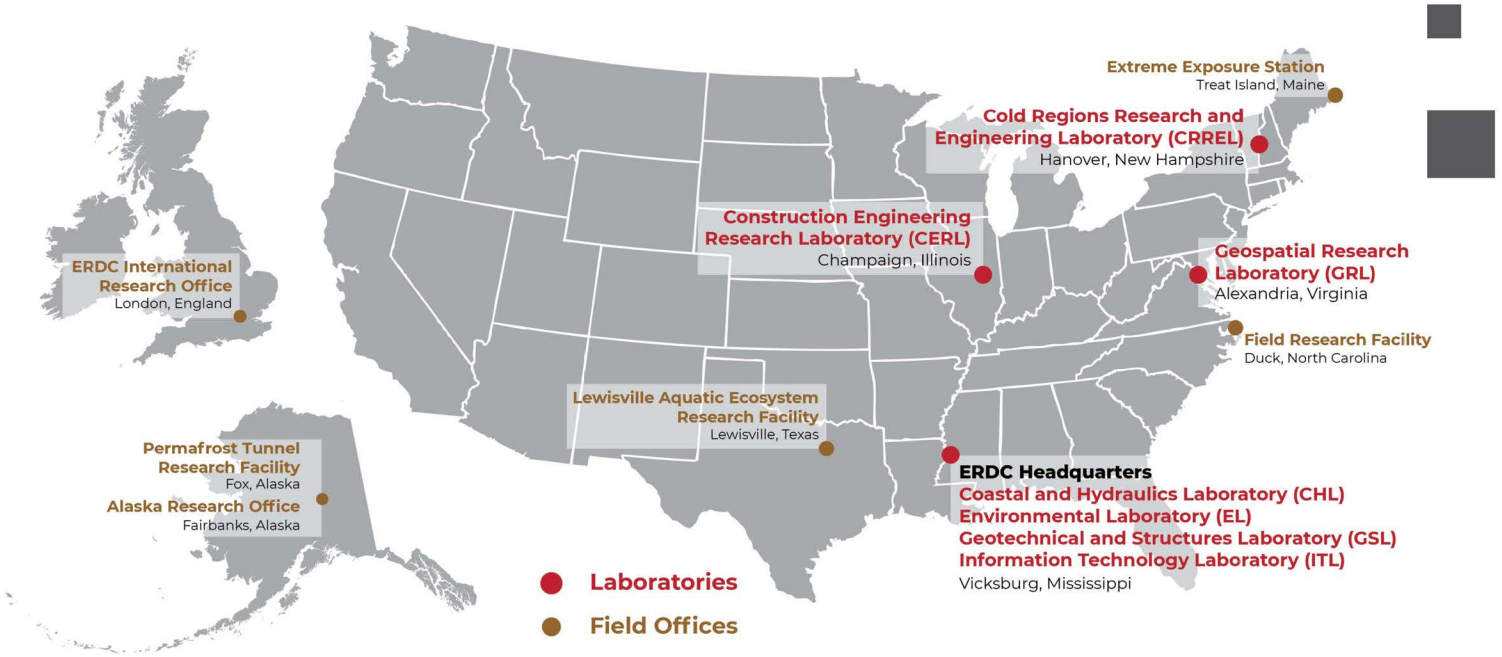
ERDC STRATEGY

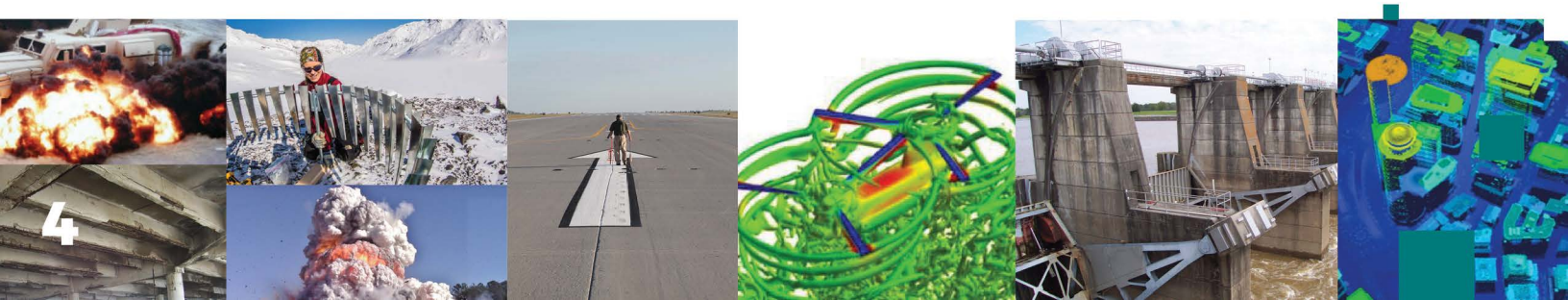
ERDC seeks to be the 'go-to' organization for the nation and our Armed Forces for solving big, complex problems in our mission space; for putting solutions into practice; and for producing results, outcomes and products that become the world standard.

We succeed because of our premier research facilities and capabilities; our extensive experience and history in finding solutions; our partnerships across the Department of Defense, industry and academia; and primarily because of our people, who are leading experts in their fields.

