BROAD AGENCY ANNOUNCEMENT

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U.S. ARMY CORPS OF ENGINEERS (USACE)
ENGINEER RESEARCH AND
DEVELOPMENT CENTER (ERDC)

Contents

For more information about ERDC visit our website at: http://www.erdc.usace.army.mil/

INTRODUCTION

The U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) includes the Coastal and Hydraulics Laboratory (CHL), the Geotechnical and Structures Laboratory (GSL), the Environmental Laboratory (EL) and the Information Technology Laboratory (ITL) in Vicksburg, Mississippi, the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, the Construction Engineering Research Laboratory (CERL) in Champaign, Illinois, and the Geospatial Research Laboratory (GRL) in Alexandria, Virginia. The ERDC is responsible for conducting research in the broad fields of hydraulics, dredging, coastal engineering, instrumentation, oceanography, remote sensing, geotechnical engineering, earthquake engineering, soil effects, vehicle mobility, self-contained munitions, military engineering, geophysics, pavements, protective structures, aquatic plants, water quality, dredged material, treatment of hazardous waste, wetlands, physical/mechanical/ chemical properties of snow and other frozen precipitation, infrastructure and environmental issues for installations, computer science, telecommunications management, energy, facilities maintenance, materials and structures, engineering processes, environmental processes, land and heritage conservation, and ecological processes. This research is conducted by Government personnel and by contract or agreement with educational institutions, non-profit organizations, and private industry partners.

The provisions of the Competition in Contracting Act of 1984 (P.L. 98-369) as implemented in the Federal Acquisition Regulation (FAR 35.016) provide for the issuance of a Broad Agency Announcement (BAA) as a means of soliciting proposals for basic and applied research and that part of development not related to the development of a specific system or hardware procurement. To be eligible for consideration and possible contract award, the technology or methodology shall be either basic research, applied research, advanced technology development not for a specific system/hardware, or demonstration and validation. BAAs may be used by agencies to fulfill their requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding rather than focusing on a specific system or hardware solution. The BAA shall only be used when meaningful proposals with varying technical/scientific approaches can be reasonably anticipated. “Basic Research” is defined as research directed toward increasing knowledge in science with the primary aim being a fuller knowledge or understanding of the subject under study, rather than any practical application of that knowledge. “Applied Research” is the effort that normally follows basic research, but may not be severable from the related basic research; attempts to determine and exploit the potential of scientific discoveries or improvements in technology, materials, processes, methods, devices, or techniques; and attempts to advance the state-of-the-art. This announcement must be general in nature, identify the areas of research interest, include criteria for selecting proposals, and solicit the participation of all offerors capable of satisfying the Government's needs. The proposals submitted under this BAA

will be subject to peer or scientific review. Proposals that are selected for award are considered to be the result of full and open competition and in full compliance with the provisions of PL 98-369, the Competition in Contracting Act of 1984. Resulting awards may be in the form of purchase orders, contracts, grants, or cooperative agreements depending upon the specifics of the effort, such as extent of Government involvement, actual scope of work, and cost.

This announcement constitutes the BAA of this Command and conforms to regulatory requirements of the Federal Acquisition Regulation and Uniform Guidance. This announcement provides prospective offerors information on the preparation of proposals for basic or applied research. Directions as to form and procedures are included. This announcement is also posted on www.Grants.gov.

Proposals from U. S. Government facilities and organizations will not be considered under this program announcement.

PERSONS SUBMITTING PROPOSALS ARE CAUTIONED THAT ONLY A CONTRACTING OFFICER MAY OBLIGATE THE GOVERNMENT TO ANY AGREEMENT INVOLVING EXPENDITURE OF GOVERNMENT FUNDS.

This BAA supersedes all previous editions and shall remain in effect until superseded.

Proposals are encouraged from Historically Black Colleges and Universities or Minority Institutions (HBCUs/MIs) for students to provide research support to any of the research and development areas listed in this BAA. HBCU/MIs interested in submitting a proposal must address the specific areas of research under which they are submitting. They must also clearly state within their proposal their capability to perform the contract and include a positive statement of their eligibility as an HBCU or MI. These contracts will be written in accordance with the Contract Student Regulation in regard to pay, GPA requirements, place of performance and every other requirement or statement within the regulation.

ERDC also encourages small business concerns, women owned small businesses, small disadvantaged business concerns, small businesses located in HUBZones, businesses participating in the Small Business Administration 8(a) program, and service-disabled veteran- owned small businesses to submit research proposals for consideration.

The Offeror, by submission of an offer or execution of a contract in response to this solicitation, certifies that the Offeror is not debarred, suspended, declared ineligible for award of public contracts, or proposed for debarment pursuant to FAR 9.406-2. If the Offeror cannot so certify, or if the status of the Offeror changes prior to award, the Offeror must provide detailed information as to its current status.

Proposals submitted under the BAA should clearly identify within the proposal

any research that is expected to be fundamental in nature as defined in National Security Defense Directive 189. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

Please see page 110 for white paper/pre-proposal submittal information. (e.g., Strategic Environmental Research and Development Program (SERDP), Environmental Security Technology Certification Program (ESTCP), DoD Basic 6.1 Research Program, RESTORE Act, etc.)

Federally Funded Research and Development Centers (FFRDCs) and Government entities (Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and cannot propose to this BAA in any capacity unless they meet the following conditions: FFRDCs must clearly demonstrate that the work is not otherwise available from the private sector AND they also provide a letter on letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to government solicitations and compete with industry, and compliance with the associated FFRDC sponsor agreement and terms and conditions. This information is required for FFRDCs proposing to be prime or subcontractors. Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority (as well as, where relevant, contractual authority) establishing their ability to propose to Government solicitations. At the present time, DARPA does not consider 15 U.S.C. 3710a to be sufficient legal authority to show eligibility.

While 10 U.S.C. 4062 may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider eligibility submissions on a case-by- case basis; however, the burden to prove eligibility for all team members rests solely with the Proposer.

Located in London, England, the International Research Office (IRO) (http://www.erdc.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/9254/Article/47 6 750/international-research-office.aspx) of the US Army Engineer Research and Development Center (ERDC) (http://www.erdc.usace.army.mil/Home.aspx) promotes cooperation with the international research community as a means to advance science and engineering knowledge and technical capabilities in areas relevant to ERDC research interests. Research Grants that address topics in this BAA; Visiting Scientist Travel Grants to ERDC laboratories; and Conference/Workshop Grants are available in this context. Please address questions for IRO concerning the submission of proposals to: Tel: +44 (0) 1895-62-6522. Cell: +44 (0) 7703-804-924. DSN: 314-524-9922. Email: julian.p.richmond.ln@army.mil.

PART I

BACKGROUND AND RESEARCH INTERESTS OF THE RESEARCH LABORATORIES

The **COASTAL AND HYDRAULICS LABORATORY (CHL)** has nationally - and internationally - recognized engineering and scientific expertise related to inland waterways and the estuarine and coastal zones. CHL has foremost capabilities in prototype data collection, experimental research and numerical modeling and simulation of processes involving water levels, current, winds, waves and tides, and their interaction with sediments and structures.

Specific and unique expertise exists in the engineering, hydrodynamics, sediment transport, dredging and dredged material disposal, physical processes associated with environmental analyses, groundwater modeling, military hydrology, harbor engineering, and riverbank and shore protection. CHL has the Tri-Service Reliance mission for Logistics-Over- the Shore (LOTS) for Sustainment Engineering. The Shore Protection Manual, which is internationally recognized as the most authoritative source of engineering design and guidance for the coastal engineering profession, was originally developed by the Coastal Engineering Research Center (CERC) and is being replaced by the CHL with an updated and greatly expanded Coastal Engineering Manual.

The **GEOTECHNICAL and STRUCTURES LABORATORY (GSL)** performs research, development and testing in many areas such as: soil mechanics, foundation design, slope stability, seepage analysis, pavements (both expedient and permanent), rock mechanics, engineering geology and geophysics, earthquake engineering, vehicle mobility and trafficability, structural dynamics, explosion and weapon effects, survivability, earth dynamics, construction materials, impact of high-velocity projectiles, development of methods for installation of fixed installation camouflage, concealment and deception, and design and analysis of structures to resist static and dynamic loading. The Geotechnical and Structures Laboratory is equipped to perform any type of laboratory testing, including centrifuge applications, needed to assist in the types of research described herein.

The **ENVIRONMENTAL LABORATORY (EL)** conducts Military and Civil Works R&D for the Corps of Engineers, other Department of Defense elements, and other Government agencies in the general areas of Environmental Restoration (Clean-up) and Environmental Conservation. Areas of research include: (a) environmental sensing development, (b) hazardous waste site characterization and treatment, (c) sediment geochemistry and biological effects, (d) water quality modeling, and unexploded ordnance (UXO).

Environmental Conservation deals with sustaining natural resources entrusted to DoD for continued use through improving and developing tools and technologies of fundamental and applied process level research, use of modeling and statistics for

forecasting; all which conserve, protect, and enhance natural and cultural resources and foster stewardship. Areas of research include: (a) environmental database development; (b) environmental impact prediction, assessment, and management; (c) environmental criteria for stream channel alteration; (d) natural resource management, and animal movement behavior response to environmental (aquatic, terrestrial, aerial, social) patterns; (e) aquatic nuisance species management; (f) threatened and endangered species protection and management; (g) ecology, restoration, and management of plant communities in aquatic ecosystems; (h) water quality; (i) outdoor recreation; (j) cultural resources; and (k) ecosystem simulation.

The **INFORMATION TECHNOLOGY LABORATORY (ITL)** conducts research, development, and studies and provides technical assistance and operational support in information technology (IT) and closely related fields, with particular emphasis on the areas of computer-aided interdisciplinary engineering, computer-aided design and drafting, building information modeling, computer-aided facilities management, computer science, high performance computing, advanced computer security, general-purpose computing, and sensor and instrumentation systems. These activities are conducted to support and enable execution of missions of USACE, the Army, and DoD.

The **CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)** offers research and development (R&D) support, as well as technical assistance, to a variety of customers throughout the Department of the Army (DA) and other Government agencies. CERL is the lead Army facility for conducting R&D on infrastructure and environmental issues for installations. CERL's research is directed toward increasing the Army's ability to more efficiently construct, operate, and maintain its installations and ensure environmental quality and safety at a reduced life-cycle cost. To accomplish the mission, CERL has two Divisions: Facilities and Installations. Researchers in these Divisions are matrixed across the ERDC organization in multi-disciplinary teams that bring the best expertise to bear on solving problems for the Department of Defense.

The mission of the **COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL)** is to solve interdisciplinary, strategically important problems of USACE, Army, DoD, and the Nation by advancing and applying science and engineering to complex environments, materials, and processes in all seasons and climates, with unique core competencies related to Earth's cold regions. As a national resource for cold regions science and engineering, CRREL promotes understanding to support mission success through development and delivery of transformative technical solutions that meet operational challenges. Key technical areas of research and development include signature physics, terrestrial and cryospheric sciences, biogeochemical processes, environmental fate and transport geochemistry, force projection and sustainment, cold regions infrastructure, water resources/geospatial applications and hydrology and hydraulics.

The **GEOSPATIAL RESEARCH LABORATORY's (GRL)** mission is to enable battlefield dominance by pioneering geospatial solutions for the Warfighter. This mission

is accomplished through research, development, operations and systems support, and the application of expertise in the geospatial, topographic, and related sciences. Throughout its history, GRL has developed and exploited geospatial-related technologies critical to meeting the Nation's military. GRL has applied its expertise to the needs of homeland defense and the global war on terrorism. These technologies and their related research, operations, and systems development activities, essential to the Army in accomplishing its global mission, include the following:

- Timely acquisition, fusing, analysis, display, and dissemination of remotely sensed multi- sourced information depicting imagery, features, elevation, and other information essential to accurately describe the land warrior battle space.
- The development of geographic information software that enables reliable, efficient, and secure information management, interoperability and accessibility for various user communities operating globally, each with different needs.
- The development of globally fielded applications and systems for acquiring, accessing, fusing, and delivering terrain and feature information to the soldier.
- The development of accurate on-the-fly global positioning systems for use with inertial guidance as essential positioning engines for acquiring near real time, dynamic, high- accuracy, remotely sensed 3-d terrain and feature information.
- The development of increasingly compact, more efficient, and more comprehensive applications and systems aimed at providing low echelon combat units with information in near-real-time, enabling rapid response to developing situations in any battle space.
- The development of new and innovative techniques to understand and visualize terrain and battle space information in all dimensions, and to accommodate reasoning within analytical results.
- The development of accurate and efficient survey and mapping systems for use by both military and civil communities.
- Capabilities in acquisition, testing and fielding of topographic systems; advanced and engineering development of imagery systems; and research and development in the areas of imagery and intelligence data exploitation.
- Operational capabilities in geospatial information and imagery requirements development; terrain, hydrologic, and environmental analysis; and information services.

CONFERENCE AND SYMPOSIA GRANTS

I. Introduction

The ERDC supports conferences and symposia in special areas of science that bring experts together to discuss recent research or educational findings or to expose other researchers or advanced graduate students to new research and

educational techniques. The ERDC encourages the convening, in the United States, of major international conferences, symposia, and assemblies of international alliances.

II. Eligibility

Notwithstanding the above, the Department of Defense (DOD) has imposed certain restrictions on the ERDC's co-sponsorship of scientific and technical conferences and symposia. Specifically, DOD instruction 5410.20 prohibits co-sponsorship of conferences and symposia with commercial concerns, i.e., ERDC cannot co-sponsor conferences or symposia with a for-profit company. Scientific, technical, or professional organizations that qualify for tax exemption under the provision of 26 U.S.C. Sec. 501 (c) (3) may receive conference and symposia grants.

III. Conference Support

Conference support proposals should be submitted a minimum of six (6) months prior to the date of the conference.

IV. Technical Proposal Preparation

The technical portion of a proposal for support of a conference or symposium should include:

a. A one page or less summary indicating the objectives of the project.
b. The topics to be covered.
c. The location and probable date(s) and why the conference is considered appropriate at the time specified.
d. An explanation of how the conference will relate to the research interests of the ERDC and how it will contribute to the enhancement and improvement of scientific, engineering, and/or educational activities as outlined in the BAA.
e. The name of chairperson(s)/principal investigator(s) and his/her biographical information.
f. A list of proposed participants and the methods of announcement or invitation.
g. A summary of how the results of the meeting will be disseminated.

Cost Proposal Preparation

The cost portion of the proposal should show:

a. Total project conference costs by major cost elements.
b. Anticipated sources of conference income amount from each.
c. Anticipated use of funds requested.

V. Participant Support

Funds provided cannot be used for payment to any federal government employee for support, subsistence, or services in connection with the proposed conference or symposium.

COASTAL AND HYDRAULICS LABORATORY (CHL)

I. Introduction

Research is performed in the areas of hydraulic structures such as locks, dams, outlet works, control gates, stilling basins, spillways, channels, fish handling systems, and pumping stations, flood control channels, navigation channels, riverine and estuarine hydrodynamics and transport processes, groundwater, hydrology; dredging-related equipment, and on coastal problems related to shoreline protection, beach erosion, navigation, sedimentation, Regional Sediment Management, inlet stabilization, and construction, operation and maintenance of coastal structures (breakwater, jetties, groins, seawalls, etc.). Major areas of interest include coastal hydrodynamics (wind waves, tides, currents, wind related water levels); coastal sedimentation (longshore transport, inlet sedimentation); coastal geology and geomorphology; design and stability of coastal structures; erosion and storm reduction potential of natural and nature-based features; system optimization methods and performance metrics for coastal operations; coastal resiliency; and interaction of structures and coastal processes. Other activities include descriptions of coastal processes; theoretical studies; watershed and regional sediment and water systems studies; numerical and physical model techniques; data collection and analysis techniques; development of laboratory and prototype instrumentation and equipment. The following sections contain information on these research areas and specific research thrusts.

II. Research Areas

A. Physical Processes in Estuaries (CHL-1)

1. The research program in estuarine physical processes deals with the hydrodynamic and transport characteristics of water bodies located between the sea and the upland limit of tidal effects. Research is directed toward knowledge that will improve field measurements and predictions of these processes. Specific areas of required research include the following physical processes in estuaries and other tidal waters.

2. Specific areas of required research include the following physical processes in estuaries and other tidal waters.

    a. The propagation of tides.
    b. Transport of salinity, mixing processes, stratified flows.
    c. Transport, erosion, and deposition of sediments, including settling velocity, aggregation of sediment, consolidation of sediment.
    d. Behavior and characteristics of sediment beds, including movement, consolidation, armoring, bonding, physical chemical characteristics, density, erodibility.
    e. Flow between aquifers and surface waters.

3. Specific areas of required research include the following activities with respect to the physical processes listed.

    a. The effect of human activities, including dredging construction, vessel traffic, flow diversion, training, structures, and protective structures.
    b. Measurements of parameters that are indicative or descriptive of the processes listed in paragraph 2 by in-situ and remote methods in the lab and field.
    c. Prediction of processes listed in paragraph 2 by analytical methods, physical models, numerical models, and other techniques.
    d. Conceptual and mathematical descriptions of the processes listed in paragraph two.
    e. Development of materials, equipment, and methods that potentially lead to applied research that would make human activities listed safer, more economical, or more effective.
    f. Development of methods, techniques, and procedures that enable the treatment of an estuary as a system.

(Contact: Dr. Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

B. Inland Hydraulic Structures (CHL-2)

1. The research program in hydraulic structures is related to the hydraulic performance of locks, dams, outlet works, control gates, stilling basins, spillways, channels, bank protection, riprap stability, pumping plants and other hydraulic structures, and with physical and/or numerical model studies to predict and analyze the physical water quality aspects of water resources projects.

2. Specific areas of required research include the following:

    a. Conduct physical and numerical hydraulic model investigations of a wide variety of hydraulic structures to verify proposed designs and develop more effective and economical designs.
    b. Analyze model and prototype data and inspection of field installations to develop design criteria for hydraulic structures.
    c. Develop methods of correlating theoretical and experimental information with design methods used by the Corps of Engineers to improve existing procedures and provide material for inclusion in appropriate manuals.
    d. Develop physical and/or numerical models to predict and analyze the water quality aspects of water resources projects and design appropriate hydraulic structures to control water as well as water quantity while satisfying the desired objectives.
    e. Conduct research and/or develop numerical codes to advance techniques for analyzing physical aspects of water quality in lakes and rivers through a

better understanding of the hydrodynamics in density-stratified environments and for improving water quality within and downstream of density-stratified reservoirs and to investigate the ability of existing and proposed water resources projects to satisfy established water quality standards.

f. Conduct basic studies for development of hydraulic design and operation guidance for hydraulic structures used in inland waterways for navigation and flood control purposes, including wave forces/loads on gates (tainter, miter, etc).
g. Conduct/analyze tests, both model and prototype, of the performance of hydraulic appurtenances to flood control and navigation dams such as spillways, outlet works, energy dissipaters, and approach and exit channels, to develop design guidance that will provide structures of maximum efficiency and reliability with minimum maintenance.
h. Develop innovative methods to prepare and revise engineering manuals for hydraulic design of various hydraulic structures.
i. Develop innovative methods to conduct training courses on design of various hydraulic structures.
j. Develop innovative methods to prepare technical reports of all work conducted.

(Contact: Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

C. Open Channel Flow and Sedimentation (CHL-3)

1. The Stable Flood Control Channel research project consists of basic studies related to development of hydraulic design guidance for designing modifications to natural stream channels to provide for local flood protection. Emphasis is placed on channel stability as well as channel flow capacity.

2. Specific areas of required research include the following:

   a. Studies related to the development of effective methods to analyze a natural stream's response to modifications made for flood control purposes.
   b. Studies applicable to development of stream bank and streambed protection methods where channel instability exists.
   c. Studies applicable to development of sediment transport, local scour, and stream form relationships for a broad range of stream types, bed and bank materials, and meteorological and hydrological conditions.
   d. Collection and analysis of data that aid in evaluating existing methods and/or developing new methods to analyze channel stability for the variety of channel flow conditions and stream types existing in natural stream systems.

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D. Dredging Research (CHL-4)

Protection and enhancement of the environment associated with operation and maintenance of navigable U.S. waterway infrastructure through dredging activities is a national priority. Dredging operations and environmental requirements of navigation projects are inseparable. Research is required to predict the time-dependent movement of non- contaminated sand and sand/silt mixtures of dredged materials placed in the nearshore zone, and all materials placed in the offshore region.

The cost of dredging operations attributable to compliance with environmental windows that are determined to be over-restrictive, inconsistent, or technically unjustified can be reduced. More effective contaminated sediment characterization and management will reduce costs and enhance the reliability of methods associated with the assessment, dredging, placement, and control of sediments from navigation projects. Better instrumentation for dredge and site monitoring is required to implement automated dredge inspection and payment methods, and accurately monitor placement of contaminated materials.

Emerging technologies regarding innovative equipment and processes should be expeditiously introduced into the dredging arena. Enhanced ecological risk management for dredging and disposal projects through technically sound approaches for characterizing, managing, and conducting risk-based evaluations are required for expanding options regarding both contaminated and non-contaminated dredged materials.

(Contact: Charles (Eddie) Wiggins, (201) 761-4229, Email: Charles.E.Wiggins@usace.army.mil)

E. Navigation Channel Design (CHL-5)

1. The research program in navigation channel design involves basic research to develop design guidance for the design of new channels and modifications of existing waterways. It involves identifying maneuvering requirements in restricted waterways that affect the channel dimensions, alignment, and location of appurtenances in the navigation channel under various environmental and vessel traffic conditions. It also involves identifying the stability of the channel, maintenance requirements and designing structures that reduce or eliminate the maintenance requirements. Finally, it involves quantifying the flow and pressure fields generated by a tow or ship passing through a waterway and the related impacts on the sediment resuspension in the channel, channel border, and side channel/backwater areas. Studies involve deep and shallow draft navigation channels and physical and mathematical models. Human factors are included in research and project studies using a ship and tow simulator.

2. Specific areas of required research include the following:

    a. Physical model investigations of a wide variety of navigation channel configurations in many environments with different type vessels to verify

proposed designs and to develop more efficient and safe designs and to lower environmental impacts.

b. Development and enhancement of mathematical models of vessels, both ships and push-tows, for use on the simulator to add vessel types not available or to increase the accuracy with which the model reproduces the vessels response.
c. Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies, including those generated by the vessel movement.
d. Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies.
e. Development of methods and techniques to prepare and display visual information for the pilot on the simulator projection system.
f. Development of methods and measurement equipment, techniques for measuring scale model performance in physical model navigation studies.
g. Development of methods and techniques to improve the ship simulator and increase reliability of design estimates, including data and tools for ship motions, draw down, squat, ship-generated waves, and ship maneuvering.
h. Development of methods and techniques for the analysis and evaluation of model results to optimize the channel design and to determine the level of safety, or conversely, risk involved with the various designs and ship transits.

(Contact: Charles E. Wiggins, (202) 761-4229, Email: Charles.E.Wiggins@usace.army.mil)

F. Computer-Aided Hydraulic Engineering (CHL-6)

The objective of this research program is to develop computer-aided design tools that can be used by hydraulic engineers in planning, design, construction, operation, and maintenance of navigation and flood control projects. The scope includes open channel and closed conduit flows, equipment, structures, and sediment transport analysis and modeling.

(Contact: Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

G. Groundwater (CHL-7)

The groundwater modeling research program is structured to enhance understanding and prediction of the flow of water and various transported constituents through the environment. We are interested in groundwater issues from contaminant remediation to levee erosion as well as surface water problems from flash flooding to nearshore coastal flows. Our main tools are computer models that solve (approximately) conservation equations for mass, momentum, and energy in various physical systems. Our work includes developing the numerical methods for solving these equations,

writing the computer code to implement the approximations in desktop and high-performance computing environments, and applying the models as part of engineering studies to investigate processes like levee erosion and overtopping, seawater intrusion, and flow through vegetation.

(Contact: Dr. Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

H. Hydrology (CHL-8)

1. Research in this area primarily addresses military applications related to mobility, counter mobility, and water supply.

2. Specific research involves the following areas:

    a. Large-scale hydrologic modeling.
    b. Rapid procedures for flood forecasting.
    c. Groundwater-surface water interaction processes.
    d. Multi-scale, multi-physics hydrologic modeling.
    e. Remote sensing and quantification of precipitation.
    f. Development of spatially varying precipitation hydrology models.
    g. Visualization of results for hydrology and dam break models.
    h. Interfacing with existing and new hydrology models.
    i. Interfacing watershed models with water quality and other environmental models.

(Contact: Dr. Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

I. H&H GIS/Database Development (CHL-9)

Research involves the following areas:

a. Electronic Navigation Charting.
b. Integration of GIS/Database and H&H models.
c. Watershed management for erosion control.
d. Larger River System management for flood control navigation.
e. Visualization Techniques.

(Contact: Charles E. Wiggins, (202) 761-4229, Email: Charles.E.Wiggins@usace.army.mil)

J. Coastal Hydrodynamics, Coastal Processes (CHL-10)

Research in shallow water wave estimation; forecasting and hindcasting of wind generated waves for oceanic to local regions; wave theory; statistical distribution of wave parameters; simulation of spectral conditions in wave basins; nearshore currents; wave breaking; wave/current and wave structure interactions; wave and sediment

interactions with natural and nature-based features; long and short waves in ports and harbors; tsunami modeling; wind generated currents; storm surge; tidal circulation; two- and three dimensional numerical simulation models (including finite difference, finite element, finite volume and curvilinear coordinate techniques); coastal meteorology; explosion generated waves; ship response to winds, currents and waves; moored ship response; mooring design and analysis, ribbon bridge hydrodynamics and turbulence.

(Contact: Dr. Julie Rosati, (202) 761-1850, Email: Julie.D.Rosati@usace.army.mil)

K. Coastal Inlets, Navigation Channels (CHL-11)

Sediment shoaling in coastal inlet channels; stability and performance of inlet channels; scour at structures; sediment transport modeling; influence of structures such as jetties and breakwaters on wave, current, and sedimentation processes. numerical modeling of inlet hydrodynamics and sediment-transport processes, including long-term geomorphologic evolution of inlet channels, shoals, and adjacent beaches, and the interaction with navigation structures. Nearshore placement of dredged sediment to foster wave reduction and sediment supply to adjacent beaches. Short- and long-term dune evolution in vicinity of coastal inlets. Shoreline evolution modeling and storm erosion of beaches, particularly concerning over wash and breaching near inlets; wind and wave generated sediment transport; sediment budget analysis; coastal and inlet geomorphology; and PC-, workstation-, and mainframe-based automated coastal engineering software (including relational and GIS data bases).

(Contract: Charles E. Wiggins, (202) 761-4229, Email: Charles.E.Wiggins@usace.army.mil)

L. Coastal Structure and Facility Design (CHL-12)

Development of functional and stability design criteria for coastal structures and facilities (breakwaters, seawalls, jetties, groins, harbors, marinas, etc.); wave run-up, over-topping, refraction, diffraction, transmission, reflection, etc.; design of floating breakwaters; breakwater stability; application of spectral wave conditions to coastal engineering; stability of riprap to irregular wave attack; stability and functional design of overtopped rubble mound breakwaters; scale modeling of armor unit strength; analysis of structural data for floating breakwaters; investigation of numerical structural models for floating breakwaters; development of wave run-up gage for rough and porous slopes; investigation of attenuation/mooring force models of floating breakwaters; development of materials and techniques to produce high quality break- water model armor units; analysis of wave run-up overtopping, refraction, diffraction, transmission and/or reflection data on coastal structures and beaches and design of structures for Logistics-Over-The-Shore (LOTS) operations.

(Contact: Charles E. Wiggins, (202) 761-4229, Email: Charles.E.Wiggins@usace.army.mil)

M. Field and Laboratory Measurements, Data Collection, and Analysis (CHL-13)

Technologies, instrumentation, and monitoring systems in coastal and riverine settings for collecting, analyzing, and disseminating data related to measurements of coastal waves, surface currents, water levels, water quality, sediment, and wind, primarily in the field, but also in a sediment laboratory; advanced data analysis (spectral and non-spectral) techniques; remote sensing techniques; bedload and suspended sediment transport; monitoring and evaluating technical and structural stability of coastal projects; advanced hydrographic survey techniques, field measurement of coastal processes; bathymetric survey systems.

(Contact: Charles E. Wiggins, (202) 761-4229; Email: Charles.E.Wiggins@usace.army.mil)

N. Experimental Coastal Model Equipment, Operation and Analysis (CHL-14)

Development of equipment and techniques for specialized model construction, experimental wave generation equipment, specialized data acquisition and analysis systems, advanced model operations techniques, and laboratory and scale effects in movable bed model studies.

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O. General Coastal Engineering, Coastal Geology, Dredging Investigations CHL-15)

Sand bypassing systems and equipment; beach fill design; coastal geology and geomorphology; functional design and evaluation of coastal works and coastal structures; methodologies to assess and track coastal resilience performance; littoral transport; coastal and offshore dredging studies; agitation dredging systems and equipment; physical monitoring of dredged material; physical processes in coastal wetlands; application of Geographic Information Systems; design of nearshore and offshore dredged material placement; evaluation of dredged material disposal sites; analysis of dredging operations management.

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P. Regional and Watershed Sediment Management (CHL-16)

Regional Sediment Management (RSM) research is intended to provide knowledge and tools that the Corps and the Nation need for effective water resource projects. RSM implies the holistic management of sediment within systems or regions to produce environmentally and economically sustainable projects. Goals include improved project design, operation, and maintenance methods, minimized disruption of

natural sediment pathways and processes, and mediation of natural processes that have adverse environmental or economic impact.

The approach of the Corps research is to produce targeted R&D serving multiple Corps business areas; to employ ongoing projects' experience (including Demonstration Projects) to provide data and lessons learned; to use enabling technologies of local-scale products and tools, including those generated by other R&D programs within and outside the Corps; to generate technologies that integrate the best available knowledge on sediment behavior and regional morphology into management decision support tools for a) regional and basin scale analyses and b) evaluation of the impacts of projects and management decisions on and by long-term, large-scale sedimentation processes. A key element in ERDC research is full coordination with other organizations with sediment management or monitoring expertise.

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Q. Marine Transportation Technologies (CHL-17)

1. OBJECTIVE: The USACE has as one of its primary missions to provide safe, reliable, efficient, effective, and environmentally sustainable waterborne transportation systems for movement of commerce, national security needs, and recreation. To accomplish this mission, the USACE requires R&D to facilitate tracking of vessels on inland waterways (shallow draft) and coastal ports (deep draft). Knowing what vessels are arriving, when, the commodities being carried, etc., will provide lock operators and operations project managers valuable tools to improve safety, efficiency, asset management, and help to make decisions on performance-based funding for navigation project maintenance and improvements.

2. DESCRIPTION:

Focus: This topic focuses on software that uses the United States Coast Guard's (USCG) Automated Identification Systems (AIS) vessel mounted transmitters which broadcasts a radio signal with the vessels name, position, heading, velocity, and a wide range of other information. Proposals are sought for developing the following:

a. Capability that will take the full suite of standard CG AIS messages and provide them in near real time to the Corps facilities in the immediate area of the vessel.
b. Capability to allow collection of the full suite of standard AIS messages simultaneously at all pertinent Corps Inland and Deep Draft facilities.
c. Capability to customize user interface to allow the Corps operations staff to view vessels in the vicinity of the Corps facilities to make decisions on the order in which to allow commercial tows to pass through lock.
d. Provide the capability for Corps facilities to transmit pertinent information to

the vessels in the immediate vicinity of the Corps facilities via AIS.
e. System optimization methods and performance metrics for vessel operations.

Special Considerations: The level of understanding of AIS technology and signal processing, the number of successful installations of similar AIS software processing capabilities; experience with USCG staff, facilities, regulations, and procedures.

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R. Post-Wildfire Hydrologic, Sedimentation and Geomorphologic Management (CHL-18)

The research program in focused on improving understanding of post-fire impacts through exploitation of affordable data acquisition methods and enhancement of numerical capabilities to assist with planning, management, and mitigation in post-wildfire environments. Immediately following a wildfire, vegetation is removed, organic soil horizons are reduced to ash and hydrophobic soils combine to result in increased water and sediment discharge and debris, mud, and hyper concentrated flows. In the years following a wildfire, ecotone shifts, gully formation, and channel incision alter the hydrologic system response, resulting in dramatic changes in hydraulic and sediment impacts down system. Wildfires represent a significant perturbation to natural systems that dramatically alter the morphologic, hydrologic and sediment regimes of impacted watersheds. The overall purpose of this area of research and development is to investigate post- wildfire impacts on hydrologic and hydraulic response, geomorphic evolution, and sedimentation, with specific areas of needed research in the following areas:

a. Studies related to cost-effective (in situ and remotely sensed) data acquisition and processing methods.
b. Studies related to better understanding the longer-term geomorphic impacts and subsequent recovery processes in post-fire environments.
c. Studies related to hydrological physical processes, empirical approaches, and numerical modeling
d. Studies related to hydraulics and sediment transport physical processes and numerical modeling

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S. Nearshore Coastal Research in Support of the U.S. Coastal Research Program (CHL- 19)

Proposals are invited to address nearshore coastal research needs within three broad research themes as identified by the U.S. Coastal Research Program (USCRP)

(see Nearshore Process Community, 2015 for more details). Nearshore systems include the complex interactions of physical, biological, chemical, and human influences within the transition region across the land and the continental shelf, spanning (from onshore to offshore) coastal plains, wetlands, estuaries, coastal cliffs, dunes, beaches, surf zones, and the inner shelf. Worldwide, nearly 1 billion people live at elevations within 10 m of present sea level, many of whom are at risk due to changing climate and storm intensity. The nearshore is a societally relevant region that requires and improved understanding of the feedbacks and couplings that shape, sustain, and alter coastal landscapes.

The Three broad research themes include a need to understand, better predict, and respond to (1) long-term coastal evolution due to natural and anthropogenic processes; (2) Extreme Events: Flooding, erosion, and the subsequent recovery; and (3) The physical biological and chemical processes impacting human and ecosystem health. Each is detailed below.

1. Long-term coastal evolution due to natural and anthropogenic processes: As global environmental change alters the rates of sea level rise and potentially storm patterns and coastal urbanization increases over the coming decades, an understanding of coastal evolution is critical. Improved knowledge of long-term morphological, ecological, and societal processes and their interactions will result in an improved ability to simulate coastal change. This will enable proactive solutions for resilient coasts and better guidance for reducing coastal vulnerability.

2. Extreme Events: Flooding, erosion, and the subsequent recovery: Hurricane Sandy caused flooding and erosion along hundreds of miles of shoreline, flooded New York City, and impacted communities and infrastructure. Overall U.S. coastal extreme event related economic losses have increased substantially. Furthermore, climate change may cause an increase in coastal extreme events and rising sea levels could increase the occurrence of extreme events. Addressing this research theme will result in an improved understanding of the physical processes during extreme events, leading to improved models of flooding, erosion, and recovery. The resulting societal benefit will be more resilient coastal communities.

3. The physical, biological, and chemical processes impacting human and ecosystem health: Nearshore regions are used for recreation, tourism, and human habitation, and provide habitat and valuable ecosystem services. These areas must be sustained for future generations, however overall coastal water quality is declining due to microbial pathogens, fertilizers, pesticides, and heavy metal contamination, threatening ecosystem and human health. To ensure sustainable nearshore regions, predictive real-time water- and sediment-based pollutant modeling capabilities must be developed, which requires expanding our knowledge of the physics, chemistry, and biology of the nearshore. The resulting societal benefits will include better beach safety, healthier ecosystems, and

improved mitigation and regulatory policies.

T. Comprehensive Water Risk Management (CWRM) (CHL- 20)

Proposals are invited to develop and explore the application of next generation technologies, methods and approaches that lead to the creation of a seamless national hydro-terrestrial capability within the USACE and partner agencies, including capabilities that support social and environmental justice in flood risk management.

CWRM envisions advanced data collection, prediction and management technologies that can provide water managers the tools required to minimize, mitigate, and better manage water hazards under a non-stationary climate. Proposals for research in the following specific areas are needed:

a. Social and Environmental Justice (SEJ): Research to support the inclusion of SEJ in water risk management through updates to existing policy, methods, and protocols to assess non-monetary benefits and impacts, or through research that supports creating new policy.
b. Inland and Coastal Compound Flooding: Research to support the inclusion of inland and coastal compound flooding in the reduction of comprehensive flood risk from riverine flows, precipitation, coastal storms, groundwater emergence, sea level rise, snowmelt, wildfires, subsidence, and other natural as well as anthropogenic events.
c. Data Collection: Research to support the collection and analysis of water data through in-situ and standoff measurements including satellite, unmanned arial system (UAS) and autonomous techniques. Needs include data collection techniques for snowpack analysis, soil-moisture determination, wave environment, estimation of under-water bathymetry, reservoir capacity, etc.
d. Artificial Intelligence and Machine Learning (AI/ML) Technologies: Research to support the use AI/ML technologies to increase the accuracy and efficiency of hydrologic and hydraulic numerical models. Capabilities include advanced data assimilation technologies for error reduction and longer forecasts.
e. Flash Flooding: Research to improve the technologies to predict and mitigate water hazards due to flash flooding. Research requirements include downscaling of weather forecasts including precipitation, wind speeds, atmospheric pressure, etc.
f. Cold Weather Water Hazards: Research to improve the performance of predictive techniques in cold regions including the arctic. Research requirements include the effects of ice cover on wave and storm mitigation, the effects of the permafrost on hydrologic processes, the effects of flood risk mitigation features on freshwater sources, etc.
g. Arid Region Water Hazards: Research to improve the performance of predictive techniques in arid regions. Research requirements include infiltration processes, groundwater and surface water interaction, aquifer recharge, wildfire hydrology, etc.
h. Numerical Model Coupling Techniques: Research to improve the

performance of numerical model coupling methods. Research requirements include inter and intra-model communication for inter-agency model collaboration.

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U. Innovations in Sediment Management (CHL- 21)

Proposals are invited to develop leap-ahead innovative and sustainable dredging and sediment management solutions to dramatically reduce costs, increase channel/infrastructure reliability, and add significant economic, environmental, and social value to the Nation. Proposals for research in the following specific areas are requested:

1. Coastal/ Hydrodynamic Engineering NBS and Hybrid Solutions: Research to inform the development of tools, techniques, and guidance behind designing and engineering nature-based solutions (NBS) and hybrid solutions. This R&D will help in the development of methods and standards which support effective planning, designing, construction, and O&M of NBS/hybrid solutions to support the reduction of coastal and inland flooding risks. This research should focus on exploring the potential for integrating NBS/hybrid solutions within existing hydrodynamic engineering and land use planning practices. This research should also consider the social and environmental justice implications of hydrodynamic engineering and the potential for inclusive and equitable risk management.

2. Innovative Dredging Technologies/ Autonomous Methods: Research to develop technologies and techniques for improved dredging operations. R&D can address evaluating next-generation technologies and dredging operations (e.g., hydrodynamic dredging), real-time dredge position and bottom mapping techniques, autonomous dredging to reduce costs, increase beneficial use of dredged material, sediment transfer and placement equipment to facilitate more beneficial uses (e.g., thin layer placement, strategic placement), reduce channel and reservoir infilling to reduce dredging need, or renewing reservoir capacity through application of technologies developed for navigation channel maintenance.

3. Hydrodynamic and Geomorphologic Response of Biomaterials: Research into the use of bio-based materials, such as biopolymers, to enhance and increase the resiliency of nature-based solutions (NBS), including earthen levees, coastal dunes, and dam embankments. This research should focus on the hydrodynamic and geomorphologic response of biomaterials to the impacts of hydrological and meteorological extremes. Considering the performance and sustainability of bio-based materials, we seek to understand the potential of bio-based materials to reduce the risk and cost of rehabilitating and maintaining these structures and increase their resiliency against potential threats. We invite research that furthers our understanding and application of bio-based materials for this purpose, as a

component of comprehensive water risk management and adaptation to climate change. The research should be designed to provide evidence and support decision making. It should be based on research available at existing open-source platforms, or data that is proposed to be collected for the research.

4. Monitoring of NBS and Beneficial Use of Dredged Sediment Projects: Research to improve the understanding of the performance of NBS and beneficial use of dredged sediment projects through monitoring. Monitoring could include the project's response to storm events and the post-storm recovery. Monitoring techniques will vary based on the project but may be comprised of satellite data, remote sensing measurements, in-situ measurements, or engaging the public to crowdsource data collection. The monitoring research may also include the development or testing of innovative sensors or monitoring techniques.

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V. Next Generation Water Management (CHL- 22)

Proposals are invited to explore the application of next generation technologies, methods and approaches that are aimed at improving water management practice within the USACE and partner agencies, including efforts that support research, development, and implementation of capabilities to support Forecast Informed Reservoir Operations (FIRO). FIRO is a management approach that seeks to improve water supply, enhance flood risk reduction, and achieve additional ecosystem benefits through application of advanced weather and watershed forecast capabilities in water management practice.

FIRO envisions advanced observation and prediction technology that can provide water managers more lead time to selectively retain or release water from reservoirs based on longer-term forecasts. When storms cause moderate-to-high reservoir levels, normal operation is to release water to re-establish flood control space. FIRO pilot studies have demonstrated that some of that water can be retained for future supply as long as no major precipitation is expected, and it can be shown that the retained water can be released past downstream flood prone areas prior to the arrival of the next storm. This strategy permits earlier supply capture in some years, improving supply reliability for downstream water users and improving the timing and volume of releases to protect water quality and provide flows needed for ecosystem benefits. Proposals for research in the following specific areas are needed:

a. Improvement of forecast skill to support advanced water management, including meteorological phenomena that are major drivers for floods in various regions across the country including atmospheric rivers, tropical storms/hurricanes, clusters of long-lived thunderstorms and Nor'Easters. This can also include improvements in weather observations and numerical weather forecasting models that result in improved forecasting lead times for water

management decision-making.

b. Improvements in data synthesis, decision support systems and data visualization capabilities to enhance water management decision-making.

c. Hydrologic and reservoir model development and application, including improvements in watershed monitoring to enhance hydrologic and reservoir models.

d. Application of FIRO screening process tools to regions of the United States where FIRO has not previously been applied or tested.

e. Application of FIRO viability assessment processes to systems of dams where multiple dams are operated within a watershed to achieve overall system water management objectives.

f. Research to support updates to USACE Water Control Manuals (WCMs) using FIRO approaches, scenarios, and principles. Updates to WCMs require numerous studies in areas of meteorology, hydrology, hydraulics, ecology, and economics. Incorporation of next generation approaches such as FIRO require research efforts to identify best management practices on how to safely and effectively incorporate these new approaches into water management practice as defined in WCMs.

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GEOTECHNICAL AND STRUCTURES LABORATORY (GSL)

I. Introduction

Research performed by the Geotechnical and Structures Laboratory's (GSL) eight branches consists of investigations in the areas of soil mechanics, engineering geology, geophysics and seismology, earthquake engineering, pavements (both expedient and permanent), mobility and traffic ability of military vehicles, structural design and performance of structures under both static and dynamic loadings, earth dynamics, and the uses and performance of concrete, cement, and other construction materials. Research areas also include measurement and analysis of seismic and acoustic signals to locate airborne and ground military targets and buried objects (including unexploded ordnance) and to characterize earth media. Research on concrete and cement is predominantly related to current recognized needs, both civil and military. Military expediency focuses additional attention on ease and speed of concrete placement, development of very high-strength materials, and use of non-traditional, indigenous, and other special materials in concrete construction. Civil works research focuses primarily on the need to improve the performance of both new and old concrete structures. Structures research involves development, testing, and evaluation of a broad class of structures to resist the effects of static and dynamic loads induced by earthquakes and other sources. The Geotechnical and Structures Laboratory also conducts research involving all aspects for improving the survivability of fixed installations.

Research in numerical modeling and computer simulation of many of these topics is also undertaken. The following paragraphs provide a synopsis of the GSL's research responsibilities and, more specifically, describe those areas in which pre-proposals will be considered.

II. Research Areas

A. Earthquake Engineering (GSL-1)

Research areas of interest include the dynamic behavior of soil and rock; liquefaction of soils, including coarse-grained and fine-grained soils; in-situ testing to evaluate properties related to dynamic behavior; centrifuge scale-model testing using a multi-waveform shake table; in-situ testing to evaluate susceptibility to liquefaction; methods of analysis of dynamic behavior of earth materials; methods of analysis of dynamic soil- structure interaction; risk-based and probability-based methods of analysis; seismic wave propagation in earth materials; seismically induced settlements in soils and remedial treatment of soils potentially susceptible to earthquake-induced instability or strength loss; computer visualization and dynamic simulation; site response analysis; and strong motion instrumentation.

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Christopher.Price@usace.army.mil)

B. Geophysics (GSL-2)

ERDC supports research in the development of land, air, or waterborne geophysical methods to be used for characterization of hazardous waste sites, detection and monitoring of seepage, nondestructive investigation of archeological sites, location of groundwater, and detection of buried objects; analytical and data-processing techniques, borehole surveys, cross hole seismic imaging, electromagnetic detection of anomalies, seismic surveys, sub bottom profiling, and acoustic impedance surveys; and uses of microgravity.