ERDC RESEARCH AND DEVELOPMENT AREAS (RDAS) INCLUDE:

- Military Engineering
- Civil Works
- Installation and Operational Environments
- Geospatial Research and Engineering
- Engineered Resilient Systems





ERDC CORE COMPETENCIES

ERDC's Core Competencies are those that USACE, Army and DOD recognize as ERDC leadership roles for the department. They are technology enablers not commonly found in the private sector or academia that represent a critical, unique need for the Army and DOD.

BLAST AND WEAPONS EFFECTS ON STRUCTURES AND GEO-MATERIALS: Enables understanding and prediction of weapons effects on surface/underground structures, and shapes solutions that counter and neutralize our adversary's energetic weapons.

BATTLESPACE TERRAIN MAPPING AND CHARACTERIZATION: Focuses on geospatial understanding of the operational environment, development of innovative mapping technologies, data management and analytics, and spatial and temporal applications that enable mission command.

COLD REGIONS SCIENCE AND ENGINEERING: Understanding/managing the challenges of operations in cold regions key to achieving operational capabilities of enhanced mission command, mobility and maneuver, and navigation/flood risk management in Arctic regions and mid- to high-latitudes and high elevations.

CIVIL AND MILITARY ENGINEERING: Technology leadership necessary for force protection, force projection and sustainment, and civil works missions (navigation, flood and coastal risk management, environmental sustainability, and hydropower and water supply).

COMPUTATIONAL PROTOTYPING FOR MILITARY PLATFORMS: Advanced engineering tools and techniques, and high-performance computing, to amplify/accelerate design operations early in the acquisition process.

COASTAL, RIVER AND ENVIRONMENTAL ENGINEERING: ERDC has a long history of leading the engineering profession in coastal, river and environmental engineering and related sciences.

MILITARY INSTALLATIONS AND INFRASTRUCTURE: Much of what is known today was developed in ERDC's 93-year history. Military Installations and Infrastructure enables military construction, installation support and Warfighter operations support overseas and in the battlespace, ensuring facilities, infrastructure and installation services are resilient, ready and efficient.




BASIC RESEARCH SUCCESSES

Proactive innovation and strategic investment in interdisciplinary R&D is paramount for success. While near- and mid-term tactical and operational R&D remains important to support USACE needs in the field as they arise, increased far-term strategic investment is critical to continued delivery of the USACE mission and vision into the future. Basic research seeks answers to fundamental questions and provides broad insights to many different scientific fields. It is vitally important because it lays the groundwork for major discoveries and innovation.

NANOMATERIALS RESEARCH

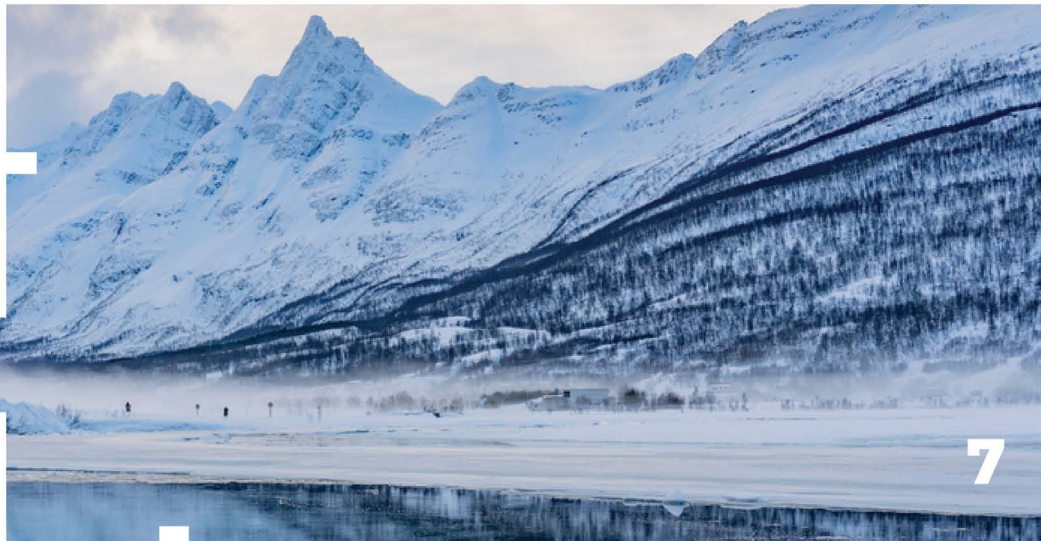
ERDC's investment in fundamental knowledge of nanomaterials characterization, detection, impact and risk has led to nano-enabled risk products. New and extraordinary physical-chemical properties of materials at nanoscale allows for new applications such as structural reinforcements, electronic properties and energy harvesting. ERDC is now the center for sustainable advanced materials, manufacturing and nanocomposites and has unique capabilities in nanomaterials research.

LITTORAL IMAGING SYSTEM

The Littoral Imaging System manages joint interests to discover, develop and deliver unmanned aerial system-based methods for the Army, Navy and Marines to assess littoral topography, water depths and near-shore hazards from standoff positions. The basic research began as bathymetry inversion algorithms and sensor evaluations and now includes a seamless bathymetry and topography along coasts for landing zone reconnaissance across the Armed Forces.