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C. Mobility of Vehicles (GSL-3)

The Mobility Systems Branch addresses engineering research on the performance of vehicles operating cross country and on-road, and/or in negotiating dry and wet obstacles in worldwide terrains. This is a highly specialized technical area involving engineering mechanics, vehicle dynamics, mathematics, statistics, computer specialties, geology, and soil mechanics. Research in this area includes developing fundamental relations between soil and vehicle running gear; improving criteria concerning the effects of vehicle vibration and ride shock on sensors and data streams from rapidly moving sensors over rough terrain; developing algorithms describing weather effects on terrain, multi-vehicle movements along road nets, stochastic processes describing influence of uncertainties of data elements, and developing modeling and simulation capabilities for near real-time assessments of mobility and counter mobility for battlefield operations and operations other than war.

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D. Pavement Technology (GSL-4)

Research in this area is conducted in support of the Corps mission to design and construct roads and airfields worldwide and other related engineering functions. This research includes the development of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of permanent and expedient airfields, pavements, and ports. Research areas of interest include improved design procedures, structural performance modeling, material characterization and evaluation, nondestructive testing, rapid repair of structures, expedient surfacing (to include novel, composite, and metallic systems), aircraft and vehicular ground flotation, access/egress systems, gravel surfaced and non-surfaced areas, the use of geotextiles and geomembranes, grid-confining systems, soil stabilization, dust-control materials and techniques, advanced binder systems, remote assessment, earth anchoring, pavement evaluation, and advanced testing, monitoring, and evaluation equipment, software, and

methods to support pavement and pavement related functions.

(Contact: Ms. Anna Jordan, 601-634-5361; Email: Anna.M.Jordan@usace.army.mil))

E. Soil and Rock Mechanics (GSL-5)

Research is needed to: (a) improve methods for prediction and control of erosion of unlined spillway channels during uncontrolled releases; (b) develop innovative methods for flood protection and flood fighting, including field evaluations of promising technologies; (c) develop guidance for applications of trenchless technology (e.g., micro tunneling, horizontal directional drilling, pipe ramming, pipe jacking, auger boring, etc.) on Corps structures, including measures to ensure safety and stability of Corps structures when trenchless technology is used to install pipelines, cables, or conduits through or beneath levees and other structures;(d) develop improved methods, including risk-based methods for analyzing earth and rock fill dams and other water control structures for both static- and earthquake-induced stresses; (e) improve the state of knowledge of physical and engineering properties of soil, rock, and clay shales; earth-rock mixtures, granular filters, cohesive and non-cohesive fine- grained soils susceptible to liquefaction; and soils susceptible to drastic volume changes (collapse, consolidation, swell); (f) develop rational analytical procedures and more reliable prediction of behavior of partially saturated soils; (g) determine the response of soils in situ to static and dynamic loading and unloading; (h) determine the susceptibility of earth dams to cracking, hydraulic fracturing, and internal erosion; (i) evaluate improved defensive design measures in use of materials, particularly in filter and transition zones and impervious barriers; (j) improve procedures for monitoring and analysis of the performance of new and existing structures, particularly the use and interpretation of observations and data from specialized instrumentation, and expedient systems for rapid inspection and evaluation of the integrity of dams; (k) improve the understanding of the aging processes in dams and the influence of aging (particularly deterioration of safety-related features) on long-term maintenance and/or rehabilitation requirements for dams; (l) develop a better understanding of failure mechanisms to improve design of defensive measures, to provide information for remedial repairs, to assess potential damages resulting from failure, and to provide a basis for emergency actions; (m) develop expedient remedial measures when hazardous conditions are identified and, thus, reduce the damages and catastrophic potential of dam failures; (n) develop methodology to evaluate forces exerted on structural elements by adjacent soil masses that result from long- term variation in soil properties; (o) develop improved methodology for design and construction procedures for shallow and deep foundations, including mats, footings, piers, and piles for buildings, hydraulic structures and waterfront structures; (p) large-scale physical and numerical modeling of deep underground structures (tunnels, shafts, chambers, and intersections); (q) predictions of rock mass dredgability; (r) acoustic emission (micro-seismic) applications in geotechnical engineering; (s) geotechnical aspects of hazardous and low-level radioactive waste disposal; (t) evaluation of rock for use as riprap; (u) grouting of soil and rock masses; (v) sliding stability of gravity structures, and (w) centrifuge modeling of structures founded on or in rock.

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F. Dam Research (GSL-6)

Research is conducted in support of the Army's Dams and Transportation Infrastructure Program, specifically the Dam Safety subcomponents. Research covers design, construction, maintenance, repair, and inspection procedures of Army dams as well as other engineering functions as they relate to transportation structures. This involves the formulation of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of dams. Research areas of interest include improved inspection procedures, material characterization and evaluation, nondestructive testing, rapid repair, scour, unknown material properties, unknown foundations, and underwater inspection.

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G. Engineering Geology (GSL-7)

The GSL conducts a broad range of research in the field of engineering geology in support of federal or other Government technical missions. Specific areas of interest within this field include application of remote sensing to geologic and geomorphic assessments; geo-archeological investigations; applied and numerical geomorphic analysis; computer applications in geotechnical engineering; 3-D visualization systems; uses of geographic information systems; geo hydrology in military and civil applications; including water quality and supply issues; geologic mapping; geologic applications of mathematical techniques and geo statistics; groundwater monitoring, including well installation and design; geologic application of groundwater models; integration of geological and geophysical subsurface exploration techniques; land-loss studies; remedial measures at groundwater contamination sites; seismic hazard characterization and evaluation; subsurface exploration methods (drilling and sampling techniques); test site selection; conceptual and geologic and hydro geologic models.

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H. Excavation, Structural Demolition, and Obstacle Creation (GSL-8)

Current criteria for improved demolitions call for significantly reduced manning levels and preparation times to accomplish assigned missions. Cost effectiveness, versatility, and safety are also of great importance. Current efforts involve technologies for the standoff creation and reduction of all types of battlefield obstacles, and the excavation of fighting positions. A prime consideration is the development of more efficient means for the application of various types of energetic materials to targets of

interest. In addition, modern materials and design principles used in typical target structures must be incorporated into future plans and guidelines for demolitions. Typical missions of interest are road cratering, anti-tank ditching, bridge and tunnel demolition, and the breaching of walls, bunkers, levees, and dams.

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I. Ammunition Storage Safety (GSL-9)

The military services must store large amounts of munitions, both for war reserves and for training purposes. New conceptual designs for components or systems for storage are needed to reduce the likelihood of an accidental detonation of stored munitions, limit the propagation of air blast and fragments, or mitigate the safety hazards produced by an accidental detonation. In addition, test data and simulation techniques are needed to aid in the definition of the safety hazards from such detonations, and the mechanics of blast propagation among munition stores. Obsolete munitions are often disposed of by deliberate, controlled detonation. Research is needed on new methods for safe, efficient, and environmentally acceptable methods for deactivation of a wide variety of munition types.

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J. Physical Simulation of Munition Phenomenology (GSL-10)

The mechanical effects induced by munition detonations are physically simulated using a variety of energy sources. Simulations are performed at full- and small (1/2 to 1/10) scale. The mechanical effects from conventional energetic materials are normally performed at small scale. These studies could benefit from improved (better fidelity, less expensive) simulators and simulation techniques. They could also enhance the development of test methodology for micro-scale (1/100 to 1/10) testing including centrifuge testing. Micro-scale test methodology includes the miniature high- fidelity energy sources, miniature sensors, advanced optical techniques, high-fidelity construction techniques for miniature structures, and theoretical developments in the scaling of material behavior.

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K. Geophysical Phenomenology - Multi-Modal Geophysical Phenomenology, Modeling, Data Processing, and Data Management (GSL-11)

The objectives include detecting, classifying, and locating airborne and ground military targets and buried objects using geophysical methods for homeland defense

and homeland security applications. Also included are invasive and non-invasive approaches for measuring and quantifying the geophysical/geologic signatures of diverse geo-environments. This can include the development of new and/or improved analytical and numerical models, rapid data- processing techniques, and new subsurface imaging techniques that include active and passive sensor modalities in a variety of rural and urban terrains.

Of particular interest is the broadband propagation of energy including, but not limited to seismic/acoustic/infrasonic/electromagnetic/ thermal/chemical, under variable conditions using a variety of sensing platforms (fixed, mobile, airborne, space). The development of new tactics, techniques, and procedures for the employment of novel sensing methods as well as the development and/or verification of empirical testing and evaluation techniques is also desirable. Data management and multi-mode integration techniques and platforms are also of interest.

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L. Laboratory Tests and Constitutive Model Development for Geologic Materials (GSL-12)

This research requires the formulation of mathematical constitutive models to simulate the mechanical behavior of geological and structural materials and incorporation of models into application-oriented prediction/analysis techniques. Also of interest are the development of dynamic test equipment and techniques and the experimental evaluation of geological and structural material response to high-pressure transient loadings.

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M. Projectile Penetration (GSL-13)

Theoretical and experimental studies of projectile stresses and trajectories due to impact and penetration into geologic and man-made targets and development of design criteria for shield systems include development of equipment and diagnostic techniques to examine the response of targets to low- and high-velocity impact of penetrators, rods, etc.

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N. Computational Structural Mechanics for DOD Applications (GSL-14)

The efficient use of scalable computers will require fundamentally new concepts in computational mechanics algorithms. Research includes mathematical formulations and development of scalable computational mechanics algorithms in the areas of

structural response, penetration, contact impact, structure-medium interaction, multi-scale, multi-physics, and interdisciplinary flow-thermal-structural interactions. This research area also includes development of computational models for new materials and composite construction (consisting of concrete, composite, and/or geologic materials), as well as the behavior and control of structures composed of such composite construction for military applications.

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O. Concrete Materials (GSL-15)

Research in this area includes improving the performance of concrete materials and systems. Performance could include very high tensile or compressive strength, high ductility, high fracture toughness, low shrinkage, rapid hardening, very low permeability, resistance to abrasion and erosion durability, chemical resistance, shock-attenuating properties, ultra-low density, thermal insulation properties, workability, and other unique attributes. This includes improvements in the materials typically used in a concrete mixture such as aggregate, cement, supplementary cementitious materials, and chemical admixtures. Aggregates could include waste and/or manmade materials such as fly ash (traditional, blended, or reclaimed), silica fume, ground granulated blast-furnace slag, recycled concrete, lightweight aggregates other potentially low cost and/or green materials. Micro- and Nanoscale aggregates, inclusions, pozzolans, cements and reinforcements such as microspheres, nanosilicates, microfibers and low-cost nanotubes or nanofibers would also be included in this research area. Chemical admixtures such as water reducers, set retarders, set accelerators, air-entraining admixtures, and foaming and defoaming agents that lend unique properties would also be considered in this research area. Since reinforcement is a critical element to the ductility and durability of concrete materials, advanced reinforcement materials that enhance these properties fall under this research area. Additionally, this topic area would include research involving nontraditional cement binders including polymer-impregnated concrete, polymer or resin concrete, polymer Portland-cement concrete and geopolymer concretes.

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P. Concrete Properties and Analysis (GSL-16)

Research in this area if focused on the development of new nondestructive and destructive test methods and analysis techniques to better characterize the properties and performance of concretes and the constituents that they are composed of at scales ranging from the nano-level to the macro-level. There are a vast number of topics in testing and analysis that could be included in this area as related to the physical and chemical properties of aggregates, cements, pozzolans, admixtures, fibers, and their interaction during the mixing, placing, curing, and service phases of a concrete. This could include but is not limited to:

1. Developing test methods and analysis techniques to better quantify material properties at aggregate-paste and fiber-paste transition zones.
2. Developing tools, test methods and analysis techniques to non-destructively define the spatial distribution of components in a concrete specimen.
3. Developing better assessment tools and criteria for predicting durability and longevity of concrete and grout.
4. Developing better methods to define and classify chemical admixtures by chemical composition and mechanism of performance.
5. Developing innovative systems to construct concrete materials and structures more economically.
6. Developing theoretical, computational, and experimental methods for effectively characterizing stress, strain, progressive damage, and fracture of engineering materials subjected to static and dynamic loads.

(Contact: Dr. Jameson D. Shannon, 601-634-2218; Email: Jameson.D.Shannon@usace.army.mil)

Q. Maintenance, Repair, and Rehabilitation of Concrete (GSL-17)

Forensic analyses such as assessment of remaining life, maintenance and minor remedial measures, repair and rehabilitation, and surveillance and monitoring are topics of interest. Structures of interest include concrete locks and dams and appurtenant concrete and steel structures (outlet works, retaining walls, gates, piles, bulkheads, tunnels, intakes, etc.), other horizontal and vertical concrete infrastructure, and metals and polymer systems related to those concrete components.

(Contact: Dr. Jameson D. Shannon, 601-634-2218; Email: Jameson.D.Shannon@usace.army.mil)

R. Other Areas of Materials Research (GSL-18)

Research is needed in the development, properties, and performance of a range of materials for military and civil applications. Needed materials research for concrete applications includes such materials as: curing compounds, coatings, and overlays; polymers or other agents for improving bond between old and new concrete; water stop materials for use in hydraulic structures, and methods for characterizing and testing such materials; grouts for injection underground in very fine fracture systems or porous media; organic and inorganic composites that are used in construction; and grout materials and technologies for waste-disposal and containment such as for both commercial and defense-related low-level and high-level radioactive wastes.

Other materials research needs include the development, testing, and prototyping of metals, composites, or other novel materials exhibiting advanced mechanical, thermal, rheological, chemical, electrical, and multi-functional properties, and performances. Research is performed on energy absorbing materials for impact,

ballistic and blast resistance; hierarchical, multi- layered, and functionally graded material systems; multi-scale reinforcement for macro performance; self-sensing and self-healing materials; and materials demonstrating advancements in durability, high strength-to-weight, fatigue resistance, and ease of application.

(Contact: Dr. Jameson D. Shannon, 601-634-2218; Email: Jameson.D.Shannon@usace.army.mil)

S. Bridge Research (GSL-19)

Research is conducted in support of the Army's Dams and Transportation Infrastructure Program, specifically the Bridge Safety and Waterfront Facilities subcomponents. Research covers design, construction, maintenance, repair and inspection procedures of Army bridges and waterfront facilities worldwide as well as other engineering functions as they relate to transportation structures. This involves the formulation of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of permanent and expedient bridge and port facilities. Research areas of interest include improved inspection procedures, material characterization and evaluation, nondestructive testing, rapid repair, scour, unknown material properties, unknown foundations, traffic safety, underwater inspection, fracture critical and fatigue evaluations, load capacity, load testing, and load ratings.

(Contact: Ms. Mariely Mejias-Santiago, 601-634-2709; Email: Mariely.Mejias@usace.army.mil)

T. Structures Research (Civil Works) (GSL-20)

Research is conducted in assessing the performance of critical structures to extreme loads, such as those resulting from seismic, terrorist attack, and storm events, as well as the effects of flow-induced vibrations. Efforts include assessing sensitivity of structural design and analysis procedures, vulnerability of structures, and critical design parameters to develop appropriate load-resistance factors. Techniques for retrofit, including use of new and innovative materials, of structures to resist extreme loads is of interest. Also, a better understanding of long-term behavior and deterioration of civil structures is needed, including factors such as material interactions, thermal stresses, and any issues affecting design of new structures and operation and maintenance of existing structures.

Nonlinear and linear system identification research includes vibration testing, data acquisition, data processing, and analysis techniques for determining linear and nonlinear dynamic and static response properties of structures and structural systems subjected to earthquakes, blast effects from mining (or other) operations, other transient random, harmonic dynamic loads, and static or pseudo static loads.

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Ms. Mariely Mejias-Santiago, 601-634-2709; Email: Mariely.Mejias@usace.army.mil)

U. Structures Research (Military) (GSL-21)

1. Research is needed on the response of aboveground and shallow-buried structures subjected to military dynamic loads; specifically, the prediction of the load and response to failure of aboveground and shallow-buried structures. This effort will involve the following research:

    a. Development of techniques to simulate military dynamic loads on aboveground and mounded structures.
    b. Development of design procedures for components in semihardened and protected facilities.
    c. Analysis of structural loading and damage resulting from internal or external detonations.
    d. Development of fast-running models for PC based applications to predict the response of structures, both hardened and unhardened, to single and multiple explosive detonations.

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2. Research on deeply based structures and hardened existing systems involving the following:

    a. Development of comprehensive structural design for deeply buried and surface-buried structures subjected to air blast-induced and direct-induced ground shock from surface and shallow earth-penetrating high-energy sources.
    b. Formulation of computer models for SSI and pre- and post-test analysis of structural response to include correlation and comparison with experimental data.

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3. Research on surveillance and intrusion detection sensors involves the constraints of the environment on sensor systems used to detect intruders and placed along the perimeter of high-value military installations. Improved methods for rapid and accurate measurement of predetermined influential environmental parameters must be developed. Analytical techniques relating to specific sensing phenomenology's and target/nontarget-generated signatures and signature wave interactions to variations in environmental characteristics are required. Of particular interest is the integration of multiple sensor systems (both detection-type and environmental/background monitoring transducers) that use various

sensing phenomena for enhanced target detection and classification and increase nuisance and background signature rejection. Research studies are required in the determination of automated techniques for monitoring sensor system response and sensitivity to provide optimum and consistent performance as a function of time varying changes of influential environmental characteristics.

(Contact: Mr. Omar G. Flores, 601-634-3263, Email: Omar.G.Flores@usace.army.mil)

4. The Corps of Engineers is involved with research on the design of military facilities for protection from high-energy sources. These efforts include the following research:

    a. Prediction of the response of structural elements common to conventional or expedient construction to military loads.
    b. Methods of retrofitting conventional buildings to harden them against nearby military high-energy sources.
    c. Development of innovative design of structural components, such as windows and doors, subject to high-energy sources.
    d. Development of analytical methods for predicting the effects of forced entry devices on structural components.
    e. Development of innovative designs using low-density materials for expedient protection of troops and equipment from the effects of military high- energy sources.
    f. Development of microprocessor-based software/hardware and supporting documentation to aid in the assessment of structural survivability to the effects of conventional and advanced weapons systems. The software will address the integration of databases, weapons effects calculations, and operational factors associated with engineer survivability missions.
    g. Development of a procedure to ensure robust codes, user-friendly interfaces, and supporting documentation for use in the testing and development of microprocessor-based survivability and structural assessment software/hardware.

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5. Composite Materials for Force Protection-Research in this area includes developing, characterizing, modeling, and testing of layered composite materials for protection against air blast and penetration/fragmentation. These materials are intended for use in lightweight expedient protective systems to protect against improvised explosive devices and conventional weapons such as small arms, standoff weapons, fragmenting weapons, and shape charges. It is envisioned that panels of these materials could be incorporated into protective structure designs to increase survivability of personnel or to protect mission-critical assets. Performance measures include such attributes as build time, low mass, cost, penetration resistance, ductility, and environmental durability. Additionally, this topic area includes methods to develop appropriate material

anisotropic and or non-homogeneous material models for incorporation into advanced computational models such as Abaqus, LS-DYNA, and EPIC. Protocols for evaluation and performance testing of composite materials subjected to energetic, high-strain rate events are desired.

(Contact: Mr. Omar G. Flores, 601-634-3263, Email: Omar.G.Flores@usace.army.mil)

6. Worldwide Construction Practices- This research includes capturing typical construction practices and construction material properties worldwide. Information of interest is material properties of structural components, building types and construction techniques, building footprints, construction timeframe/era of buildings, and location of the building (country, world region, urban terrain zone).

(Contact: Mr. Omar G. Flores, 601-634-3263, Email: Omar.G.Flores@usace.army.mil)

V. **Multispectral Camouflage Research (GSL-22)**

This research area involves all aspects of fixed-facility survivability incorporating signature management and other technical effects. Fixed facilities include stationary and relocatable high-value targets. The general goal is to directly and indirectly increase the survivability of U.S. and Allied facilities and improve the U.S. and allied counterintelligence, Surveillance, and Reconnaissance (counter-ISR) capability against adversaries. Multispectral refers to those areas of the electromagnetic spectrum used by the United States and potential adversaries in reconnaissance and surveillance and in attack platform target acquisition and detection. Major objectives include: quantifying or otherwise evaluating counter-ISR technology effectiveness; investigating materials and techniques for signature modification; developing technical effects and physical countermeasures, procedures, and applications; developing computer-based analytical procedures for simulating scenes; developing instrumentation for and conducting target/background signature measurements; assessing the United States and threat operations and sensor capabilities with both currently fielded and new design reconnaissance and surveillance and attack platform sensors and systems; developing applications for intelligence information for military missions; providing guidance to field commanders and information for the RDT&E community; and studies of the interaction of camouflage technology with other operational factors, particularly in determining operational supportability, costs and manpower, interoperability, and joint interoperability requirements.

(Contact: Mr. Carey D. Price, 601-634-3886, Email: Carey.D.Price@usace.army.mil)

W. Advanced Maneuver Technologies (GSL-23)

This research addresses ground vehicle maneuver in urban environments which poses many new operational and tactical challenges for the Army and Joint Forces. While many improvements have been made in protecting ground vehicles in the last

decade, these improvements come with a cost, namely limited situational awareness due to reduced visibility and limited maneuverability in tight spaces because of larger vehicle size. Both of these constraints seriously reduce the mobility of ground vehicles in urban environments. To address these constraints, research is needed to develop technologies to identify nearby dynamic hazards for ground vehicles in urban environments and provide early warning to ground vehicle operators or autonomous driving systems. Specifically, this research will address methods and procedures to develop advanced technologies that will be used for detecting dynamic hazards in urban environments such as traffic flow rates and congestion, pedestrians, buried threats, constricted roads, and other obstacles or anomalous objects in real-time. In addition, further research is needed to develop technologies that will deliver the information in a consolidated or data excerpt manner and report the locations of interest and concern to the driver and or operator. The performance of emerging technologies in sensors and data processing to provide better situational awareness in near real-time to ground vehicle operators maneuvering in dynamic urban terrain is also of interest.

(Contact: Ms. Lesley F. Miller, 601-634-7244; Email Lesley.F.Miller@usace.army.mil)

X. Railroad Technology (GSL-24)

Research in this area is conducted in support of the Corps mission to design, construct, and operate railroad systems worldwide. This research includes railroad design, construction, inspection, evaluation, maintenance, and rehabilitation. Research areas of interest include advanced and composite materials, rapid repair, non-destructive evaluation, geotextile use in construction, in-situ additive manufacturing of components, soil stabilization, GIS, and remote assessment.