ARCTIC RESEARCH

This basic research investment in the Arctic and arctic climates provides Army mission planners with high-fidelity battlefield overlay maps and accurately shows terrain threats (soil, hydrology and snow/ice) in complex terrain not captured by current terrain mapping capabilities. This ensures movement through restrictive terrain by providing high-fidelity information in data-limited environments that aligns with USACE's R&D strategy of Defending the Arctic.



USACE R&D STRATEGY:
A BOLD NEW ERA

During a visit to the U.S. Army Engineer Research and Development Center in January 2021, Lt. Gen. Scott Spellmon issued a challenge that we must elevate and open a bold, new era for R&D within USACE.

In adopting that challenge from our leader, USACE and ERDC officials developed the "USACE Research and Development Strategy" and named 10 priorities to help guide our world-class R&D capabilities.

In adopting these "Top Ten R&D Priorities," we seek to apply our talents, our facilities and most of all, the top-notch expertise of our people – the Power of ERDC – to find innovative solutions to some of the toughest engineering challenges faced by our generation, or any other.

For decades, our R&D efforts have been focused on civil works, installations and operational environments, supporting our nation's Warfighter and helping others. While those key areas remain, this new alignment allows us to be more targeted in our approach.

From taking on the challenge of mitigating the impact of climate change, to discovering vital solutions to both protecting and defending the Arctic, USACE and ERDC have the experience and passion to thrive in this time of heightened research and development.

Investment in strategic R&D is a force multiplier. Successful outcomes in each priority area will be measured in two ways: how well they support the advancement of national priorities and how they enable USACE to deliver its mission more efficiently and effectively – faster, cheaper, stronger, safer and smarter.

SCAN USING YOUR SMART PHONE DEVICE

USACE R&D STRATEGY

- MITIGATE AND ADAPT TO CLIMATE CHANGE
- WIN FUTURE WARS
- MODERNIZE OUR NATION'S INFRASTRUCTURE
- SUPPORT RESILIENT COMMUNITIES
- ENABLE SMART AND 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







MITIGATE AND ADAPT TO CLIMATE CHANGE

At no time in our history have the challenges caused by a changing climate been more ominous. However, while these challenges are historic, so are the human capabilities to confront them. USACE and ERDC are researching more resilient and renewable energy resources, developing better ways to curtail greenhouse gas emissions, and delivering better models to forecast extreme weather events.

Post-Wildfire Flood Risk Management

ERDC provides accurate modeling forecasts for post-wildfire flood debris flows, helping emergency management officials better plan evacuations.

8:1 RETURN
on pre-hazard mitigation capability investment

Low Carbon Footprint Construction Materials

ERDC and partners are developing new materials that significantly reduce the carbon footprint, including the ability to permanently sequester carbon.

Near-term reductions in carbon footprint
UP TO 30%
over next five years

Carbon Sequestration Toolkit for DOD Lands

ERDC toolkit will enable installation leadership to estimate and maximize carbon sequestration on DOD lands.

Accounts for
50-80%
of DOD greenhouse gas emissions and promotes additional annual carbon storage increases

WIN FUTURE WARS

R&D of new and nimble technologies is vital to ensuring the U.S. military's advantage in the battlespace, whether that is on land, in the air, at sea or in space. USACE, fueled by ERDC research, provides the innovation, creativity and entrepreneurship that prepares the military for the conflicts of today and tomorrow.

Expedient and Expeditionary Airfield Damage Repair

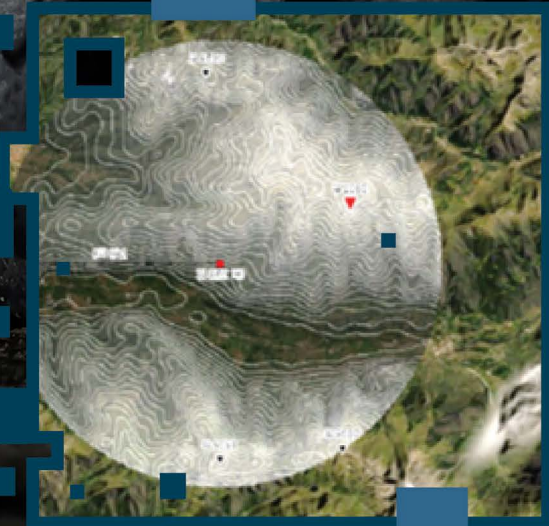
ERDC has reduced manpower, equipment and pre-positioned repair materials needed to operate forward air facilities with just-enough, just-in-time solutions.

C-130 TRANSPORTABLE EQUIPMENT set for worldwide distribution

Modular Protective System

ERDC developed a family of expedient protective structures that are rapidly assembled and reusable and require no equipment or special tools for construction.

Systems have been DEPLOYED WITHIN DAYS to protect Warfighters in Iraq, Afghanistan and other operational theaters

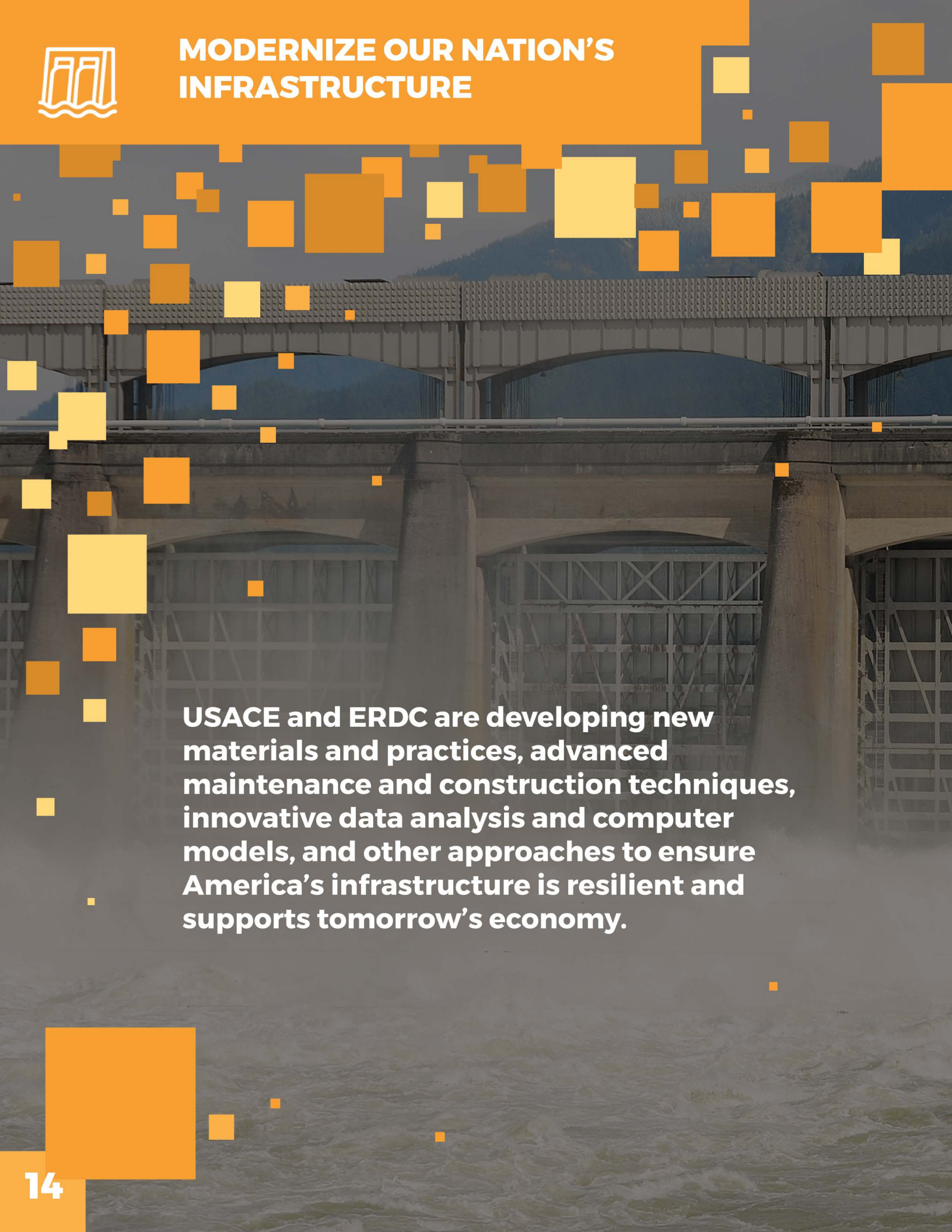


Map-Based Mission Planning

ERDC has developed geospatially enabled, collaborative mission planning capabilities that allow planners, staff and leaders to collect, process, store, display and share data and information.

MBMP enables IDEA SHARING and SITUATIONAL UNDERSTANDING in all phases of military planning

MODERNIZE OUR NATION'S INFRASTRUCTURE

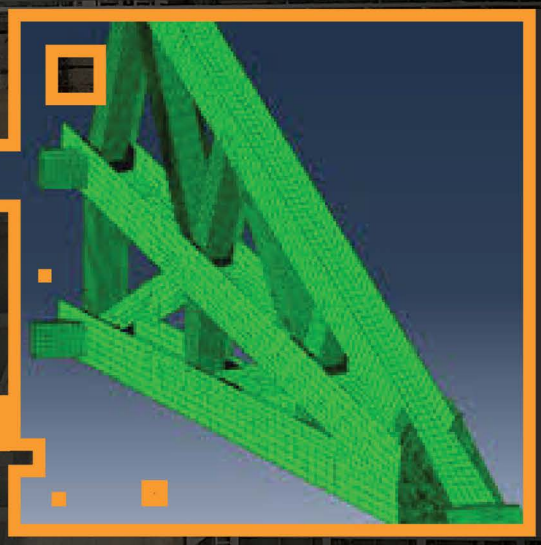


USACE and ERDC are developing new materials and practices, advanced maintenance and construction techniques, innovative data analysis and computer models, and other approaches to ensure America's infrastructure is resilient and supports tomorrow's economy.

Fiber-Reinforced Polymers

ERDC developed a process to use Fiber-Reinforced Polymers to repair fatigue-induced cracks in hydraulic steel structures, increasing service life and reducing repair time at significantly lower costs.

$2M (annually) operation and maintenance savings on one typical navigation project



SMART Gate

ERDC developed a platform for data-driven decision making to support optimization to operate and invest in infrastructure assets.

Avoid unscheduled lock outages, which cost local economies approx.