(Contact: Ms. Anna Jordan, 601-634-5361; Email: Anna.M.Jordan@usace.army.mil)

ENVIRONMENTAL LABORATORY (EL)

For all topic areas, white papers or "pre-proposals" will be evaluated to possibly initiate collaborative proposal development for third-party funding sources (e.g., Strategic Environmental Research and Development Program (SERDP), Environmental Security Technology Certification Program (ESTCP), DoD Basic 6.1 Research Program, research related to the RESTORE Act, etc.). White papers must clearly outline work to be conducted, public benefit of the work, appropriate technology transfer, personnel qualifications, and all associated costs. Funding of jointly prepared full proposals is contingent upon acceptance and funding by the third-party funding source.

ENVIRONMENTAL SENSING

I. Introduction

Current research is in the acquisition of information by remote sensor systems, the impact of the environment on imaging and other sensor systems, and advanced signal processing. Sensors using electromagnetic, seismic, and acoustic energy forms are of interest. In addition, work is conducted to determine terrain and other environmental effects on high- technology sensor systems. Sensor systems include optical and infrared millimeter wave (active and passive). Briefly described below are specific research areas.

II. Research Areas

A. Sensing (EL-1)

The EL has an ongoing program to develop and demonstrate advanced technologies that support the Army's requirements for improved detection and discrimination of unexploded ordnance (UXO), depleted uranium (DU) munitions, radiological threats, and deployment platforms. Additional research work is needed for subsurface (land-based) and underwater (proud and buried) UXO sensing, data analysis, display, and platform navigation/positioning. Special areas of interest include novel sensing concepts for the detection and relocation of buried objects (DU, metallic, and nonmetallic targets) using magnetic, electromagnetic induction, ground penetrating radar, seismic/acoustic, chemical, and/or radiological methods or a combination thereof. Fundamental measurements and models that define/predict the performance of these sensing methodologies in varying environmental conditions for UXO, DU and radiological targets are also of interest. Research is also needed to develop advanced data analysis techniques that can significantly reduce the number of false positives arising from natural anomalies and man-made sources.

(Contact: Mr. John Ballard, 601-634-2446; Email: John.H.Ballard@usace.army.mil)

B. Environmental and Military Sensing (EL-2)

1. Research in this area includes basic and applied research to develop environmental sensing, characterization, and monitoring capabilities necessary to quantify environmental site conditions and trends at local and regional scales. In the military area, research is conducted on basic signature research, to better understand target and environmental background signature characteristics.

2. Specific areas of required research include:

    a. Development, integration, and application of remote sensing technologies and the use of these data in geospatial models to characterize site conditions over large areas.
    b. Development of innovative data fusion approaches, particularly the combined use of hyper spectral and bathymetric and/or topographic LIDAR data for the extraction of environmental information.
    c. Research to identify, model, and mitigate the effects of the environment on novel sensing techniques that address environmental and military requirements.
    d. Development of ground-based and airborne remote sensing approaches, and associated modeling, for unexploded ordnance detection, minefield detection, military targets and vehicles, and smart weapons development.
    e. Rapid collection, analysis, and visualization of sensor data for environmental quality and military applications.

(Contact: Mr. Mark R. Graves, 601-634-2557; Email: Mark.R.Graves@usace.army.mil)

C. Environmental, Sensing, Characterization, and Modeling (EL-3)

There is an ongoing program to develop artificial intelligence (AI) and machine learning (ML) technologies for enhanced characterization of vegetation across large swaths of the Earth. The novel technologies should leverage remotely sensed data to better understand vegetated ecosystems. Numerous benefits for defense, environmental stewardship, and climate adaptation exist from identifying, quantifying, visualizing, and understanding vegetation data that is traditionally obtained through in situ sampling. Research is needed to capitalize on recent developments in AI based big data analytics to characterize forests and other ecosystems.
Outputs of research must be validated through comparison to measured vegetation metrics.

(Contact: Dr. Nathan R. Beane, 601-634-4602, Nathan.R.Beane@usace.army.mil)

D. Environmental Instrumentation (EL-4)

1. Research and development in this area includes basic and applied research and technology demonstrations that support rapid measurement of biological and

chemical hazards of the environment.

2. Specific areas of required research include:

    a. The integration and interoperability of environmental instrumentation with future and existing military robotic systems: this includes unmanned aerial systems, ground robotics, autonomous submersibles, and robotic surface watercraft.
    b. Provide new applications that support faster processing on small low-power hardware to triage environmental measurements to immediately identify biological and chemical hazards.
    c. Techniques that support biomimicry in robotic systems and the differentiation of biotic from abiotic systems. Instruments that are low-power, small, and compact to assess the biological and chemical characteristics of water, soil, and air, in surface and subterranean environments.
    d. Research into sensing of aerosols and/or plumes from either ground or airborne platforms.
    e. Research into novel uses of unmanned aerial systems for environmental characterization and change detection - including fusion of active and passive modalities.

(Contact: Mr. Jay Bennett, 601-634-3924; Email: Jay.Bennett@usace.army.mil)

CONTAMINATED SITE CHARACTERIZATION, ASSESSMENT & REMEDIATION

I. Introduction

An extensive research and development program is being conducted by the Department of Defense to assist in the cleanup of contamination at military installations. The EL is developing technologies for characterizing, monitoring, and applying physical, chemical, and biological treatment of toxic and hazardous waste in contaminated surface and ground waters and soils. The EL is also developing, evaluating, and verifying numerical models and guidance for solid waste disposal systems.

II. Research Areas

A. Innovative Technology for Environmental Sensors and Tools. (EL-5)

The EL has an ongoing research program to develop advanced technologies for environmental sensing, characterization, and monitoring in order to quantify environmental conditions at sites of interest. The program is actively developing field-based tools and sensors to conduct rapid site characterization/screening for environmental contaminants. Additional research is needed in the areas of novel sensing technologies for detection of chemical and biological contaminants allowing for rapid field-based data acquisition. Also, research is needed to develop technologies and platforms allowing for rapid data analysis/interpretation/reporting. Fundamental

measurements and models that define/predict the performance of new sensing methods in soil, water and air are also of interest.

(Contact: Dr. Matt Glasscott, 601-634-5518; Email: Matthew.W.Glasscott@usace.army.mil)

B. Innovative Technologies for Treating Contaminated, Sediment, Soil, Surface Water, Ground Water, and Hazardous Waste (EL-6)

Presently, EL is continuing to conduct research, develop technologies and apply strategies to treat complex organic- and metal-contaminated hazardous liquids, off-gases, soils, sludges, sediments, and residuals from past disposal practices. Research is divided into two major categories: technologies for treating contaminated soils and sediments, and innovative technologies for treating contaminated surface and ground waters. Areas of R&D include: (1) physical and chemical technologies to destroy/detoxify or reduce the quantity and/or toxicity of the contaminated materials, (2) biological processes and methods to detoxify/destroy hazardous waste constituents, (3) techniques for in situ treatment of groundwater aquifers, (4) laboratory design criteria for and field implementation of piloting equipment for promising technologies, (5) computer-based techniques to assess operational performance of various treatment processes/systems and (6) improved analytical chemistry techniques and methodology to assess treatment technologies.

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Dr. David Gent (physical- chemical organics), 601-634-3798.
Dr. Heather Knotek-Smith (bioremediation), 601-634-4216; Email: Heather.M.Smith@usace.army.mil
Dr. Anthony J. Bednar (analytical chemistry methods), 601-634-3652; Email: Anthony.J.Bednar@usace.army.mil)

C. Design, Evaluation, Verification and Modeling of Solid and Hazardous Wastes and Contaminated Sediments (EL-7)

Efforts are continuing to develop water balance and leachate models for solid waste disposal systems and dredged material disposal facilities. Additional work is needed to model innovative designs, nonsoil surface materials, cobbled surfaces, preferential flow through heterogeneous waste materials and other layers, and effects of complex mixtures of vegetation including trees. Similarly, additional work is needed to verify the existing models.

(Contact: Dr Chris Griggs 601-634-4821, Email: Chris.S.Griggs@usace.army.mil)

SEDIMENT GEOCHEMISTRY AND BIOLOGICAL EFFECTS

I. Introduction

Potential adverse environmental impacts of disposal of contaminated sediments must be assessed prior to permitting operations. This includes the determination of the impacts that contaminated dredged materials exert on the environment prior to dredging.

II. Research Areas

A. Environmental Risk Assessment (EL-8)

Current research on the fate and effects of environmental contaminants occurs under the general paradigm of Environmental Risk Assessment. Specific studies fall into one or more of the following areas:

1. Hazard Identification. This is the process of showing causality (i.e., a chemical or complex mixture can cause some adverse effect). If this causality can be demonstrated, the chemical is referred to as a "hazard." If there is no causal link, risk need not be quantified. Important target receptors are also identified by this stage (for example, humans, endangered species, and ecologically or economically important species). Research is conducted to develop the technology for hazard identification and the establishment of causality.

(Contact: Dr. Todd Bridges, 601-634-3626; Email: Todd.S.Bridges@usace.army.mil)

2. Effects Assessment. While Hazard Identification decides if a chemical or complex mixture is toxic; Effects Assessment establishes the relationship of the toxicant dose and associated biological response. This is accomplished via experimental research in which surrogate species are exposed to gradients (spatial, concentration, etc.) of the hazard in question, and biological effects are monitored. Biologically important endpoints measured include survival, growth, reproduction, and population-level parameters. These endpoints must be accompanied by technically sound interpretive guidance. Results are expressed in dose- response or exposure-response relationships. Research is conducted to develop the necessary experimental/statistical designs, technically sound tests (for example, chronic sub lethal sediment bioassays) and appropriate extrapolations (for example, high dose to low environmentally realistic exposures, and surrogate test species to receptor of interest). Analysis of the uncertainty associated with these effects assessments is also conducted.

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3. Exposure Assessment. In Exposure Assessment, the magnitude, frequency, and duration of contaminant exposure relative to the target receptor(s) are determined. This research is model-intensive, with both descriptive and quantitative models being used to evaluate pathways and routes. A pathway

exists if the hazard travels between the initial source of contamination and the ultimate biological receptor. An exposure route is pathway that the chemical contacts the receptor (for example, ingestion, inhalation, dermal absorption, bioaccumulation, trophic transfer). Analysis of the uncertainty associated with these exposure assessments is also conducted.

(Contact: Dr. Guilherme Lotufo, 601-634-4103, Email: Guilherme.Lotufo@usace.army.mil)

4. Risk Characterization, Management, Communication, and Analysis. Outputs from the Effects Assessment and Exposure Assessments are joined in Risk Characterization to yield an estimate of risk. Research is conducted to determine the best ways to characterize risk both numerically and descriptively. Also, uncertainty analysis is undertaken to identify the qualitative and quantitative important sources of uncertainty. Techniques employed include error propagation, probability distributions, sensitivity analysis, Monte Carlo simulation and others. Once environmental risk has been quantified, management action may be required.

5. Research is conducted to develop management alternatives, which range from no action to extensive (and expensive) remediation. Results of the Environmental Risk Assessment are weighed and balanced with other factors such as applicable laws and regulations, engineering feasibility, potential benefits, costs, economic impacts, and the socio-political decision environment.

Risk Communication is a dialogue that occurs at two levels: between the risk assessor and the risk manager, and between the risk manager and the public. Research is conducted to identify optimal procedures for communicating environmental risks, including an appreciation for the limits and uncertainties of the numerical results. Risk Analysis is a broad, inclusive term encompassing the processes of Risk Assessment, Risk Management, and Risk Communication as well as any field verification or monitoring activities. Field verification is a study or studies carried out to determine the accuracy of laboratory observations and predictions. Field monitoring (in the context of Risk Assessment) is undertaken to ensure that steps taken to manage the chemical risks were successful. Field research studies are carried out for both verification and monitoring purposes.

(Contact: Dr. Mark Ballentine, 601-634-2910; Email: Mark.L.Ballentine@usace.army.mil)
(Contact: Dr David Moore, Email: david.w.moore@usace.army.mil)

6. Engineering With Nature® (EWN®) Research Supporting Innovative Field Sampling Practices, Natural Infrastructure (NI) Construction/Deployment and Related Technologies. Conduct a broad array of EWN research and development that may include, but is not limited to: research pertaining to placement of scientific instruments and/or pursuit of novel experiments that

advance field-based sampling and laboratory practices for the purpose of measuring and archiving the performance of natural infrastructure (NI); conduct research and/or test innovative instrumentation that records/monitors natural and engineering processes resulting from the placement of NI and/or hybrid infrastructure; conduct research and test new technologies that result in accelerated construction/placement of natural and nature based features and/or improved placement strategies for dredged sediment used to construct EWN projects.

(Contact Dr. Jeffrey King, 202-706-3534; Email: Jeffrey.K.King@usace.army.mil)

7. Technology Transfer Development for Engineering With Nature® (EWN®) Research Areas. Research, develop and analyze technology transfer concepts; analyze target audiences for technical information; test innovative methods of transferring EWN research results and technology to supplement conventional technology transfer. Included may be such items as interactive internet and PC technology applied to training and general information transfer; technology applications of electronic media using the Internet; and innovative public information systems/products. Audiences include Corps of Engineers and the Department of Defense; Congress and other Federal, State, and local agencies; port and transportation authorities; universities; environmentalists and other public interest groups; and the general public.

(Contact Dr. Jeffrey King, 202-706-3534; Email: Jeffrey.K.King@usace.army.mil)

B. Sediment Water Interactions (EL-9)

Sediment/Soil Water Properties. Current research encompasses a wide range of investigations designed to increase understanding of sediment-water interactions. Emphasis is on conduct of investigations for determining the impacts that sediment/soil properties have on sorption and transformation of explosives and release of semi-volatile contaminants to the atmosphere. Factors responsible for sorption and transformation of explosives include redox potential, pH, and the geochemical characteristics of the soil or sediment. Factors affecting the release of semi volatile contaminants from soil or sediment to the atmosphere include relative humidity, wind speed, contaminant concentration, moisture content, porosity, and organic carbon content. Research is also conducted on colloidal system contaminant transport, accelerated sediment oxidation, and the role of solution chemistry in contaminant partitioning between sediment and water.

(Contact: Dr. Mark Chappell, 601-634-2802; Email: Mark.A.Chappell@usace.army.mil)

Diverse research activities focused on characterizing microorganisms and microbial communities in natural and engineered environments relevant to contaminant transformations, biogeochemical cycling, host-microbiome-contaminant interactions, bio- enabled materials, synthetic biology, and environmental biological threats are

currently underway.

1. Biodegradation of Contaminants. Studies in the biodegradation area emphasize destruction of organic contaminants for remediation purposes. Emphasis is on (1) bioinformatics of microbial community diversity and activities in various ecosystems; (2) delineating biodegradation pathways, enzymes, and genes; (3) determining intermediate and final end- products; (4) assessing the role of environmental and genetic factors regulating the pathways utilized and the rate and extent of destruction of the parent compound; (5) determining the survival and activity of microorganisms added to ecosystems, and biotreatment systems; and (6) enhancing biodegradation to obtain the maximum destruction of organic contaminants within a soil, sediment, or treatment system.

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(Contact: Dr. Carina Jung, 601-634-7247; Email: Carina.M.Jung@usace.army.mil)

2. Microbial Sensing. Novel microbial, cellular, molecular and/or genomic approaches are sought and developed for the rapid functional and DNA-based identification, detection, and monitoring of microorganisms in various environmental matrices including soils, sediments, and surface waters. Novel ecological approaches to detect, monitor and predict prokaryotic/eukaryotic microbes are sought that combine physiology, molecular tools, biochemistry, modeling, and remote sensing for the management of high biomass events and environmental toxins.

(Contact: Dr. Karl Indest, 601-634-2366; Email: Karl.J.Indest@usace.army.mil)
(Contact: Dr. Fiona Crocker, 601-634-4673; Email: Fiona.H.Crocker@usace.army.mil)

3. Biomaterials and Composite Structures. Novel biological materials and/or techniques are sought to manipulate bioprocesses and biomineralization pathways as additives to aggregate and composite products. These products will support advancements in material structural properties that support civil works and military operations.

(Contact: Dr. Karl Indest, 601-634-2366; Email: Karl.J.Indest@usace.army.mil)

4. Insect and plant field collections, insect husbandry, plant maintenance with greenhouse access is sought for various microbiome projects. Needs will be seasonal and very specific to limited insect or plant systems as dictated by internal projects.

(Contact: Dr. Carina Jung, 601-634-7247; Email: Carina.M.Jung@usace.army.mil)

C. Techniques for Contaminated Dredged Material Disposal and Treatment (EL-10)

1. Development/implementation of innovative technologies to reduce or eliminate

contamination present in surface sediment and/or dredged materials. Research to include 1) technologies for cost effective in situ treatment of surface sediments to reduce bioavailability/toxicity; 2) ex situ treatment technologies to reduce contamination and facilitate expanded opportunities for beneficial use of treated material.

(Contact: Dr. David W. Moore, 601-634-4199; Email: David.W.Moore@usace.army.mil)

2. Development or enhancement of computer models to be included in the Automated Dredging and Disposal Alternatives Modeling System (ADDAMS) to evaluate the environmental impacts of dredged material disposal. Evaluations include water quality impacts of initial release in open water, effluent discharge, runoff and leachate, benthic impacts, plant and animal uptake, and volatilization.

(Contact: Dr. Paul R. Schroeder, 601-634-3709; Email: Paul.R.Schroeder@usace.army.mil)

3. Development and/or application of new or improved environmental chemistry methodologies to assess contaminant concentrations of dredged material and other complex matrices (e.g., elutriates, bioaccumulation tissues, etc.) focusing on specific compounds or classes, cost effectiveness, quality assurance, lower detection limits, and removal/reduction of challenging matrix interferences.

(Contact Dr. Anthony J. Bednar, 601-634-3652; Email: Anthony.J.Bednar@usace.army.mil)

D. EMERGING CONTAMINANTS IN THE ENVIRONMENT (EL-11)

1. Presently, EL is continuing to conduct research, develop technologies and apply strategies to address emerging contaminants (ECs) in the environment. Research falls into for 5 broad categories:

    a. Detection and Measurement:
    b. Development and application of technologies for the detection and measurement of ECs in environmental media at environmentally relevant concentrations.
    c. Application of innovative technologies to discern source of EC contamination.
    d. Screening level methodologies to facilitate near real time detection and measurement of ECs in the field.
    e. Development of forensic methodologies and computational approaches for detection, measurement, prediction of EC precursors and/or degradation products in environmental media.

(Contact Dr. Anthony J. Bednar, 601-634-3652; Email: Anthony.J.Bednar@usace.army.mil)
(Contact Dr Ashley Kimble, Email: Ashley.N.Kimble@usace.army.mil)

2. Exposure Assessment:

Development and application of technologies for measuring/predicting the movement and fate of ECs in the environment.

(Contact Drs. Jodi Ryder (modeling), 601-631-1852, Email: Jodi.L.Ryder@usace.army.mil; Dr. Guilherme Lotufo (passive sampling technology, bioavailability, trophic transfer), 601-634-4103, Guilherme.Lotufo@usace.army.mil)

3. Effects Assessment:

Development and/or application of technologies for establishing the effects of ECs on important ecological and human health receptors/endpoints.

(Contact Dr. Kurt Gust (subcellular responses), 601-634-3764; Email: Kurt.A.Gust@usace.army.mil) ; Dr. Al Kennedy (whole organism responses), 601-634-3344, Email: Alan.J.Kennedy@usace.army.mil)

4. Risk Characterization/Management:

   a. Development and/or application of innovative technologies for characterizing risk of ECs in environmental media. Development and/or application of decision-making tools to support EC related risk management decision-making.
   b. Development and/or application of innovative technologies to remove, concentrate, and/or destroy ECs in environmental media.
   c. Development and/or application of innovative technologies to assist in identification of safer alternatives.

(Contact: Dr. David Moore, phone 601-634-4199, Email: David.W.Moore@usace.army.mil)

ENVIRONMENTAL AND WATER QUALITY MODELING

I. Introduction

The Corps of Engineers is involved in research and development related to water quality and contaminant fate/transport modeling for surface water, watersheds, and the subsurface, or groundwater. This encompasses a wide range of environmental issues, such as water quality and ecosystem linkages, contaminant transport and fate, eutrophication, effects of land use/management on watershed runoff quality, total maximum daily loads (TMDLs), and ecological and human health risk assessment as related to contaminants in the environment. Research may include model development and field and laboratory investigations to improve model descriptions and to provide required data for model validation.

II. Research Areas

A. Numerical Water Quality and Contaminant Modeling (EL-12)

This area of work is oriented toward development and application of water quality and contaminant fate/transport models for surface water and the subsurface, or groundwater. Surface water modeling includes watersheds and receiving waters, e.g., riverine, reservoir, wetland, estuarine, and coastal water bodies. Groundwater modeling includes modeling both the unsaturated and saturated zones, as well as multi-component flow and transport. Models are utilized for conventional water quality (e.g., nitrogen, phosphorus, carbon, dissolved oxygen, etc.) and contaminants, i.e., toxic substances, such as organic chemicals, trace metals, radionuclides, explosives, and other military unique compounds. Emphasis includes the following: formulation of appropriated physical, chemical, and biological algorithms; improvement of mathematical and numerical methods; collection and assemblage of data for model evaluation; conduct of field and laboratory process investigations designed to develop/improve model descriptions, dynamic linkage of water quality and biological models, including biomass-based, individual-based, and population- based biological models; integration of contaminant exposure models with biological effects data or models to quantify risk; incorporation of uncertainty analysis into modeling; linkage of physical/chemical models with biological population models; linkage of cross- domain models for system wide modeling; development of routines/linkages to include the effects on water quality of watershed landscape features (e.g., buffer zones) and vegetation management; development of a risk assessment modeling system; and development of software to provide graphical user interfaces and modeling environments to enhance model utility and ease of application.

(Contact: Dr. Barry Bunch, 601-634-3617; Email: Barry.W.Bunch@usace.army.mil)

B. Complex Adaptive Systems (EL-13)

The central goal of this effort is to identify the rules and feedback processes that govern how interactions between modular components in natural system shape important holistic properties, like the global resiliency to disturbances, and, invariably, the fate of the individual components themselves. These tasks are central to basic research efforts in Complex Adaptive Systems (CAS); an area that impacts a wide range of critical needs in both military and civil works (e.g., immune system responses, decision-making, social feedbacks, and ecosystem management). Current research focuses on ecological systems in which the use of different species and study systems is encouraged to provide diverse and novel solutions to understanding, predicting, or improving the resiliency of complex systems. Recent case studies range from a contaminant's (e.g., altered water quality, noise, chemical) impacts on individual development and performance, the social roots of information cascades in social vertebrates (spanning from fish and humans), to overall ecosystem functioning based on infrastructure design, overharvesting, or mismanagement. This topic area is

inherently interdisciplinary and emphasizes team efforts in the combination of analytical, numerical, and laboratory experiments to test competing hypotheses.