$3M PER DAY

Digital Twins

ERDC-developed digital twins of USACE infrastructure will streamline data processing and analysis and provide a centralized platform for modeled scenario conditions to inform decision making.

REDUCED TIME to achieve outcomes by 75% and REDUCED REACTIVE MAINTENANCE by 40%

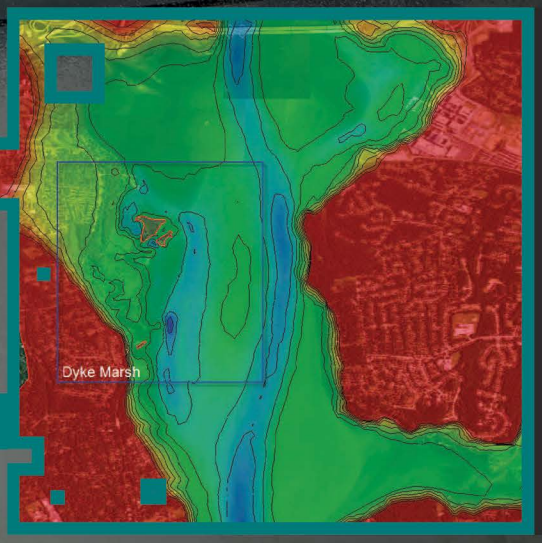
SUPPORT RESILIENT COMMUNITIES

Focused research by USACE and ERDC aims to develop advanced predictive models and tools to support water resource management, prevent and mitigate disasters, develop new approaches for improved emergency response, and develop multi-purpose risk reduction infrastructure that makes communities safe while adding social and environmental benefits.

Forecast-Informed Reservoir Operations

FIRO uses next-generation weather and watershed modeling to improve water-level forecasts in reservoirs and waterways, improving water supply reliability.

During 2020 pilot at Lake Mendocino, water was provided to an additional
60K PEOPLE



Coastal Storm Modeling System

CSTORM's integrated suite of high-fidelity storm modeling tools supports a wide range of coastal engineering needs.

Saves
$100s
OF MILLIONS
in regional construction costs

Dredge Scheduling Optimization

ERDC has developed a tool to optimally scale and sequence regional dredging contracts and maximize economic safety and security benefits.

$100M+
in yearly savings by addressing chronic maintenance backlogs

ENABLE SMART AND RESILIENT INSTALLATIONS

USACE and ERDC R&D are developing technologies and analytical capabilities to nurture smart installations that save money and energy and are more resilient to risks and hazards. The U.S. Army's greatest strength is its people, and the installations where they work and, in many cases, live must keep pace with civilian infrastructure and support a modernized formation.

VTIME

The Virtual Testbed for Installation Mission Effectiveness combines information from assets, sensors and enterprise databases, applying the latest in machine learning and artificial intelligence to optimize decision making.

Will reduce the number of systems personnel must access

Deep Energy Retrofit

The key to making a Deep Energy Retrofit cost effective is to leverage its timing as part of a major building renovation where funds are purposefully allocated to satisfy minimum energy requirements.

70% REDUCTION in energy costs and

90% carbon dioxide emission reduction

Automated Construction of Expeditionary Structures

ACES provides the capability to print custom-designed expeditionary buildings and materials with minimum personnel, providing structures that improve the safety, security and quality of life for forward-deployed troops.

44% reduction in concrete materials

ENSURE ENVIRONMENTAL SUSTAINABILITY AND RESILIENCE

In addition to leading ecosystem restoration activities throughout the country, USACE and ERDC are developing nature-based solutions and programs, such as the USACE Engineering With Nature® initiative, to improve and sustain the health and resilience of ecosystems.

HABITATS

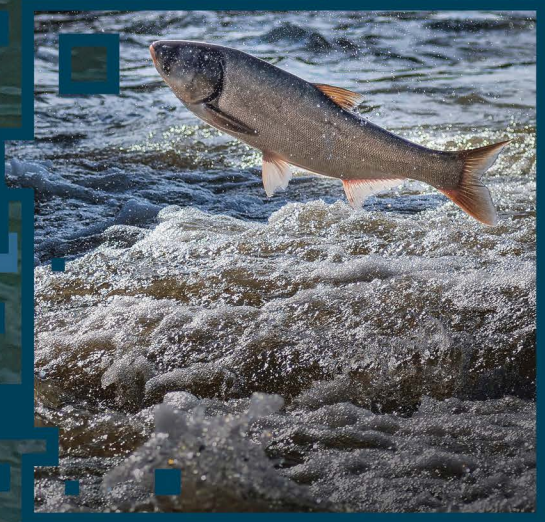
The Harmful Algal Bloom Interception, Treatment and Transformation System provides a scalable capability to remove algae and nutrients from large bodies of water and enable efficient management of the resulting biomass.

Pilots collected 4K GALLONS of algae slurry and created 700K GALLONS of clear water

Mangrove Forest Models

ERDC and U.S. Naval Academy partners built large-scale physical models to provide insight on wave reduction attributed to mangrove forests, enabling greater use of these natural systems for coastal resilience.