(Contact: Dr. Bertrand Lemasson, 541-867-4045; Email: Bertrand.H.Lemasson@usace.army.mil)
(Contact: Dr. Christa Woodley, 601-634-4831; Email: Christa.M.Woodley@usace.army.mil)

C. Water Quality and Behavior Modeling (EL-14)

This research topic focuses on developing early warning indicators to demonstrate how changes in water quality can affect critical ecological processes, thereby raising the subsequent risks imposed on animal populations. We focus on demonstrating when environmental quality is not merely a potential hazard, but how it elicits a functional (e.g., physiological) change during early exposure stages that can impact future performance and, invariably, population survival. Anthropogenic disturbances would include sediment plumes, temperature spikes, or contaminants. Animals typically display stable and, generally, predictable physiological and behavioral patterns in non-stressful conditions.

However, sub- lethal (including chronic) or acute environmental changes can drastically alter behavior and activity, remain undetected, and invariably introduce unacceptable levels of error in model predictions. Current methodologies range from simple bioassays to more complex physiological consequences at the individual level, to long-term costs/benefits at higher ecological levels (i.e., habitat use, populations, and communities). Hypothesis testing based on a combination of laboratory and modeling is encouraged, along with field data when possible. Findings from these efforts play an important role in both civil works and military activities.

(Contacts: Dr. Christa Woodley, 601-634-4831, Email: Christa.M.Woodley@usace.army.mil)
(Contact: Bertrand Lemasson, 541-867-4045, Email: Bertrand.H.Lemasson@usace.army.mil).

CONSERVATION

Environmental Impact Prediction, Assessment and Management

I. Introduction

This research program addresses environmental impact prediction, assessment, and remediation and is intended to provide Corps, Army, and other field operating elements with techniques and methodologies for environmental assessments and EIS preparation, guidance on selecting appropriate planning, design, construction, and operation alternatives, and implementation of the planning function pursuant to NEPA and other legislation and guidance.

Specific objectives include:

A. Developing, verifying, and demonstrating practical prediction and assessment techniques including applying and refining habitat-based evaluation methods, evaluating mitigation measures, developing streamlined frameworks for environmental monitoring, applying ecosystem simulation principles to environmental analysis, and estimating future habitat quality.
B. Documenting and quantifying environmental effects associated with various types of Corps, Army, and other activities. Research has included the effects of aquatic habitat modification on anadromous fishes, the effects of selective clearing and snagging on in stream habitat, and t h e benefits of channel modification for aquatic habitat in reservoir tail waters and local flood control channels.
C. Developing and demonstrating design, construction, and management alternatives that will minimize adverse effects and protect natural and cultural resources. Research has included techniques for managing wildlife habitats, preserving archeological sites, and stabilizing eroding shorelines.
D. Developing, validating, and demonstrating novel systems biology-, computational biology- or bioinformatics-based approaches to understanding and quantifying toxicological impacts of environmental contaminants in environmentally relevant organisms.

II. Research Areas

A. Biotechnical Shore Stabilization (EL-15)

Biotechnical (sometimes called bioengineering) shore stabilization is the use of a combination of live vegetation and structural materials (for example, breakwaters, geotextiles, erosion control fabrics/mats, building materials) for erosion control of shores. Shores of particular interest are those of streams, lakes, or dredged material deposits and subject to erosion from waves, surface runoff, and wind. Research is needed to determine the causes and amounts of erosion and to identify and assess cost-effective biotechnical erosion control methods. Studies may include, but are not limited to, identifying, developing, and cultivating appropriate flood- tolerant plants and varieties or cultivars and cost-effective installation procedures of biotechnical techniques.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

B. Freshwater Fishery Investigations (EL-16)

Primary areas of research are predicting environmental impacts of navigation and flood control projects on fishes, freshwater mussels, and other aquatic fauna; benefits of restoring aquatic habitat including environmental flows; conservation of endangered fish and mussel species; evaluating freshwater and coastal wetland fish

communities; management of invasive species movement and colonization including Asian Carp; and fishery management in vegetated waterbodies. New and innovative approaches to determine physiological, behavioral, population and community level responses of fishes to habitat variables are of interest, along with technological advancements in sampling and multivariate data analysis capabilities. Demographic and landscape habitat models are anticipated products of this research

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(Contact: Dr. Todd Slack, 601-634-4138; Email: Todd.Slack@usace.army.mil)

C. Freshwater Macro invertebrate Investigations (EL-17)

Research focuses on assessment of aquatic and terrestrial invertebrate communities, with emphasis on insects and mussels. Studies include stream and river biotic assessments, terrestrial and aquatic insect surveys, assessment of threatened and endangered invertebrate populations, feeding ecology of fishes, and evaluation of stream and river food webs and energetics. Assessments of environmental effects of USACE activities, including stream and river impoundments and structural changes, are also performed using naturally occurring macroinvertebrate and mussel communities as indicators of current and past ecological shifts. Restoration and management recommendations are also made through the analysis of these invertebrate communities in both freshwater and terrestrial ecosystems. Technical and analytical advancements, including sampling and data analysis are of interest.

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(Contact: Dr. Todd Slack, 601-634-4138, Email: Todd.Slack@usace.army.mil)

D. Mitigation (EL-18)

An avoidance, minimization, and/or compensation process is required for impacts from water resources projects on ecological resources (fish, wildlife, habitat, or installation activities). Planning and implementing mitigation are a complex process, and new ideas that contribute to success of mitigation are invited. Subjects such as Best Management Practices for avoiding or minimizing impacts, planning for mitigation based on impact analysis, incremental analysis to justify mitigation, mitigation banking, future predictions, and mitigation for indirect or cumulative impacts are included.

(Contact: Kyle Gordon, 601-634-3717; Email: Kyle.B.Gordon@usace.army.mil)

E. In Stream Flow Requirements for Aquatic Biota (EL-19)

Research focuses on development and application of fish habitat assessment methods. Currently, the most widely used system, the Physical Habitat Simulation System (PHABSIM), is used to assess the effects of reservoir operations on downstream fish habitat. Research is needed to better quantify the relationships for fish

preference and flow conditions, as well as habitat requirements for aquatic invertebrates. When appropriate, laboratory-based studies can support field-based modelling efforts. Verification studies of these models will be required as development continues. Assessment methods must be able to evaluate the impacts of a variety of reservoir operations such as base load or peaking hydropower releases and at multiple scales from single project to basin – wide studies.

(Contact: Dr. Dave Smith, 601-634-4267; Email: David.L.Smith@usace.army.mil)

F. Behavioral and Structural Fish Barriers (EL-20)

Entrainment of fish at Corps hydropower projects may result in passage of fish through turbines with attendant death or injury from impact with runner blades, pressure changes, or shear forces. Evaluations of a number of behaviorally based technologies and structural barrier designs conducted under laboratory and field conditions have yielded results that are generally inconsistent. Consequently, there currently exist no consistent guidelines for selection of appropriate technology for site-specific applications at Corps dams. Research is required to relate effectiveness of different technologies to size and species of fish, dam design, operations, season, and other site-specific conditions. The information produced by this research will be used to develop specifications and guidelines for fish protection technologies at Corps dams to reduce entrainment and mortality. This effort may involve literature synthesis, laboratory research, design and fabrication of prototype systems, or field studies as well as simulation analysis of fish movement/passage patterns.

(Contacts: Dr. David Smith, 601-634-4267; Email: David.L.Smith@usace.army.mil)
(Contact: Dr. R. Andrew Goodwin; 503-382-7194; Email: Andy.Goodwin@usace.army.mil)

G. Fish Guidance and Bypass Systems (EL-21)

CE water resource activities may result in blockage of historical fish migration routes through waterways. These blockages, with associated fragmentation of habitats, may have severe impacts on anadromous and catadromous fish populations. A variety of bypass system technologies are available to guide fish around dams. However, many of these systems operate at reduced efficiencies because they damage fish, fish are unable to locate entrances to the systems, or because fish become disoriented and "fall back" after an initial successful passage. Research is required to better understand the hydraulic and behavioral characteristics of fish bypass systems, including the use of behavioral technologies to guide fishes towards these systems and to successfully orient them within the system.

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(Contact: Dr. R. Andrew Goodwin; 503-382-7194; Email: Andy.Goodwin@usace.army.mil)

H. Coastal Ecology (EL-22)

Research topics in coastal ecology include multidisciplinary investigations of the environmental impacts of engineering activities in the coastal zone, such as dredging, dredged material disposal, and construction of coastal structures (e.g., jetties, breakwaters, groins, seawalls, marinas). Emphasis is placed on improved technologies for assessment, protection, and management of fish and shellfish resources and their habitats. Of particular relevance are proposals dealing with endangered species (e.g., sea turtles, marine mammals), beneficial uses of dredged material and habitat restoration in the coastal zone (e.g., marsh, oyster reef or mudflat creation), and application of population dynamics and ecological models for impact prediction and assessment at population/community/ecosystem/watershed levels. Other areas of interest include effects of beach nourishment and use of offshore borrows areas, seasonal restrictions on dredging and disposal operations, artificial reef technologies, and cumulative impact determination and mitigation techniques.

Other focus areas include:

a. Effects of beach nourishment on benthic communities and surf-zone (near-shore) fishes,
b. Active and passive fisheries acoustics to assess fish migratory patterns, spawning habitat, fish density and spatial distribution patterns near dredging operations and placement sites.
c. Essential Fish Habitat (EFH) protection from increases in turbidities and suspended sediments.
d. Fish entrainment
e. Behavioral changes to marine organisms (e.g., migratory blockage of migratory fishes due to the presence of the dredge, particularly in narrow or constricted waterways).
f. Underwater noise impacts to aquatic species due to dredging and disposal operations.
g. Ecosystem restoration (e.g., filling offshore/near-shore borrow areas to natural bathymetry).
h. Artificial reef creation using dredged rock and other suitable material to enhance fisheries and shell fisheries resources.
i. Thin-layer placement, re-contouring natural bathymetries.

Increased costs associated due to compliance with environmental windows/seasonal restrictions imposed on dredging and disposal operations, and cumulative impact determination and mitigation techniques.

(Contact: Dr. Safra Altman, 601-634-3435; Email: Safra.Altman@usace.army.mil)

I. Techniques for Designing, Operating and Managing Dredged Material Disposal Facilities and Beneficial Use Projects (EL-23)

1. Refinement and verification of techniques for designing, operating, and managing

dredged material disposal areas.
2. Development of a computerized economic database for costs associated with dredging sediments; disposing of dredged material; and constructing, rehabilitating, and operating and managing dredged material disposal areas.
3. Development and refinement of computer models for dredged material management and beneficial use to be included in the ADDAMS.

(Contact: Dr. Paul R. Schroeder, 601-634-3709; Email: Paul.R.Schroeder@usace.army.mil)

J. Systems Biology, Computational Biology, and Bioinformatics for Environmental Impact Assessment (EL-24)

A wide spectrum of research in systems toxicology, biological networks, synthetic biology, predictive toxicology, genomics, bioinformatic data mining of next-generation sequencing data, adverse outcome pathway development, toxicological modes of action discovery, herbicide resistance mechanisms, structural biology, chemoinformatics, and molecular modeling is currently underway. Proposed research in mechanistic/predictive toxicology, structural biology, bioinformatics, or computational biology would complement current research areas.

1. Novel genomics, epigenetics and synthetic biology approaches are sought and developed to assess biochemical, physiological, or other toxicological (adverse) effects on the biota at molecular, cellular, tissue/organ, individual, population, community, or ecosystems levels.

(Contact: Dr. Kurt Gust, 601-634-3764; Email: Kurt.A.Gust@usace.army.mil)
(Contact: Dr. J. Erik Mylroie, 601-634-5314; Email: John.E.Mylroie@usace.army.mil

2. Novel in silico modeling and data mining approaches that are based on computational biology, biophysical or bioinformatics principles and techniques are sought and developed to systematically analyze and interpret big data generated using cutting-edge and high- dimensional biotechnologies such as next-generation DNA sequencing, hybridization-based microarray, proteomics, and metabolomics technologies. Novel mathematical approaches and analysis methodologies are also sought to interpret or describe data generated using novel experimental protocols, and which may account for internal forces, energy and information flows that regulate biological, biophysical, or bioenvironmental processes.

(Contact: Dr. Michael Mayo, 601-634-7230; Email: Michael.L.Mayo@usace.army.mil)
(Contact: Dr. Kevin Pilkiewicz, 601-634-5382; Email: Kevin.R.Pilkiewicz@usace.army.mil)

3. Tools for assessing environmental impacts of synthetic biology. This work

involves identifying synthetic biology technologies and understand their current state of use, development, technology readiness, as well as their potential environmental impact. This includes hazard identification, effects assessment, fate, transport, and transferability of various technologies. Moreover, the work entails quantifying environmental impacts of synthetic biological technologies through experimental and modeling approaches. This includes establishing screening mechanisms for genetic and physiological traits for synthetically derived systems, microcosm experiments with tractable organisms to assess potential for spread/transfer of synthetic constructs.

(Contact: Dr. Kurt Gust, 601-634-3764; Email: Kurt.A.Gust@usace.army.mil)

ENVIRONMENTAL CRITERA FOR STREAM CHANNEL ALTERATION PROJECTS

I. Introduction

The Corps of Engineers is involved in the alteration of stream channels for flood damage reduction, navigation, channel stabilization, and ecosystem restoration, as well as alterations performed by others as part of the Clean Water Act. Modifications to channels include removal of snags and vegetation, channel alignment (straightening), channel enlargement, construction of levees, stream bank protection, and grade control. The Corps is also involved in regulating and furnishing technical assistance to States in regard to other types of channel alterations such as gravel mining. Work at the US Army Engineer Research and Development Center's Environmental Laboratory (EL) and elsewhere has generated environmental design criteria for stream channel alterations to improve the net effect of these projects. Examples of environmental design features include low-flow channels, combinations of structure and vegetation, management of cutoff bend ways and other backwater areas, and recreational trails.

II. Research Areas

A. Riparian and In Stream Habitat Restoration (EL-25)

Current research includes formulating guidelines for stream restoration and environmental enhancement of flood control and aquatic ecosystem restoration projects. Among the general issues addressed are, in-stream and riparian habitat assessment; benefits of habitat improvement, structures, and techniques; impacts of vegetation on flow conveyance and/or sustainability, channel stability, and sediment transport; construction practices; and monitoring and maintenance. Proposals are invited in these general areas and related efforts. In addition, specific needs include the following: (1) Techniques to quantify habitat and other environmental benefits of restoration efforts, as well as quantification of adverse impacts to the aquatic environment, (2) Algorithms that account for momentum losses at vegetated floodplain/channel interfaces, (3) Data supporting evaluations of the hydraulic impacts of in-stream structures, (4) Development and refinement of related computerized databases and models, and (5) Calculating impacts to and identifying vulnerabilities of

riparian systems due to climate change.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

B. Assessing Benefits of Channel Modifications (EL-26)

Dams and local flood control structures may degrade aquatic habitat conditions in tail waters and streams. In some cases, habitat degradation can be eliminated, stabilized, or reversed through channel modification for aquatic habitat (i.e., construction of low-cost, low head weirs to create pools) with minimal changes in dam operation or flood channel design. However, there are no widely accepted methods available to incrementally relate in stream aquatic habitat value, channel modifications, and in stream flows to allow trade-off analyses among cost, design, and habitat benefits. It is desirable to modify existing in stream flow methods or develop new methods that will allow incremental assessment of habitat values, alternative flows, and different channel designs. This work may involve data collection, analysis, interpretation, and software development.

(Contact: Dr. David Smith, 601-634-4267; Email: David.L.Smith@usace.army.mil)

NATURAL RESOURCE MANAGEMENT

I. Introduction

As a part of its mission, the Corps of Engineers must maintain and manage millions of acres of land, much of it surrounding over 700 water resource development projects throughout the United States. This includes fish and wildlife habitat sites, specific communities such as riparian zones and wetlands, and recreation sites. Technology needed for managing and enhancing these facilities includes research associated with endangered species, waterfowl, riparian zone management, range and turf grass management, insect pest management, and the general stewardship of these natural resources. Developed technology is provided to Corps Civil Works projects as well as military installations and other cooperating Federal agencies.

II. Research Areas

A. Natural Resources Stewardship (EL-27)

1. Integrated Natural Resources Management. Research includes biological diversity, holistic ecology, and the stewardship and management of habitat-related natural resources at Corps water resource projects and military installations. Emphasis is on integrated natural resources management, which includes the analysis of human-related activities on biological resources and the effects of biological resources on other resources. Current research includes integrated ecosystem management, analysis of impacts to natural landscapes and their components, habitat delineation and analysis, and program

development for natural resources management. Related components to complete stewardship include management of information and databases. The work involves literature synthesis, field studies, data analysis, and report preparation.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

2. Riparian Zone Management. Research addresses riparian habitat assessment, restoration, and management for natural resources stewardship on Civil Works lands and Department of Defense military installations. Emphasis is on the development of methods and technical guidelines appropriate for managing riparian zones and associated habitats on multiple-use lands. This also includes research on transition areas between riparian areas and other systems. Research includes literature searches, field investigations, restoration projects, data analysis, and development of reports and management action plans. Priorities will depend on regional needs, as determined by study sponsors (i.e., Corps districts/sponsors and military installations).

(Contact: Dr. Richard Fischer, 502-454-4658; Email: Richard.A.Fischer@erdc.dren.mil)

3. Tools for Natural Resources at Multiple Scales. Management of resources in today's climate requires an awareness of scale and context of those resources. Issues ranging from genetic diversity to watershed or landscape planning are relevant to management decisions. Planners, regulators, and land managers must be able to use existing tools (decision-support systems, models, databases, procedures, etc.) and adapt new tools for their needs. Although the general processes of resource inventory, impact assessment, and management or mitigation will remain applicable; those activities may be conducted in a different context or at more scales than before. Work under this announcement will supply tools for natural resources management in an ecosystem or holistic context.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

4. RESTORE Act Research addresses the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act) or is associated with the Gulf Coast Restoration Trust Fund in connection with the Deepwater Horizon Oil Spill. Research topics include restoration, protection, and mitigation of damage to the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region. Other areas of interest include research supporting infrastructure projects that benefit ecological resources, (e.g., port infrastructure) and coastal flood protection.

(Contact: Dr. Safra Altman, 601-634-3435; Email: Safra.Altman@usace.army.mil)

B. Wildlife Resource Management (EL-28)

The EL is developing user information for Department of Defense (DoD) personnel involved in the administration, planning, and operation of wildlife management programs and activities. The emphasis is to provide technology transfer on biologically sound, technically reliable, and cost- effective wildlife-related management strategies appropriate for Civil Works projects and DoD installations. The major product is the "U.S. Army Corps of Engineers Wildlife Resources Management Manual." Reports for the manual are arranged in nine chapters. Reports are currently needed on wildlife species, management techniques, and plant materials. Reports are primarily extensive literature reviews on a particular subject, which results in the presentation of appropriate information in a comprehensive and readable style. The basic format is established in the reports completed to date. Proposals should identify a specific section (or sections) to be prepared and should include an outline and description of topics to be developed for the report. Other tasks in this work area include habitat assessments, population surveys, and development of management plans.

(Contact: Dr. Richard Fischer, 502-454-4658; Email: Richard.A.Fischer@erdc.dren.mil)

C. Animal Movement Behavior (EL-29)

The management of civil infrastructure and rangelands often depends on understanding and forecasting the response of animals to patterns in their environment (aquatic, terrestrial, aerial), such as patterns in water, forage, wind, and/or other individuals in the population. Numerical models and empirical analyses may reveal the underlying behavioral, sensory, cognitive, social, and/or other internal/external factors that give rise to observed movement and distribution patterns. This understanding can be used to improve management, forecast future animal movement/distributions, and/or inform the design of engineered systems.

(Contact: Dr. R. Andrew Goodwin; Email: Andy.Goodwin@usace.army.mil)

D. Endangered Species (EL-30)

This effort involves studies of endangered and threatened species on DoD and other Federal agency lands. Tasks would include site-specific surveys, habitat analysis, and development of management plans for species of concern. Individual studies would involve literature searches and synthesis of information, field investigations, data analysis, coordination with Federal and state agencies and conservation organizations, and preparation of endangered species survey reports and management guidelines. Management recommendations will be specific to the region of study. Species of concern will vary, depending on requests from Civil Works projects and military installations.

(Contact: Dr. Richard Fischer, 502-454-4658; Email: Richard.A.Fischer@erdc.dren.mil)

E. Wetlands (EL-31)

Wetlands research, especially as it pertains to wetland restoration and assessment, has been an ongoing activity of the Corps of Engineers since the 1970s. Specifically, wetlands play a key role in supporting environmental, navigation, or flood control objectives and are regulated under the Clean Water Act. The Corps of Engineers has been at the forefront in developing technologies and methodologies to evaluate wetland conditions under various scenarios and document ecological succession of wetlands following restoration/creation. In addition, approaches for delineating and assessing wetlands across the nation are required under the regulatory framework utilized by State and Federal agencies. Research supporting these objectives is expected to continue as part of a series of wetlands task areas. Research task areas outlined below will be conducted both in-house, with other agencies, or will be contracted. Studies must be short term (1-3 years) due to funding and time constraints and must address one or more of the following research tasks.

(Contact: Dr. Jacob Berkowitz, 601-634-5218; Email: Jacob.F.Berkowitz@usace.army.mil)

1. Critical Processes of Wetlands. This task examines the basic physical, chemical, and biological processes that allow wetlands to provide important functions and applies those processes and functions to improve Corps of Engineers activities. Research may include evaluations of wetlands in areas undergoing management to improve wetland function, and the creation, restoration, or maintenance of wetlands. Critical processes in wetlands encompasses biogeochemical processes and/or interactions requiring interdisciplinary research approaches. As a result, research tasks may include investigations of nutrient cycling, soils, flora, fauna, invasive species, sea level rise, and other topics critical to improving our understanding of wetlands.

2. Wetlands Delineation, Assessment, and Evaluation. Objectives of this task address the needs of US Army Corps of Engineer staff to quantify ecological, structural, or other aspects of wetlands within the landscape, including the creation, restoration, or maintenance of wetlands. These investigations include but are not limited to the use of dredged materials or other substrates in the development or restoration of wetland ecosystems. Additional task objectives include the examination of assumptions in the 1987 "Corps of Engineers Wetland Delineation Manual" and the development of techniques to assess wetland condition and function. Objectives will be accomplished through a combination of field and laboratory studies that examine hydrology/vegetation/soil relationships, morphological development of hydric soils, physiological response of vegetation to soil saturation, and other topics. This may include analysis of wetland response to management regimes, changing conditions (natural or anthropogenic), and site conditions at a variety of spatial and temporal scales.