Reduces flood damages by $60B

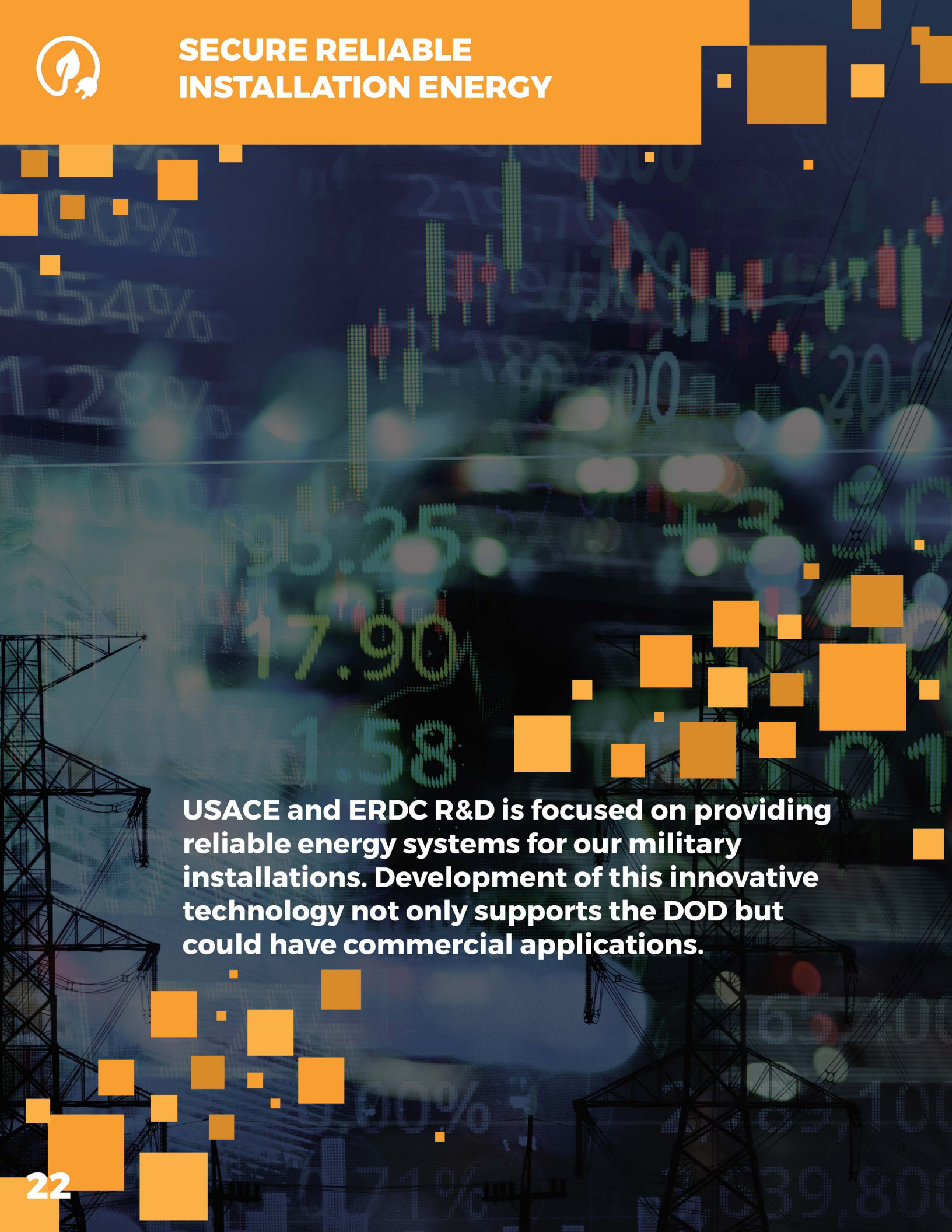


Confronting Invasive Carp

ERDC research uses swim tunnels and flumes to challenge live invasive carp with various frequencies and duration, providing critical information for electric barrier system protocols.

Preserves healthy $7B/YEAR Great Lakes fisheries

SECURE RELIABLE INSTALLATION ENERGY



USACE and ERDC R&D is focused on providing reliable energy systems for our military installations. Development of this innovative technology not only supports the DOD but could have commercial applications.

Tactical Microgrids, Mobile Nuclear Power Plants

Tactical microgrids can support additive manufacturing, hospital power, electric vehicle charging, on-site fuel production, power beaming, electrified rail, missile and air defense, laser defense and more.

MNPPS can provide power for MONTHS TO YEARS on a single fuel load

Fuel Cell Technology

ERDC is expanding and enhancing fuel cell technology, giving continuous reliable power to mission-critical facilities.

REDUCE DEPENDENCE on utility scale power and fossil fuels and reduce electrical costs

Thermal Energy Systems Resilience in Extreme Climates

ERDC is establishing thermal energy system metrics and requirements, filling a critical need for extreme weather climates.

INCREASES longevity of building systems

REVOLUTIONIZE AND ACCELERATE DECISION-MAKING

USACE and ERDC have recognized the value of machine learning, artificial intelligence, computer simulations, autonomy, and robotics and how they revolutionize operations. To reach this objective, ERDC is seeking tools that can reduce costs, streamline operations, and improve decision making through automation and data analysis.

DamBot

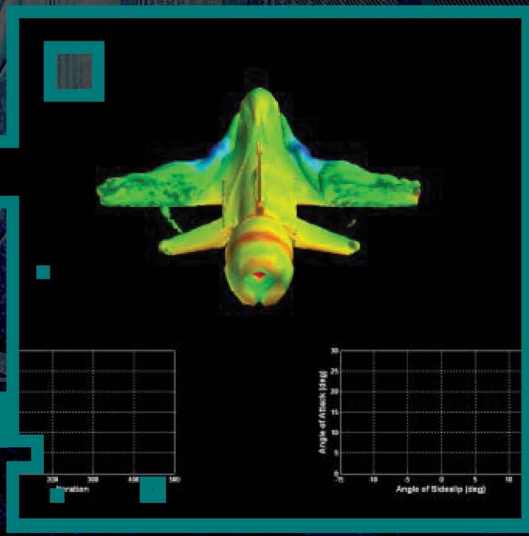
The DamBot provides a safer method for inspecting closure gates and other dam components, while giving a more thorough view of the facility's structural health.

REDUCES RISK to inspection personnel and provides RAPID, HIGH-RESOLUTION and repeatable inspections

Data Analytics for Faster, Effective Solutions

ERDC is incorporating accurate and faster data analytics to support more efficient dredge and hydropower operations, as well as to predict completion times for ongoing military construction projects to within 85 percent accuracy.

10% REDUCTION in overall dredging operation costs



Engineered Resilient Systems

ERS combines advanced engineering tools and techniques with unmatched high-performance computing to significantly amplify design options during early stages of the acquisition process.

TRANSITIONED techniques for HPC to DOD acquisition community

IMPROVE CYBER AND PHYSICAL SECURITY

Through innovations in risk detection and reduction, and by leveraging its expertise in support of the Warfighter, USACE and ERDC are conducting R&D to keep our nation's infrastructure and military safe. Aided by ERDC research, USACE is developing methods to identify cyberattacks and innovative solutions to repel them before damage occurs and operations are disrupted.

AVERT

A portable barrier designed to stop vehicles in their tracks, the Aggressor Vehicle Entry Readiness Technology will enhance the physical security of military and homeland installations.

Provides an effective vehicle barrier that is PORTABLE, MODULAR and EASY TO ASSEMBLE

Red Team

Operating as a Red Team under interim authority from the National Security Agency and U.S. Cyber Command, ERDC's cybersecurity team works to identify potential security holes and where defenses might fail in an attack on a secure network.

IDENTIFIES VULNERABILITIES of information systems

Hardened Alternative Trailer System

ERDC developed low-cost, versatile and rapidly assembled shelters that are blast and forced-entry resistant, providing superior protection to facilities and personnel around the world.

ROBUST, INEXPENSIVE and EASY to manufacture

PROTECT AND DEFEND THE ARCTIC

Ongoing R&D is seeking solutions for the Arctic and other extreme environments to mitigate the impact of climate change to ecosystems and vital infrastructure. Advancements built upon the history of both USACE and ERDC in cold regions research have led to breakthroughs in mapping, modeling, construction and other technologies to ensure operations can be maintained. This work also fits within the DOD's effort to both protect and defend the Arctic.

Winter Mobility Forecasting

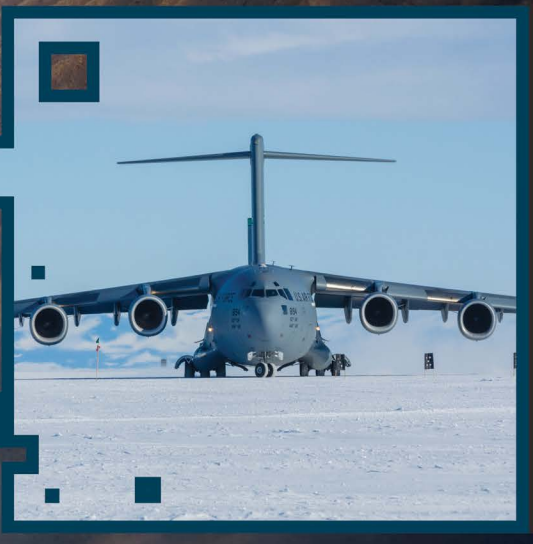
ERDC developed tactics, techniques and procedures to enhance mobility of military vehicles across snow-covered terrains, including timely and accurate performance characterizations of winter tires, cold-weather all-terrain vehicles and more.

IMPROVED MOBILITY FORECASTING for Arctic and northern terrains

Permafrost Research

Using its Permafrost Research Tunnel Facility in Alaska, ERDC's research into permafrost, and the changes caused when it thaws, enables improved Warfighter terrain state analysis and forecasting for Arctic and northern terrains and provides a deeper understanding of the environment.

Enables U.S. Army to PROTECT critical infrastructure and the homeland



Arctic Theater Power Projection

ERDC has developed maneuver decision support algorithms that provide solutions for energy logistics supply chain difficulties in Arctic environments.