Efforts will focus on development of technical guidance with the capacity to assess wetland resources for the purpose of improving management, public benefit, and ecological functional capacity within US Army Corps programs and Department of Defense lands.

(Contact: Dr. Jacob Berkowitz, 601-634-5218; Email: Jacob.F.Berkowitz@usace.army.mil)

F. Ecological Trace Detection and Characterization (EL-32)

Research is sought that addresses the detection, characterization, quantification, etc., of plant, animal, and fungal traces in the environment, particularly traces of a "genetic" nature such as environmental DNA (eDNA) and RNA (eRNA), though other traces may be of interest. Many organisms are difficult to detect, survey, or monitor using visual, acoustic, or other direct methods, but may leave detectable levels of eDNA, eRNA, etc., in the areas they frequent. Such traces represent probabilistic evidence of the species presence and may be used in place the of or in combination with more direct approaches. In some cases, ecological trace applications are not required in order to effectively study or monitor a species, but may be more efficient, less costly, or less hazardous. In many cases established conventional approaches and trace approaches will be complementary. Ecological traces may also be used for community-level studies via approaches such as eDNA metabarcoding. Noninvasive genetic approaches, such as species and sex identification from hair or scat samples, molecular scatology, and related endeavors can also be considered under ecological trace research and are of interest. Advances in theory, application, and best practices are needed for nearly any class of ecological trace study. Examples of potential topic areas include:

a. New classes of ecological trace
b. Broadened suite of data classes that can be discovered, recovered, or characterized via environmental traces
c. Enhancement of ecological trace data quantity and/or quality
d. Characterization and prediction of ecological trace deposition, dispersal, and persistence in complex environments
e. Enhanced capacities to predict individual organism states, population attributes, or community phenomena using ecological traces
f. Use of ecological traces to populate and validate environmental and ecological models, the use of such models to predict trace patterns, and the effective coupling of models and trace applications to enhance natural resource management
g. Unmanned ecological trace sampling, sample processing, and sample analysis, as well as methods and technologies for utilization of trace sampling by non-experts
h. Inclusion or consideration of ecological trace approaches in cost-benefit analysis, structured decision making, and related endeavors

(Contact: Richard Lance, 601-634-3971; Email: Richard.F.Lance@usace.army.mil)

ENVIRONMENTAL CHEMISTRY

I. Introduction

Environmental chemistry at the EL provides chemical expertise in the areas of experimental geochemistry, computational, organic, inorganic, materials, and analytical chemistry for the other ERDC researchers and laboratories, for USACE district, Army, and other Department of Defense customers

(Contact: Ms. Amber Russell, 601-634-4302; Email: Amber.L.Russell@usace.army.mil)

II. Research Areas

A. Experimental Chemistry (EL-33)

This team seeks to characterize and understand the fate of metals, explosives, and other emerging compounds of interest in the environment by measuring relevant concentrations and physical properties, as well as environmental fate, degradation, and other geochemical reactions. All aspects of environmental geochemistry are of interest, including development of methods for unique compounds, assessing geochemical reactions in complex matrices, and environmental distribution and fate, related to the Corps of Engineers Military and Civil Works missions. Ongoing work includes the identification of intermediates in degradation pathways for explosives, ultralow detection methods for emerging compounds of interest, and development of unique analytical techniques to identify metals speciation and nanomaterials in complex environmental media. These unique capabilities are applied to the behavior of natural systems where fate and environmental attributes can be characterized and quantified.

(Contact Dr. Anthony J. Bednar, 601-634- 3652; Email: Anthony.J.Bednar@usace.army.mil)

B. Computational Chemistry (EL-34)

This team seeks to understand the fate, effects and transport of contaminants and explosives in the environment by predicting relevant physical and chemical properties and by delineating degradation pathways and understanding environment as a threat. Ongoing work includes the prediction of rates of reactions for contaminants and explosives and for all intermediates in degradation pathways, prediction of optical properties, photodegradation, interfacial interactions, surface modification, surface sorption, development of multifunctional materials, complex environmental models using atomistic level to coarse- grained approaches.

Application of machine learning in the computational chemistry research is another area we are actively working. QSAR methods are also developed to aid in the

prediction of physical properties and in relating the chemical structures of explosives and contaminants to their toxicity.

(Contact: Dr. Manoj Shukla, 601-634-5431; Email: Manoj.K.Shukla@usace.army.mil)

NONINDIGENOUS AQUATIC NUISANCE SPECIES MANAGEMENT

I. Introduction

In a 1993 report, the U.S. Congress, Office of Technology Assessment estimated that nonindigenous pest species have resulted in U.S. losses of millions to perhaps billions of dollars annually. They reported documented losses of $97 billion between1906-1991. When environmental conditions are favorable, non-indigenous species, such as hydrilla (Hydrilla verticillata) and the zebra mussel (Dreissena polymorpha), become established and disrupt the aquatic environment and economy of infested areas. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) as reauthorized and amended by the National Invasive Species Act of 1996 (PL 104-332) and the River and Harbor Act of 1958 (Public Law 85-500) as amended, direct the Corps of Engineers to develop environmentally sound control methods to prevent, monitor, and control introductions of non-indigenous aquatic nuisance species.

II. Research Areas

A. Aquatic Plant Control (EL-35)

Aquatic plant research for the management of non-indigenous aquatic plant species in navigable waters, tributary streams, connecting channels, and other allied waters is a continuing activity of the Corps of Engineers. The research thrust is to reduce non- indigenous plant populations to non- problem levels, enhancing and/or replacing these non-indigenous species with indigenous species as more beneficial and productive aquatic habitat. Areas of technology development include advanced management strategies and applications, techniques for establishing desirable aquatic vegetation, and computer-based systems for aquatic plant management planning.

(Contact: Michael Greer, 716-879-4229; Email: Michael.J.Greer@usace.army.mil)

1. Aquatic Plant Ecology. Research and development on invasion and restoration ecology of both native and invasive aquatic plants is needed; including phenology, modes of spread, distribution models, methods of restoration of native-dominated aquatic plant communities, and effects of non-indigenous plant invasion and management on native plant communities and aquatic ecosystems, both under contemporary and expected climate change environmental conditions. Development and evaluation of aquatic plant community quantification techniques are needed to support both research and operational needs. In addition, the development of PC-based simulation models of plant

growth or effectiveness of management techniques is desired. Expansion of these models to include spatial distribution to 2-D and 3-D graphical displays to enhance management planning and implementation are also sought.

(Contact: Ms. Lynde Dodd, 972-436-2215, ext. 221; Email: Lynde.L.Dodd@usace.army.mil)

2. Biological Control Methods for Aquatic Plants. Current research involves biological control of problem aquatic macrophytes using microorganisms, aquatic invertebrates, and vertebrates. The objective is to develop an operational capability for biological agents to control invasive aquatic plants. Research topics of interest include foreign exploration for natural enemies, specificity, and ecology of microflora of aquatic macrophytes, stimulants and attractants of invertebrates impacting aquatic macrophytes, biology (including thermal tolerances) of invertebrates that feed on aquatic plants, and revegetation with desirable aquatic plants for the inhibition or prevention of problem plant species.

(Contact: Mr. Nathan Harms, 601-634-2976; Email: Nathan.E.Harms@usace.army.mil)

3. Chemical Control Methods for Aquatic Plants. A need exists for development of aquatic plant management methods, which utilize both herbicides and plant growth regulators to selectively control or maintain plant populations below nuisance levels. Research is needed on the physiological weak points in the growth cycle of nuisance aquatic plants for application of control measures, herbicide delivery systems (water- dispersible granules, emulsifiable concentrations, flowable suspensions, etc.) to deliver the active ingredient to the target plant, and field evaluations of the effects of aquatic herbicides and plant growth regulators on nuisance species as well as selected non- target plant species. Evaluation of the effects of chemical control on plant growth, flowering/seed production and reproductive structures is also needed.

(Contact: Dr. Bradley Sartain, 601-634-2516; Email: Bradley.T.Sartain@usace.army.mil)

4. Aquatic Plant Establishment and Succession. The presence of invasive species in the U.S. has altered native vegetation community succession, especially in concert with increased environmental disturbance often resulting in persistent nuisance plant infestations in aquatic habitats. Proposals should examine methods establishing native aquatic plants or altering the species composition of aquatic plant communities to minimize the growth of exotic weedy plant species, be compatible with existing non-plant invasive species (e.g., exotic snails, other herbivores), and encourage the growth of native dominated, sustainable aquatic vegetation communities both under contemporary and expected climate change environmental conditions.

(Contact: Ms. Lynde Dodd, 972-436-2215, ext. 221; Email: Lynde.L.Dodd@usace.army.mil)

5. Relationships between Fish and Aquatic Plants. Aquatic plant control methods are developed to be environmentally compatible, regardless of the situation and/or the control method being implemented. Aquatic plants, though problems to water uses, provide habitat for fisheries and organisms that support fish populations. Currently, there is insufficient data for developing the relationships between fish and aquatic plants that are needed to dictate the degree of control of the plants without destroying the habitat, thus ensuring compatibility.

(Contact: Dr. Jack Killgore, 601-634-3397; Email: Jack.Killgore@usace.army.mil)
(Contact: Dr. Todd Slack, 601-634-4138; Email: Todd.Slack@usace.army.mil)

6. Genetics of plant invasions. Invasive plants may be introduced into new areas multiple times from different source regions, leading to variation in performance and success at invading new communities. Post-introduction evolution may also lead to unique locally adapted invader lineages. Multiple invader lineages may require lineage-specific management tools because of differences in phenology, environmental tolerances, or other character traits (e.g., growth rate, reproductive output). An understanding of invader genetics (inter and intra-population genetic variation, source of introduction(s)) supports Corps of Engineers management R&D and control activities. Use of invader genetics to inform their management is now becoming more common. However, genetic data is lacking for many damaging species. Proposals should address the need for genetic surveys of target species and provide clear endpoints (i.e., source region, number of unique haplotypes, etc.) of the research.

(Contact: Dr. Nathan Harms, 601-618-9536; Email: Nathan.E.Harms@usace.army.mil)

B. Aquatic Nuisance Species (EL-36)

1. Harmful Algal Blooms (HABs), which can be caused in freshwater by various cyanobacteria, represent a significant and costly threat to our Nation's economy and natural resources. Research proposals submitted under this topic area (EL-35-1) should examine methods, develop and/or demonstrate innovative technologies for HAB detection, prevention and management intended to reduce the frequency and effects of HABs on our Nation's freshwater resources. Proposed methods and technologies must be scalable to meet the need of very large freshwater HAB events. Explicitly addressing the scalability requirement in proposals is strongly encouraged. Note that water quality, including impacts to drinking water, is not an explicit USACE mission. Proposals that focus exclusively on water quality may be limitedly considered. Proposals that use UAS as a monitoring or surveying method will not be considered.

(Contact: Michael Greer, 716-879-4229; Email: Michael.J.Greer@usace.army.mil)

2. Research is needed to better quantify and model the dynamics of invasive

aquatic species through the development and application of a variety of integrated, multimedia models that can project spatio-temporal patterns of these species. This research involves the use of novel techniques for coupling models with different spatial and temporal resolutions. Modeling frameworks should be developed to address a wide variety of invasive species and should integrate models from different disciplines relevant to the study system. Models can include, but are not limited to, traditional engineering- and physics-driven models, population, and community dynamics models (including, spatially explicit, structured population, individual- based, among others), and socio-economic models. The integrated model suites will be utilized to analyze interrelations and dependence of environmental and anthropogenic factors that drive successful colonization of invasives.

(Contact: Dr. Todd Swannack, 601-415-3509; Email: Todd.M.Swannack@usace.army.mil)

SUSTAINABLE ECOSYSTEM AND SPECIES MANAGEMENT

I. Introduction

Aquatic ecosystem restoration (AER) is a major mission area for the Corps. In addition, the Corps is responsible for natural resource management of millions of acres of land and aquatic resources. As part of this mission, the Corps must account for and manage impacts to Threatened and Endangered (T&E) species and minimize impacts of invasive and nuisance species in all USACE missions, to include AER and navigation activities. Examples include conservation activities, such as endangered fish and bird species, and management of invasive and nuisance species, such as Harmful Algal Blooms, Invasive Carp, and hydrilla. Advanced technologies and strategies are needed to prevent, detect, and manage a diverse range of species for sustainable and resilient ecosystems. Forecasting and managing T&E and invasive species and monitoring the long-term success of healthy ecosystems is central to the overall USACE mission. Applications involving advanced data collection and analytics via innovative technologies such as sensors, remote detection systems, and/or Next-Generation Ecological Modeling to support proactive ecosystem restoration and/or investigate impacts of climate change on the landscape and species movement are needed to enable stewardship and management of USACE water resource development projects for sustainable and resilient ecosystems.

II. Research Areas

A. Prevention of Ecosystem Degradation (EL-37)

There is a need to understand the current and future impacts of ecosystem degradation due to a changing landscape from shifting climate regimes/scenarios and Corps activities (e.g., Potential expansion of invasive species; new invasion of invasive species; temperature shift impacts on native species). Key considerations involve

preventing loss of critical habitats, environmental resiliency, introduction and spread of invasive/nuisance species (e.g., invasive fish and other faunal species, aquatic invasive plants, harmful algal blooms), and adverse impacts to T&E species. Areas of interest include comprehensive ecosystem health assessment; innovative ways to understand species response to ecosystem conditions; species and landscape threat analysis; and invasive species prevention tools and management techniques.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

B. Detecting and Predicting Ecosystem Health and Species Presence and Movement (EL-38)

There is a need to develop detection tools, sensors, and interfaces to rapidly and when possible, remotely detect and evaluate ecosystem health; invasive/nuisance species presence; and track movement of threatened, endangered, and at-risk species, while also tracking movement of invasive and native species in vulnerable landscapes. Areas of interest include innovative sensor technology development; advanced species monitoring systems; real-time monitoring systems for ecosystem health and species occurrence through sensor deployment; and predictive modeling tools and interfaces to predict species movement and impacts.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

C. Management of Invasive/Nuisance Species, Threatened and Endangered Species, and Ecosystem Health (EL-39)

Managing natural resources and navigable waterways is central to the Corps mission. There is a need to develop innovative and effective management strategies to foster healthy and sustainable ecosystems. Areas of interest include development of biological, chemical, mechanical, and physical control technologies for invasive/nuisance species; rapid treatment response tools for invasive/nuisance species; integrated species and ecosystem decision support tools to rapidly evaluate treatment alternatives and trade-offs; overall best management practices for priority species; and novel considerations and plans for proactive ecosystem restoration in the face of climate change.

(Contact: Dr. Jennifer Seiter, 601-634-4038; Email: Jennifer.M.Seiter@usace.army.mil)

WATER QUALITY AND ECOLOGICAL SYSTEMS

I. Introduction

The Corps of Engineers is involved in research to develop water quality and ecological system models for riverine, reservoir, wetland, coastal and marine surface, and groundwater.

Current research encompasses a wide range of environmental issues. Emphasis is on short- and long- term field and laboratory investigations to improve the techniques for evaluating water quality and developing water quality management guidelines. The research also emphasizes the development of biological models for terrestrial, lacustrine, palustrine, estuarine, and coastal environments to assist in evaluating potential effects of natural and man-made alterations.

II. Research Areas

A. Ecological Modeling (EL-40)

Research into the development and application of a variety of biological models for terrestrial, lacustrine, palustrine, estuarine, and coastal habitats. This research involves the use of traditional population and community dynamics models as well as spatially explicit, structured population and individual oriented models for addressing a wide variety of biological problems. Research is also ongoing for the integration of physical and biological models spanning different spatial and temporal scales. The integrated models can be utilized to analyze interrelations and dependence across trophic levels in a simulation mode and to determine the potential effects of alterations (natural and man-made perturbations) to the ecological system.

(Contact: Dr. Patrick Deliman, 601-634-3623; Email: Patrick.N.Deliman@usace.army.mil)

OUTDOOR RECREATION

I. Introduction

Research and development are conducted in support of outdoor recreation planning and management at 463 multipurpose reservoirs located in 43 states. These projects include 11.5 million acres of an adjacent water and a total shoreline length over triple the coastline of the continental United States. The Corps of Engineers is the largest supplier of water- oriented outdoor recreation opportunities in the nation. All aspects of public use of multi- purpose water resource development projects are considered in recreation research and development. The trend is, where feasible, to develop automated tools for use by the planner and manager in the interest of efficiency of operation. This objective is considered in the context of providing high quality recreation experiences for the visitors to these lakes in a safe and pleasant atmosphere. Some current examples of research thrust in this area follow.

II. Research Areas

A. Carrying Capacity (EL-41)

Ongoing research and technical support are currently concentrated on physical and social carrying capacity of lake water surface and lakeshores. Shoreline

management aspects of this work addresses commercial marina development, public access for boating and related activities, and management of private use of public lands at approximately 450 projects. Land- based support facilities including boat-launching ramps, parking, and pedestrian access are important features.

(Contact: Ms. Dena Williams, 615-202-4095; Email: Dena.K.Williams@usace.army.mil)

B. User Fees (EL-42)

Investigate and develop automated systems for registration of users, collection and analysis of trends data, and special feature capabilities including differential pricing, reservations, and credit card use in support of camping and day-use recreation fees at Corps of Engineers' recreation sites. Automated systems are designed for onsite use of personal computers.

(Contact: Ms. Dena Williams, 615-202-4095; Email: Dena.K.Williams@usace.army.mil)

RISK AND DECISION SCIENCE

I. Introduction

USACE increasingly relies on risk and decision science to improve decision-making and stakeholder engagement through application and development of formal quantitative methods and techniques. Research methods and tools of multi-criteria decision analysis, cognitive modeling, portfolio analysis help to describe relevant risks, identify, and compare risk management alternatives, develop consensus among disparate stakeholder groups, and provide repeatable and transparent processes for future decisions.

II. Research Areas

A. Stakeholder Engagement with Technology Support (EL-43)

Stakeholder Engagement with Technology Support (SETS) is an approach to stakeholder engagement that enhances the quality and fairness of decision making. Stakeholders collaborate to collectively identify the important criteria to consider when making some decision as well as ways to evaluate alternative courses of action against these criteria using the tools of decision analysis.

(Contact: Dr. Benjamin Trump, 978-318-8793; Email: Benjamin.D.Trump@usace.army.mil)

B. Decision Analysis (EL-44)

This decision support can be provided in the form of a deliberate method for making a decision, for considering how best to incorporate different types of evidence

into an existing decision framework, or for creating a mathematical tool to help clients to effectively manage complex dynamic systems. Specific applications include Multi-Criteria Decision Analysis (MCDA), Weight of Evidence, Portfolio Analysis, Value of Information Analysis

(Contact: Dr. Igor Linkov, 978-318-8197; Email: Igor.Linkov@usace.army.mil)

C. Resource Allocation and Adaptive Management (EL-45)

Optimal resource allocation and adaptive management are necessary for management of environmental systems to mitigate compounding threats. Advice and guidance are needed on how prioritize or combine alternatives to target optimal performance across threats from multiple domains. These approaches use performance measures and advanced decision analytics to suggest management strategies for multiple scenarios, many of which are unprecedented.

(Contact: Mr. Jeff Cegan, 978-318-8881; Email: Jeffrey.C.Cegan@usace.army.mil)

D. Systems Analysis and Resilience (EL-46)

System dynamic and network science approaches are necessary to inform engineering solutions in complex systems. Efforts in the area of complex network assessment to facilitate design of engineered and ecological systems that perform well and gracefully recover from both known and unknown threats are especially important for the USACE.

(Contact: Dr. Igor Linkov, 978-318-8197; Email: Igor.Linkov@usace.army.mil)
(Contact: Dr. Benjamin Trump, 978-318-8793; Email: Benjamin.D.Trump@usace.army.mil)

E. Equity in Disaster Planning and Response (EL-47)

The Center for Engineering for Public Health and Human Factors (EPH) functions to improve considerations for public health and human factors in engineered planning, design, operations, and management. EPH coordinates cross-disciplinary research to support agencies and organizations with equity planning across engineering, infrastructure, and public health settings where public and personnel health and safety intersect with natural and built environments.

(Contact Dr. Benjamin Trump, 978-318-8793; Email: Benjamin.D.Trump@usace.army.mil)

NATURAL AND MAN-MADE ENVIRONMENTAL DISASTERS

I. Introduction

ERDC supports US Government Agencies in understanding, forecasting, predicting, and assessing the impacts of natural and man-made environmental disasters. These include intentional release of chemicals into the environment within combat zones, the impacts of climate change related storms on civil society, workforces, and food security, environmental disasters resulting from intentional or accidental release of biological organisms, among many others. Research methods and tools in this area include horizon scanning and technology threat assessments, wargaming R&D to advance the ability for existential threat simulations and responses anywhere in the world, basic and applied research to advance game theory, computational toxicology, and non-animal approaches for predicting chemical and biological effects in human systems.

II. Research Areas

A. Horizon Scanning and Technology Threat Assessments (EL-48)

We use Horizon Scanning and Technology Threat Assessment approaches to forecast when new threat agents may emerge, and the probability that new threat agents will emerge. ERDC R&D in this area includes natural language processing approaches to cast a wider net and ingest open-source intelligence more quickly. We are also developing threat communication visuals and infographics to facilitate understanding of complex concepts.

(Contact with Edward Perkins, email Edward.J.Perkins@erdc.dren.mil)

B. Biological Systems Assessment (EL-49)

Understanding and predicting the response of biological systems (humans, agriculture plants/animals, microbial communities) to natural and man-made environmental disasters. We are also interested in predicting population effects using Bayesian approaches. Our biological systems simulations will also be incorporated in future wargames and simulations.

(Contact with Edward Perkins, email Edward.J.Perkins@erdc.dren.mil)

C. Cryptic Ground and Environmental Signatures (EL-50)

In the midst of, and following, natural and man-made environmental disasters we need to monitor and identify the movement of people and animals through the natural and built environments. As humans and animals move through the environment, they leave behind cryptic traces and signatures.

Cryptic signatures include, but are not limited to, human gait, footprint information, vehicle tracks, speed, intent, biochemical signatures from breath, latent DNA, footprint depth. We are interested in sensor payloads for drone swarms that may allow us to monitor human, or latent animal movement in response to human

movements, that cannot be observed by conventional remote sensing technologies due to tree canopy or other cover (e.g., tunnels or alleyways).