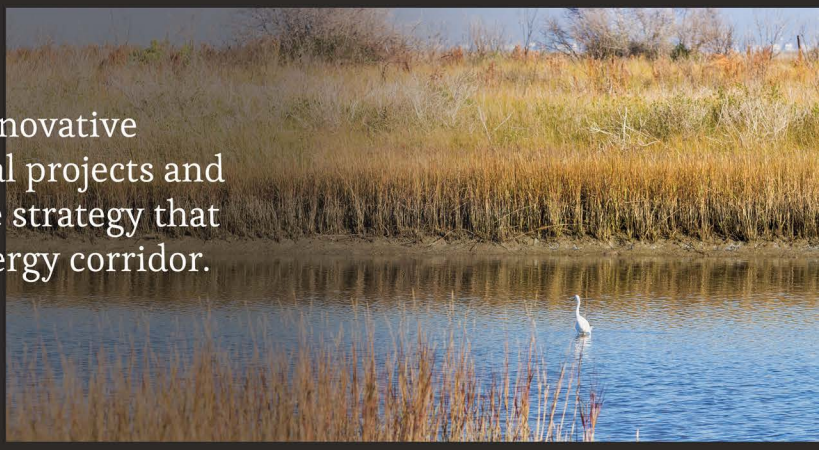
IMPROVED POWER PROJECTION in austere Arctic environments

ENGINEERING WITH NATURE®

USACE's Engineering With Nature® initiative is a collaboration of world-class engineers and scientists focused on incorporating nature-based solutions to address infrastructure around the nation and world. These projects produce billions in additional economic, environmental and social benefits, while building more resilient and sustainable solutions and communities.

Sabine Pass to Galveston Bay CSRM Project

The USACE Galveston District used innovative nature-based designs to inform coastal projects and implement a multiple lines of defense strategy that broadened resilience for the Texas energy corridor.



Simulations and hazard analysis saved
$300M
for the Sabine-to-Galveston Coastal Storm Risk Management Study

Maximizing Long-Term Function of Coastal Islands: Swan Island

Material from USACE Baltimore District maintenance dredging was used to restore Swan Island and support marsh growth and dune vegetation.

Provides RISK REDUCTION to surrounding islands and supports local ecological systems

Reservoir Sedimentation and Sustainability

ERDC research provides new and improved methods for stabilizing eroding shorelines, with special emphasis on incorporating in-situ materials and enhancing protection designs with natural components.

REDUCES reservoir sedimentation and downstream flooding

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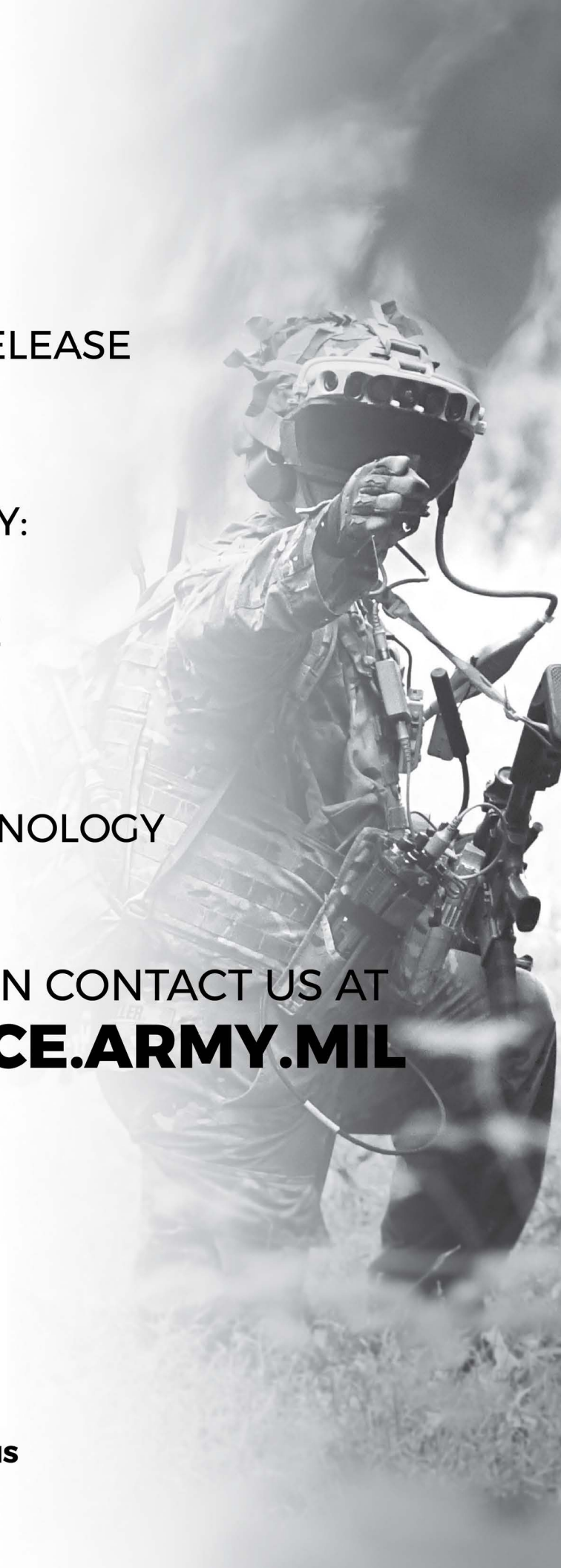
AUTHORED AND EDITED BY:

ERDC CORPORATE
COMMUNICATIONS OFFICE

DESIGNED BY:

ERDC INFORMATION TECHNOLOGY
LABORATORY

FOR MORE INFORMATION CONTACT US AT
ERDCINFO@USACE.ARMY.MIL



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