We are also interested in developing environmental signatures of cities and non-urban locales. Environments tend to have a certain “buzz” about them. We are interested in using still and video imagery and sound information to identify a particular locale and the time of day or day of the year. Having concurrent sound and imagery will also allow us to avoid deep fake situations, where the imagery and sounds do not match. This information will help us identify where videos and photos may have been taken before, during, or after a man-made or natural environmental disaster. This has many potential military uses from humanitarian to intelligence operations. Being able to use shadows and natural light to approximate time of day and latitude/longitude (if time of day were approximately known as well as potential weather effects) is also of interest.

(Contact with Edward Perkins, email Edward.J.Perkins@erdc.dren.mil)

INFORMATION TECHNOLOGY LABORATORY (ITL)

I. Research Areas

A. Computational Science and Engineering (ITL-1)

Research in computer-aided interdisciplinary engineering; scientific and engineering software development and interoperability; and numerical analysis is conceived, planned, managed, conducted, coordinated with ERDC R&D programs and related reimbursable projects. ITL collaborates with researchers in other DoD research organizations, the DoD High Performance Computing Center, and the other ERDC laboratories to advance the state of practice in numerical modeling and assessment applied to civil engineering, military engineering, digital engineering and digital twining, and environmental quality challenges. In this research area, ITL performs the following:

1. Researches, develops, refines, validates, and applies advanced computational methods and mathematics to model physical, biological, and sociological systems. Works to make these advanced computational systems more practical, meaningful, useful, and available to address problems of the Corps, Army, and Nation. Interacts with high-performance computing centers to achieve optimum synergy between computational machine architecture and operating systems and computational techniques.

2. Researches the application of emerging Quantum Computing and Quantum Technology capabilities to develop faster solutions to challenging problems. Applies quantum computing to create novel solution methods to cybersecurity, physics-based modeling, artificial intelligence, and other areas in order to address problems of the Corps, Army, and Nation.

3. Researches, develops, refines, validates, and applies advanced mathematical and computational models that model the physical world. Works to transition these methods to address problems of the Corps, Army, and Nation.

4. Research autonomy and the development of robotic and autonomous systems, develops methods of integrating sensors and computational resources on robotic systems, and creates novel techniques to apply robots and autonomous systems.

5. Investigates a wide range of high-end data systems solutions in response to technical requirements. Researches and develops capabilities that address data display, data analysis, data visualization, data archiving, and mass storage. Design state-of-the-art algorithms, scientific data analysis, for large and small-scale software system configuration, sizing, and development methodologies utilizing recognized techniques and scientific data format standards. Provides emerging need capabilities in systems engineering research, including areas of data- and decision-centric analytics, mission engineering, operations research,

wargaming, and leading-edge advanced modeling and simulation methods.

(Contact: Dr. Jeffrey Hensley, 601-634-4596; E-mail: Jeffrey.L.Hensley@usace.army.mil)

B. Software Engineering and Informatics (ITL-2)

Best practices in software engineering and informatics are applied to the research and development of new uses of information technology to solve multidisciplinary problems in military engineering, civil and environmental engineering, basic sciences, and geospatial and business applications. Integrated systems are developed for USACE and its customers; prototyping is performed in collaboration with other USACE and government organizations, universities, and commercial partners; and testbeds are developed to prove concepts in an operational environment. Unique software, hardware, commercial off-the-shelf software, and data systems solutions are analyzed, designed, tested, developed, and integrated to meet customers' requirements. ITL performs the following in support of this research area:

1. Investigates software engineering methodologies; conducts research, development, and studies of information systems and applications; and develops, tests, operates, and maintains decision support systems for ERDC, USACE, and other federal agencies. Plans and develops systems and modules to provide for interoperability and reuse and to conform with applicable information assurance requirements; and provides technical assistance to internal and external customers in these areas.

2. Coordinates capabilities, requirements, and deployment for computer-aided design (CAD), building information modeling (BIM), and computer-aided facilities management (CAFM) technologies throughout the tri-services with an emphasis on maintaining the life-cycle use of facilities data through planning, design, construction, operation, maintenance, and disposal. Develops and maintains acquisition vehicles in support of the USACE, Army, DoD, and other partners and customers. Performs research, development, and technology transfer on a wide range of geospatial, geographic information system, CAD, BIM, CAFM, and related technologies in support of DoD and other federal agencies and customers across a wide range of activities. Conducts research and deployment on relevant hardware and software systems. Performs technology transfer to deliver improvements and new techniques to the user community.

3. Provides services and supports ERDC research and development projects through categorization, archiving, management, optimization and retrieval of information and knowledge to include library and information systems science services.

4. Technology transfer services include creation of technology transfer products, such as videos, Web sites, pamphlets, brochures, articles, bulletins, technical

notes, pamphlets, brochures, and technical editing and document production management. Technology Transfer Specialists work with program managers of major Corps R&D programs and research laboratories to transfer technology that emerges from R&D work units to the appropriate audiences and assist the ERDC researchers in establishing a program identity for the Corps and its research programs.

(Contact: Mr. Quincy Alexander, 601-634-2905; E-mail: Quincy.G.Alexander@usace.army.mil)

C. High Performance Computing (HPC) (ITL-3)

The ITL, maintains largescale, supercomputing resources for the DoD Research, Development, Test and Evaluation (RDT&E) and Acquisition Engineering (AE) communities. In addition to providing supercomputing resources, the ITL conducts research related to the efficient use of high-performance computing (HPC) systems and networking technologies by a geographically dispersed community. Of special interest are technologies, services, and techniques for innovative access to workflow management on HPC resources, i.e., the incorporation of GUI based zero client interfaces that are user customizable and data storage, management, and accessibility by providing holistic capabilities that are incorporated into the HPC environment that create capabilities that are independent of the capabilities of a particular HPC system.

(Contact: Mr. Robert Hunter, 601-634-3766; E-mail: Robert.M.Hunter@usace.army.mil)

D. Cybersecurity (ITL-4)

Cybersecurity is the state of being protected against the criminal or unauthorized use of electronic data and/or automated controls and the measures required to achieve this for information technology and operational technology systems. There is an interest to develop tools or algorithms to protect critical Research and Development and infrastructure networks, industrial control systems (ICS), supervisory control and data acquisition (SCADA) systems, and programable logic controllers (PLC) against adversaries that continually develop, modify, and adapt threats to constrain the ability to effectively and securely operate in cyberspace. The new and innovative capability will leverage networked-, host-, and behavior-based concepts to provide a holistic cybersecurity defense approach and provide cyber situational awareness. These new products will contribute to assured compliance assessment solutions that include vulnerability assessment and scanning capability, host-based protection and defense capabilities, network-based monitoring and firewalls, multi-router traffic grapher, network flow statistics and cyber operational attributes.

(Contact: Mr. Quincy Alexander, 601-634-2905; E-mail: Quincy.G.Alexander@usace.army.mil)

E. High Performance Data Analytics (ITL-5)

High performance data analytics is the process of examining data sets so large or complex that traditional data processing applications are inadequate for a variety of data types to uncover hidden patterns, unknown correlations, multidimensional trends, and other useful information. There is an interest to leverage High Performance Computing, emerging heterogeneous computing resources, next generation computational algorithms, and software tools to develop an ecosystem approach to manage and conduct high performance data analytics with complex data sets created by a combination of physics driven, high-fidelity model processes, experiments, and observations. It is desirable for these new and innovative high performance data analytic techniques to exploit heterogeneous hardware platform that are driven by applications and may include CPUs, GPUs, neuromorphic, neural network, and data sciences driven processors and associated heterogeneous storage systems. High performance data analytics in context of this BAA can apply to additive manufacturing, compute at the edge, digital engineering/digital twining and can include large-scale data processes such as data capture, data curation, search, sharing, storage, transfer, and visualization.

(Contact: Dr. Jeffrey Hensley, 601-634-4596; E-mail: Jeffrey.L.Hensley@usace.army.mil)

F. High Performance Computing (HPC) Enabled Additive Manufacturing (AM) Technologies (ITL-6)

Additive manufacturing or 3-D printing will lead to many opportunities in fabricating complex and innovative systems and components rapidly for wide class of certifiable DoD and Army applications at the point of need. AM provides higher degree of freedom beyond the geometry to fabricate new systems and components. However, DoD applications demand multi- functional, multi-scale, and multi-material AM technologies with tailored properties and desired functions. These applications are complex and difficult with current AM technologies that can provide rapid components and systems at the edge. Future developments in HPC driven computational approaches that seamlessly integrate, and guide AM technologies are needed to rapidly fabricate reliable and certifiable components and systems. Research topics of interest for HPC enabled AM technologies include: (a) high-fidelity multi-physics, multi-scale computational AM approaches; (b) Optimization; (c) trade-space analytics; (d) integration of AM with deployable HPC; (e) Uncertainty quantification and validation; (f) data driven approaches; (g) Machine learning based simulation approaches to assist designers; (h) virtual testing; (i) AI enabled certification; (j) HPC enabled optimized process control; (k) innovative AM technologies.

(Contact: Dr. Raju R. Namburu, 202-819-6013; E-mail: Raju.R.Namburu@usace.army.mil)

G. Artificial Intelligence and Machine Learning Models to Inform Materials Discovery (ITL-7)

Research in developing and/or utilize existing Artificial Intelligence (AI) and Machine Learning (ML) algorithms to rapidly discern future trends in the field of Materials Science. These developed AI and ML algorithms will be used to inform future research directions in the development of novel materials with advanced properties in scientific fields, such as polymer chemistry, transducers, biomaterials, semiconductors, ceramics, metals, composites, high-capacity storage, etc. The output from the AI and ML algorithms must be experimentally validated through synthesis and fabrication of products with the predicted desirable properties/chemistry/etc. Research is needed in the development of these novel AI and ML algorithms to predict future directions in high-performance products with the addition of experimental validation of the models.

(Contact: Dr. Jeffrey Hensley, 601-634-4596; E-mail: Jeffrey.L.Hensley@usace.army.mil)

CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)

A. Advanced Methods and Designs for Additive Construction (CERL-1)

Proposals are sought for novel, basic and applied solutions in the areas of advanced construction (construction 3D printing) that provide support for deployed force infrastructure. The focus of military utilization of additive construction is on on-demand infrastructure, mobility, and sustainment assets using locally available materials, which improves cost, reduces logistics, and saves lives. Areas of continued research include, but are not limited to:

1. Innovative and novel deposition and evaluation (such as rheology & shape stability) of printable mixtures (not limited to polymers, composites, cementitious, dispersion of fibers into matrix, etc.),

2. Printable material or equipment solutions that use locally available, recycled, or indigenous materials,

3. Mixtures, comparison of mixtures, and solutions that can provide a unique application solution, including but not limited to enhanced fire protection or high durability for extreme environments,

4. Methods for assessing and managing the performance of printed components OR standard serviceability tests and performance criteria for printed elements,

5. Novel and scalable approaches including stationary, modular, and component builds, withstanding the spectrum of potential operating environments, and complex geometries through topology optimization,

6. Design and innovative approaches including stationary, modular, and component builds, withstanding the spectrum of potential operating environments, and complex geometries through topology optimization,

7. Semi-autonomous to fully autonomous methods related to additive construction for austere environments (including reinforcement and other compatible construction techniques).

(Contact: Ms. Justine Yu 217-373-4526; Email: Justine.A.Yu@usace.army.mil)

B. Advancing Army Installations to 5G Network Capabilities (CERL-2)

We seek 5G network research proposals relating to Army installations. Since low latency and high bandwidth have been made possible by 5G and beyond, we are interested in compelling ideas that can advance basic principles and technology concepts that can bring new capabilities in communications and data sharing to Army Installations. Some examples that 5G is well suited to support are automated vehicles, robotics, vision systems, augmented reality, AGV/LGV, video as a sensor, drones, V2X,

micro-location, control systems, and mobile human-machine interface (HMIs). Additional areas of compelling research would be those that improve 5G efficiency and security such as AI/machine learning, reconfigurable intelligent surfaces, integrated access and backhaul (IAB), and O-RAN architecture.

(Contact: Andrew Johnson 217-373-7293; Email: andrew.l.johnson@usace.army.mil)

C. Innovative Construction Material Systems (CERL-3)

Proposals are sought which investigate novel or innovative construction material systems for engineer operations or construction of temporary, semi-permanent, or permanent structures. Future concepts for sustainment and maneuver support missions require enhanced understanding of materials and manufacturing techniques that are massively scalable and broadly adaptable to various environments. Considering the needs of a mobile force, the ideal material systems would be locally or naturally available and reduce logistics burdens for contingency construction or onsite production of force protection assets. Major MILCON projects would benefit from enhanced total lifecycle performance of emerging material system technologies. Research in this area includes, but is not limited to:

1. Engineered mass timber systems for enhanced insulation and weapons effects performance.

2. Alternative concrete and asphalt binder technologies

3. Modeling and modification of pumped material flow characteristics

4. Construction material sourcing strategies and modeling to predict or reduce logistics burdens

5. Large-scale technology insertion of emerging construction material systems

(Contact: Dr. Peter Stynoski 217-373-3484; Email: Peter.B.Stynoski@usace.army.mil)

D. Innovative Energy Efficiency and Energy Security Initiatives (CERL-4)

Proposals are sought which address the need for improved energy efficiency and improved energy security by federal, state, and private sector energy users. Federal agencies are required to meet stringent energy efficiency targets mandated by Executive Order.

Products/methods/techniques that will improve overall energy efficiency or reduce reliance on non-renewable energy sources are of interest. These include but are not limited to combined heat and power generation, fuel cells, low Nox boilers/burners, natural gas cooling and compressed air, storage cooling, wind, geothermal, and solar power generation, and high efficiency heating/ventilating/and air-conditioning systems.

In addition, proposals are also sought for products/methods/techniques that will improve the robustness of energy delivery systems and reduce the risk of loss of energy services due to economic dislocations, depletion of natural resources, natural or man-made disasters, as well as for products/ methods/techniques which will facilitate cost effective, reliable, and sustainable utility support to deployed forces in underdeveloped regions of the world.

(Contact: Mr. Aaron Petri, 217-373-3377; Email: Aaron.C.Petri@usace.army.mil or Scott Lux, 217-373-4438, scott.m.lux@usace.army.mi)

E. Fuel Cell & Hydrogen Technology Advancements (CERL-5)

Proposals are sought which address the following research areas for fuel cell, hydrogen, reformers and electrolyzer technology:

1. Design and/or development of an advanced technology base
2. Innovative and/or lower-cost manufacturing, packaging, and assembly processes
3. Balance-of-plant (BOP) components
4. Experimental demonstrations of innovative system components.
5. Storage and transportation advancements
6. Innovative fuels research and development efforts

(Contact: Mr. Nicholas Josefik, 217-373-4436; Email: Nicholas.M.Josefik@usace.army.mil)

F. Contingency Basecamp Operational Energy (CERL-6)

Definition of Operational Energy: The energy and associated systems, information and processes required to train, move, and sustain forces and systems for military operations.

This research would identify new opportunities for contingency base camp operational energy reduction (demand-side management) achieved through new and innovative technologies, improved system, or operational modifications. This research would also identify new and innovative opportunities for improved power generation, to include renewables and energy storage (supply-side management) with the focus on.

1. Reducing reliance on vulnerable resupply operations (both fuel and water) – this enables greater operational freedom of action and reduces the Soldier and system burden at the tactical edge,
2. Conserving resources

In addition, technologies considered should be able to withstand the harsh, demanding, and austere conditions of an operational environment. The research would provide results on the latest base camp operational energy technologies or operational changes and quantify the associated cost/benefits for any proposed change.

3. Metering and Monitoring

Technologies to measure, collect, and sent operational energy data on a DoD facility provides Warfighters the ability to provide energy management data to allow the Commander to make energy informed decision.

(Contact: Tom Decker, 217-373-3361; Email: Charles.T.Decker@usace.army.mil)

G. Autonomous Robotic Solutions for Engineer Operations in the Deployed Environment (CERL-7)

Proposals are sought for novel, basic and applied solutions in the areas of ground/air robotics to enable the automation of complex Army Engineer operations such as horizontal/vertical construction, mechanical obstacle reduction/removal, etc. ERDC-CERL is conducting research in the broad area of robotic engineering support in challenging and highly dynamic operating environments. Focus is on integrating solutions into existing Engineer tasks and equipment in order to expand the Engineer's capacity and capability. Research in this area includes, but is not limited to:

1. Creation of standoff capabilities through the use of non-line-of-sight teleoperation.

2. Multi-spectral, near real time mapping; creating semantic models of complex environments; continuous update of extracted site features through change detection.

3. Mission planning and control tool to visualize the semantic site models, monitor task completion, and coordinate tasks among multiple pieces of equipment; and

4. Semi-autonomous solutions specifically for end effector control of construction type equipment

(Contact: Mr. Ahmet Soylemezoglu; 217-373-3481; Email: ahmet.soylemezoglu@usace.army.mil)

H. 4-D Printing of Geopolymer Composites or Polymer-Stabilized Soils (CERL-8)

CERL is interested in the technology for rapid robotic 4-D printing of geopolymer composites for use under extreme environments of temperature (freezing or fire) or nuclear radiation. A variety of reinforcements or filler phases can be added to produce

structural or radiation shielding geopolymer composites. Various geopolymer formulations can be developed capable of fire resistance to 2500°F. Prefabricated panels can be joined or hinged into rapidly deployable structures such as bush fire-resistant huts. Protection of pavement subjected to excessive heat during helicopter or vertical lift off (VLO) aircraft take off and landings can also be achieved with heat resistant geopolymer pads.

(Contact: Joseph Gamez, 217-373-4469, joseph.a.gamez@usace.army.mil)

I. Fiber Reinforced Polymer (FRP) Composites for Infrastructure Applications (CERL-9)

The research program in structural fiber reinforced polymer (FRP) composites supports both the Military and Civil Works missions of the U.S. Army Corps of Engineers. This work focuses on research, development and field tests related to the implementation and maintenance of FRP composite materials in infrastructure applications. This includes both thermoset and thermoplastic technical composites along with other reinforced polymers.

For military installations, the Government seeks development of concepts for facility construction applications using composite materials systems. This includes vertical and horizontal construction, seismic retrofit, structural upgrade, force protection and other military engineering other applications.

In civil works, there is interest for further development of wear resistance, inspection, maintenance, and repair technologies for FRP composites structural components. These components include, but are not limited to gates, valves, bulkheads, guide walls and bumpers, wall armor and fenders, recess panels, trash screens and sheet pilings.

The application of structural FRP composite materials and systems to military and civil works applications involves working knowledge of composites manufacturing, interfacial and laminar behavior, fracture mechanisms, joining technologies, design criteria, durability and aging, quality assurance, smart and multi-functional composites, repair and inspection techniques, and other appropriate phenomena. Research interests include the ability to develop constitutive and other predictive models of these phenomena for the intended applications.

(Contact: Dr. Peter Stynoski, 217-373-3484; Email: peter.b.stynoski@usace.army.mil)

J. (CERL-10) RESERVED

K. Innovative Corrosion Control (CERL-11)

This area focuses on research, development, and field tests to prevent and reduce corrosion of building components and infrastructure at military and civil works

facilities. The components most susceptible to corrosion include building exteriors, HVAC (heating, ventilation, and air conditioning) systems, underground pipes (gas water, steam, high temperature hot water), water storage tanks, water treatment plants, sewage treatment plants, bridges, and navigation and dam structures. The general areas of interest include the following corrosion control technologies:

1. Coatings,
2. Cathodic Protection,
3. Advanced (Corrosion Resistant) Materials Selection and Design,
4. Water Treatment, and
5. Remote Corrosion Assessment and Management.

(Contact: Ms. Rebekah Wilson, 217-373-4467; Email: Rebekah.C.Wilson@usace.army.mil)

L. Geotechnical Scaled Physical Modeling at Normal Gravity (CERL-12)

This research area seeks to capitalize on the unique capabilities of the Construction Engineering Research Laboratory's shake table, known as the Triaxial Earthquake and Shock Simulator, by focusing on the development, evaluation, or demonstration of techniques to perform scaled physical modeling of geotechnical structures at normal gravity for military and civil works applications. Research on this topic can be either basic or applied. It includes but is certainly not limited to: (a) development of scaling relationships to overcome incompatibilities at normal gravity, (b) dynamic scaled physical modeling of geotechnical structures (e.g., earthquakes), (c) static (i.e., monotonic) scaled physical modeling of geotechnical structures, and (d) soil-structure interaction.

(Contact: Joseph Gamez, 217-373-4469, joseph.a.gamez@usace.army.mil)

M. Novel Soil Stabilizing Agents (CERL-13)

This research area focuses on the development, evaluation, or demonstration of novel soil stabilizing agents for construction or other purposes. The intent of this research area is to develop soil stabilizing agents that can be used in environments ranging from austere and extreme (i.e., military engineering) to the typical construction conditions (i.e., civil works). Research on this topic can be either basic or applied and includes but is certainly not limited to: (a) development of new classes of soil stabilizing agents, and (b) novel soil stabilizing agents that impart unique properties to soil.

(Contact: Joseph Gamez, 217-373-4469, joseph.a.gamez@usace.army.mil)

N. Integrated Water Security for DOD Installations (CERL-14)

Proposals are desired which address the need for an enhanced capability to protect facility/mission critical water supplies and infrastructure (i.e., fire hydrants) from chemical and/or biological attacks, as well as accidental contamination incidents. In particular, innovative and non-developmental methodologies and systems are sought. Ideally, the processes/equipment would have the capability to expeditiously retrofit/commission/operate and maintain technologies intended and designed to prevent, detect, treat, decontaminate, and rehabilitate DOD water systems that have been accidentally and/or deliberately contaminated by acts of vandalism or terrorism. These enhancements would therefore protect and result in rapid rehabilitation of CONUS/OCONUS DOD installation and/or Forward Area Base Camp water supplies and water distribution networks.

The technologies should be integrated into the installation water infrastructure in such a way that systems and functions on the DOD base are not negatively impacted. We are also interested in ways to optimize the effectiveness of such prevention, detection, treatment, decontamination, and rehabilitation systems while minimizing life cycle costs and improving reliability and confidence in the system's required levels of protection. In addition, we are interested cost effective methods of certifying and recertifying water supply/infrastructure protection enhancements.

(Contacts: Mr. Mark Ginsberg, 217-373-6754; Email: Mark.D.Ginsberg@usace.army.mil)

O. (CERL-15) RESERVED

P. Critical Infrastructure Protection for Utility Systems (CERL-16)

Utility systems provide the electricity, water, transportation fuel, heating, cooling, communications, and compressed air that are required for carrying out military installation missions. The objective of this research is to develop methods, simulation tools, and models to enable installation and military planners to plan, assess, optimize, and monitor the ability of utility systems to support normal operations requirements, as well as military force projection. New technologies and methods are needed for conducting utility system simulations using real-time data, as well as historical, generic, or hypothetical scenarios.

(Contact: Mr. Mark Ginsberg, 217-373-6754; Email: Mark.D.Ginsberg@usace.army.mil)

Q. Infrastructure Management, Facilities Maintenance (CERL-17)

This research calls for facilities and infrastructure component-level modeling; condition and functional assessment; life cycle performance measurement and service life forecasting; maintenance, repair, sustainment, restoration, and modernization work identification and resource optimization; and long-term impact analysis under different

investment policies and funding levels. Specifics include automated and/or continuous condition assessment, damage detection, condition monitoring and facility equipment diagnostics, reliability-centered maintenance, risk, and resiliency analysis.

(Contact: Michael Grussing, 217- 398-5307; Email: Michael.N.Grussing@usace.army.mil)

R. Modeling and Simulation/Analysis tools for Infrastructure Applications (CERL-18)

This research supports facilities and infrastructure life cycle decision support tools for smart and resilient installations. This includes the development of tools and analysis methods that formally establish a connective link from infrastructure capacity and capability measures to mission objectives and installation readiness levels. Specifics include data-driven techniques for strategic facility investment analytics; modeling and simulation of infrastructure risk, reliability, and resiliency; and system optimization under multiple scenarios, changing mission requirements, complex operational constraints, and general conditions of uncertainty.

(Contact: Michael Grussing, 217- 398-5307; Email: Michael.N.Grussing@usace.army.mil)

S. Innovative Coating Systems and Applications (CERL-19)

This area focuses on research, development, and field validation tests for all aspects of protective paints and coatings for military and civil works infrastructure, including building surfaces and structural components, utility systems, industrial structures and systems, and navigation, hydropower, and flood protection structures. Required research includes, but is not limited to: (a) innovative methods for the preparation of surfaces for painting, including the removal of coatings containing lead and other hazardous materials and the assessment of prepared surfaces; (b) innovative approaches to paint application and curing; (c) reducing the cost or environmental impact of surface preparation and painting, (d) coating systems for the protection of steel immersed in abrasive, turbulent water, (e) specialty coating applications, such as fire protection, mold control, thermal insulating coatings or heat transfer coatings, and high durability coatings for severe environments; (f) methods for assessing and managing the performance of coatings; (g) the development of coatings performance and service life models, and (h) standard serviceability tests and performance criteria for coating systems.

(Contact: Ms. Rebekah Wilson, 217-373-4467; Email:Rebekah.C.Wilson@usace.army.mil) (Contact: Ms. Brooke Divan, 217-373-3364, Email: Brooke.A.Divan@usace.army.mil)

T. Global Warming Reduction Technologies or Studies (CERL-20)

Proposals are sought for research, development, evaluation, and/or demonstration of technologies that reduce or eliminate the emission of substances with global warming potentials that are applicable to DoD installations, systems and federal facilities located in worldwide locations. This may also include studies of the global warming contributors and reduction opportunities for these facilities' operations. Topics of interest may include, but not limited to, refrigerant reduction/substitution/elimination, greenhouse gas control/reduction/elimination, and other emerging technologies with low to zero global warming potential that may replace current technologies with high global warming contributions. Technologies, proofs of concept and/or studies are sought to serve a variety of sites and applications including various sized contingency bases, permanent installations both CONUS and overseas, mobile sources, and weapon systems.

(Contact: Dr. K. James Hay, 217-373-3485; Email: Kent.J.Hay@usace.army.mil)

U. Structural Health Monitoring Technologies of Large-Scale USACE Civil Infrastructure in Aquatic Environment (CERL-21)

The USACE owns, operates, and maintains a massive infrastructure portfolio in support of waterborne/riverway transportation, hydropower, and flood-risk management. By the nature of the application, this infrastructure exists in environments that are less than ideal for durability of typical structural materials and often precludes visual inspection. Proposals are sought for technologies and approaches in support of, and to be integrated into, ERDC's existing program that develops and deploys structural health monitoring (SHM) technologies to assess condition and inform maintenance needs of this infrastructure. Proposals addressing the following will be particularly valuable, though other novel approaches to SHM of large-scale infrastructure may be considered: Novel sensors or sensing technologies for long-term deployment to directly detect structural damage modes typical of steel and/or concrete structures and structural components that are continuously submerged and subjected to significant icing and silt/debris accumulation.

Non-contact (e.g., computer-vision-based, laser-based) approaches to automated structural inspection and condition assessment of large-scale infrastructure that is continuously submerged in water of very high turbidity. Of particular interest is surface-based technologies or approaches that can acquire information from land through the air/water interface, though other approached will be considered. Note: UAV/ROV-based approaches are unlikely to be considered at this time. Technologies or approaches to detect excessive friction, or directly determine friction coefficient, in large-scale trunnions/bearings/joints between very slow-moving components such as lock and dam gates.

(Contact: Brian Eick, 217-373-4432, brian.a.eick@usace.army.mil)

V. Inventory, Assessment, and Monitoring (CERL-22)

This research develops innovative and improved technologies and procedures

for (1) inventorying threatened and endangered plant and animal populations and assessing long term population viability and habitat health and (2) inventorying archeological sites, traditional cultural sites, and historic structures and landscapes; assessing their eligibility for listing on the National Register of Historic Places; and monitoring impacts to significant sites, structures, and landscapes, and (3) inventorying maneuver and range land landscapes. Research efforts should consider ecosystem and regional as well as local installation contexts when evaluating population viability, habitat health, significance of cultural sites, and effectiveness of ranges and maneuver areas. Specific research efforts are requested in the following areas:

1. Improved methods for inventorying threatened and endangered species and collecting related environmental data pertaining to endangered species management,

2. Improved methods for measuring a full range of habitat conditions and biological and abiotic environmental parameters,

3. Inventory and assessment of invasive species,

4. Predictive modeling of archeological sites,

5. Environmental reconstruction and geomorphological analysis related to identifying areas of past human habitation and use,

6. Geophysical techniques for surveying and assessing archeological sites, ranges, and maneuver lands, including improved methods for collecting, processing and dissemination of high definition 3-D laser scans and point clouds.

7. Identifying, documenting, creating digital models, and assessing the significance of historic structures and landscapes and archeological sites,

8. Condition assessment and monitoring systems for historic structures and landscapes,

9. Inventory and monitoring systems for archeological sites,

10. Acquiring, processing, integrating, and/or analyzing remotely sensed data and imagery for natural and cultural resources, ranges and training land-inventory, assessment, and monitoring, including automated delineation of vegetation properties, estimation of forest constituent properties, soil carbon, and carbon cycling.

(Contact: Angela Rhodes, 217-299-2035; Email: angela.m.rhodes@usace.army.mil or Heidi Howard, 217-373-5865; Email: heidi.r.howard@usace.army.mil)

W. Land Management (CERL-23)

The goal of research in land management is to develop and improve planning and management tools and procedures that enable land managers to address the priorities of the military mission, meet the requirements of environmental legislation, and support the stewardship of natural and cultural resources on military lands. Specific research efforts are requested in the following areas:

1. Impacts of military land use activities on species listed pursuant to the Endangered Species Act and developing management plans and mitigation strategies,

2. Fragmentation of habitat of threatened and endangered species,

3. Developing technologies for integrating cultural and natural resources management planning,

4. Predicting and controlling erosion and dust associated with military training activities,

5. Evaluating the carrying capacity of training lands and improving understanding of the impacts of military training on the environment,

6. Developing new technologies designed to mitigate environmental effects of training on the landscape,

7. Assessing and modeling the effects of helicopter, aircraft, blast, and small arms noise on animals and humans,

8. Designing noise data collection systems for installations,

9. Developing noise impact mitigation techniques,

10. Developing technologies for control of invasive species,

11. Developing sustainability indices and risk assessments for military training lands,

12. Designing predictive computer models and decision support tools for assessing environmental change, the effects of both human and natural influences on the environment, and the integrated management of natural and cultural resources,

13. Developing a full range of land use planning tools to facilitate long term sustainability of defense installations,

14. Developing databases relevant to land and ecosystem management and improving information flow for modeling and decision support purposes,

15. Identifying, designing, and/or developing a computing system environment and/or protocols to facilitate interactions between analysis tools and common delivery mechanisms under development by CERL and ERDC.

16. Developing technologies and approaches for hydrologic and hydraulic assessment of military lands,

17. Developing technologies and approaches to quantify military lands and impacts using non-invasive remotely sensed technologies,

(Contact: Angela Rhodes, 217-299-2035; Email: angela.m.rhodes@usace.army.mil or Heidi Howard, 217-373-5865; Email: heidi.r.howard@usace.army.mil)

X. Waste to Energy Conversion Systems - Energy, Diversion, Value Recovery (CERL-24)

Proposals are sought for research, development, evaluation, and/or demonstration of waste stream conversion systems applicable to DoD installations, federal facilities, and similar waste generating locations. Technologies are sought to serve a variety of sites including various sized contingency bases or permanent installations both CONUS and overseas. This variation translates into a range of waste throughput from less than one ton to one hundred tons per day. The materials that could be processed include, but are not limited to, wastewater, energetic waste streams (e.g., munitions byproducts and wastewater), solvents, and the entirety of municipal solid waste streams or portions thereof, such as food, vegetative materials, construction debris and demolition materials, biosolids, or plastics. Integrated technology solutions are prioritized in this sequence: net electric power, net thermal energy, and conversion to, and subsequent storage of, fuels or specialty chemicals. The solutions offered must build a business case for cost avoidance, integrated operations, reduction in emissions, and residual waste remains with consideration given to novel methods including chemical, thermal, or other conversion process methods.

(Contact: Mr. Stephen Cosper, 217-398-5569; Email: Stephen.D.Cosper@usace.army.mil)
(Contact: Ms. Dominique Gilbert, 217-373-3488, Email: Dominique.S.Gilbert@usace.army.mil,)
(Contact: or Dr. Aaron Petri, 217-373-3377, Aaron.C.Petri@usace.army.mil)

Y. Compliance at Troop Installations (CERL-25)

This research calls for basic and applied research, and technology solutions to meet environmental regulation as it applies to installation activities. Research under this BAA includes technologies that enable continued operation of compliance sites, meeting regulatory requirements without negative impact on mission for CONUS installations. This includes but is not limited to technologies that address compliance issues associated with solid waste, hazardous waste/hazardous materials, water

quality, wastewater, storm water, air emissions, and soil remediation. This also includes compliance reporting tools to provide consistency in environmental assessment data.

(Contact: Ms. Angela Urban, 217-373-4421, Email: Angela.B.Urban@usace.army.mil) or Ms. Dominique Gilbert, 217-373-3488, Email: Dominique.S.Gilbert@usace.army.mil)

Z. Pollution Prevention (CERL-26)

Proposals are sought for research into, or demonstration of pollution prevention technologies, methodologies, processes that support or eliminate environmental compliance issues. Topics of interest include technologies for alternative surface cleaning to eliminate or minimize solvent use; energy efficiency in wastewater treatment; food waste management; solid waste recycling systems; composting; and "green building" upgrades.

(Contact: Mr. Stephen D. Cosper, 217-398-5569; email: Stephen.D.Cosper@usace.army.mil)
(Contact: Ms. Angela Urban, 217-373-4421, Email: Angela.B.Urban@usace.army.mil)

AA. Business Process Reinvention (CERL-27)

This research calls for new business processes and supporting technologies that will enable the DoD and civilian Federal agencies to efficiently and effectively exchange information, evaluate performance, and ensure regulatory compliance. Specific emphasis is on the support of Environment, Safety and Occupational Health (ESOH) regulatory compliance research and program development, including the application of audit business processes and Environmental Management System program development.

(Contact: Angela Rhodes, 217-299-2035, Email: angela.m.rhodes@usace.army.mil or Heidi Howard, 217-373-5865, Email: heidi.r.howard@usace.army.mil)

BB. Socio-Cultural Analysis (CERL-28)

Understanding urban and social environments requires the ability to model complex interactions between 1) infrastructure systems and services, 2) human populations and society, and 3) natural and man-made environments and their impact on military operations. Proposals are sought for the development of new and improved concepts, methods, and tools for acquiring and representing spatial-temporal information that can be combined with cognitive and behavioral processes to advance the fundamental understanding of the spatial- temporal, socio-cultural dimensions of human social dynamics. Specific research efforts are requested in the following areas:

1. Understanding human military theater phenomena including but not limited to aggregate behavior, nonlinear phenomena, networks with distributed or local control, and combinations of continuous and discrete behavior.

2. Development of computation techniques that enable discovery of new information and relationships that cut across disciplines (spatial and behavioral).

3. Development of abstract models or ontologies to represent fundamental understanding of the complex urban environments.

4. Development of technology transfer methods to take theory/concepts to operational environments through use of novel computation and simulation techniques.

5. Develop improved methods to characterize non-trivial spatial and temporal patterns and define relationships between physical environment (i.e., soils, vegetation, climate, surface geology) and human/cultural aspects (i.e., population/ethnic group movement, human patterns, and behaviors).

(Contact: Ellen R. Hartman, 217-398-5305; Email: ellen.r.hartman@usace.army.mil)

CC. (CERL-29) RESERVED

DD. Adaptive Intelligence Systems Architecture (CERL-30)

The following capabilities requirements regarding virtual capabilities to simulate a base camp in all phases of its life cycle Simulations will provide analytical tools for planning and design, tools for optimization of construction management, systems monitoring and data collection/analysis for optimal base camp operations, training of base camp designers and operators, planning and analysis capabilities for transfer and closure of facilities.

The virtual capabilities to be provided include; but, are not limited to the following component systems: Power generation, distribution, and monitoring systems; water systems management analysis that are focused on use/demand requirements, collection/generation, distribution, storage, and reuse/recycle; waste component systems management that is used to address solid waste, hazardous waste, and sanitary waste; impact of human and natural dynamics on base camp systems; simulation of economics systems (costs, availability of material systems, labor and funding).

This effort will provide and understanding of the relationship dynamics of the operational base camps component systems as well as the dynamics between the component systems and the human, natural, and economic environments in which the base camp operated.

(Contact: Mr. Ahmet Soylemezoglu, 217-373 373-3481, Email: Ahmet.Soylemezoglu@usace.army.mil)

EE. (CERL-31) RESERVED

FF. (CERL-32) RESERVED

GG. Regional and Ecological Planning and Simulation (CERL-33)

Research in this domain involves the design, development, and application of ecological, economic, social, climate change, and urban growth models to help forecast the direct, indirect, and cumulative consequences of proposed management plans. Research is intended to support military installation long-term planning and sustainability by finding local and regional plans over time and space that support current and future military missions.

Virtual Representation of Landscape Characteristics focuses on research and development to accurately represent real world landscape attributes in a virtual environment. Proposals are sought to address simulation of physical properties of real-world objects including visual, auditory, and tangible characteristics, accounting for natural variation in properties, novel methods for data acquisition and application, rapid and automated population of attributes, and accurate depiction of the real world. The types of objects sought include weather, water, rocks, soil, vegetation, and wildlife.

(Contact: Angela Rhodes, 217-299-2035; Email: angela.m.rhodes@usace.army.mil or Heidi Howard, 217-373-5865 (heidi.r.howard@usace.army.mil))

HH. (CERL-34) RESERVED

II. Mitigation of Wide Area Biological Contamination Events (CERL-35)

Proposals are desired which address the need for improved capabilities to respond to wide area biological contamination events that can impact critical equipment, infrastructure, or national resources. Contamination events might be naturally occurring or manmade. Research proposals for the development, integration, and research demonstration of physical, chemical, or biological mitigation approaches are of interest. Supporting detection and clearance methods are of interest. Candidate approaches should be efficient, safe, and practical for the target application. Target applications may include building protection and remediation, mitigation of Harmful Algal Blooms (HABs) in large water bodies, wide area decontamination of infrastructure, and decontamination of corrosion-sensitive equipment.

(Contact: Dr. Martin Page, 217-373-4541, Email: Martin.A.Page@usace.army.mil) (Alternate Contact: Mark Ginsberg, 217-373-6754, Email: Mark.D.Ginsberg@usace.army.mil)

JJ. (CERL-36) RESERVED

KK. Innovative Water Efficiency and Water Resilience Initiatives (CERL-37)

Proposals are sought for evaluations and demonstrations of innovative technologies that will improve water efficiency, conserve water resources, and improve resilience of water delivery systems. Federal agencies are required to meet stringent water conservation targets mandated by Executive Order. In addition, the Army has set challenging goals for Net Zero Water attainment at installations. Products/methods/techniques that will improve overall water efficiency or reduce reliance on potable water sources are of interest. These include but are not limited to water conservation and ultra-efficient plumbing fixtures and controls, smart landscaping, smart irrigation controls, rainwater and storm water collection and reuse systems, condensate capture and reuse systems, water efficient energy technologies, distribution system leak detection, drain line transport issues, and net zero water. In addition, proposals are sought for products/methods/ techniques that will improve the resilience of water delivery systems and reduce the risk of loss of water services due to economic dislocations, depletion of natural resources, and natural or man-made disasters.

(Contact: Dr. Martin Page, 217-373-4541, Email: Martin.A.Page@usace.army.mil)
(Alternate Contact: Nicholas Josefik, 217-373-4436, Email: Nicholas.M.Josefik@usace.army.mil)

LL. Bioelectrochemical Systems (CERL-38)

Proposals are sought to evaluate, optimize, demonstrate, and validate state-of-the-art bioelectrochemical systems (BES), such as microbial fuel cells (MFC) and microbial electrolysis cells (MEC), for applications to Army problems. BES utilize the natural biodegrading capacity of microbes to oxidize the organic matter content of an input water stream (e.g., wastewater), thereby treating the water, while simultaneously generating electrical current. In this regard, BES have potential to be enabling components of effective wastewater treatment systems that do not require, or at least minimize, input of external energy at resource limited and remote military sites. Proposals can study key aspects of wastewater treatment or clean water production by BES including the type and design of BES used, the source of microbe inoculate used, the effectiveness of treatment, material performance, modes of operation that balance electrical current output with rate of organic matter oxidation, management of generated electrical current to power system components, scalability of BES volume to wastewater loading rate, and cost vs. benefit. Other possible topic areas include requirements, design, and standardization of BES, system fabrication, anaerobic digestion as a pretreatment step, the microbiology occurring within BES, materials research on BES components, process analysis and modeling, power management and self-powered autonomous diagnostics, scale-up designs, and demonstration.

(Contact: Clint Arnett, 217-373-5507; Email: Clint.Arnett@usace.army.mil)

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL)

I. Introduction:

CRREL has two major organizational elements to perform its mission: the Research and Engineering Division (RED) and the USACE Remote Sensing/Geographic Information Systems Center of Expertise (RS/GIS CX). RED is composed of five research branches: Biogeochemical Sciences, Engineering Resources, Force Projection and Sustainment, Signature Physics, and Terrestrial and Cryospheric Sciences. The RS/GIS CX comprises three functional research groups: Water Resources/GIS, LiDAR and Wetlands, and Terrain and Ice Engineering.

II. Research Areas:

A. Signature Physics Technical Area (CRREL-1)

The Signature Physics technical area focuses on research to increase knowledge and understanding of the variability in electromagnetic, acoustic, and seismic signatures of personnel, vehicles, aircraft and other military and non-military sources in response to weather, changing terrain state and complex terrain features and geometry. The understanding gained serves to improve our ability to predict signature behavior in support of materiel development, algorithm science and technology, sensor performance templates for tactical decision-making, force protection, and visualization for mission planning and rehearsal.

Military broadband wireless communication networks will operate in radio frequencies ranging from hundreds of MHz to several GHz. Terrain and environmental variability will significantly influence network performance. Research is focused on innovative approaches to gain fundamental understanding of geo-environmental influences, including terrain and terrain condition, on propagation at millimeter to meter wavelengths. Basic experimentation, theoretical formulation, and simulation activities in this technical area include: the description of propagation along the surface of the earth; novel techniques for characterizing impacts of large and small-scale topographic features; the electrical properties of surficial materials, including vegetation; and the effects of near-surface, tropospheric, and stratospheric atmospheric disturbances.

Seismic and acoustic spectrum research focuses on the development of fundamental understanding of the propagation processes in different terrestrial materials and in the lower atmosphere, and algorithm development for improved target detection and classification. Of particular interest, this technical area seeks to develop theory and validation for full three dimensional expression of (1) the character of seismic surface waves under strongly heterogeneous near-surface geological conditions and complex surface geometry at multiple scales; (2) the character of acoustic waves as affected by the atmosphere (predominantly the boundary layer, troposphere, and stratosphere), heterogeneous ground impedance; and topographic and terrain feature controls; (3) the phenomenology of seismic-acoustic coupling, and (4) novel materials for attenuating linear and nonlinear sound waves and vibrations. Other research

focuses on the variation in personnel and vehicle signatures (seismic, infrared, visual) due to weather, terrain, and cultural activity, and mitigating the impacts of environmental impacts on signature recognition.

Products of this technical area support information superiority critical to military operations through improving terrain analysis support to command, control, communication, computer, information, surveillance, and reconnaissance (C4ISR) and tactical communications. By increasing our understanding of geo-environmental impacts on sensing (C4ISR) and signal propagation, this research will lead to improved terrain analysis and mission planning tools. Seismic-acoustic interest extends to applications in the Biogeochemical Processes in Earth Materials technical area (CRREL-3), such as reducing military generated noise and mitigating its adverse impacts. The research area operates in a unique niche that combines experimentation with physics-based modeling and simulation, with an emphasis on the implications of the dynamics of the environment on systems performance. The Signature Physics technical area is highly complementary to CRREL's Terrain Properties and Processes technical area (CRREL-2).

(Contact Mr. Paul M. Kutia, 603-646-4337; Email: paul.m.kutia@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Environmental effects on seismic and acoustic wave propagation and sensors.

2. Innovative and/or integrative research in geospatial research and engineering.

3. Seismic-acoustic target localization or anomalous activity detection in urban and other complex environments.

4. Acoustic/seismic sensor performance modeling.

5. Seismic signal modeling for battlefield sensors.

6. Site characterization for seismic-acoustic signal modeling.

7. Surface radio wave propagation.

8. Weather and terrain effects on intrusion detection sensor performance.

9. Seismic, acoustic, and infrasound propagation in complex environments.

10. Electromagnetic remote sensing and sub-surface detection of buried metal objects including UXOs.

11. Electromagnetic modeling and numerical methods.

12. Signature phenomena and other exploitation techniques for remote sensing of kinetic hazards.

13. Near-surface electromagnetic wave propagation over rough terrain.

14. Quantification of uncertainties in Unmanned Aircraft Systems (UAS) and counter UAS sensor performance due to weather and terrain.

B. Terrestrial and Cryospheric Sciences Technical Area (CRREL-2)

The Terrain Properties and Processes technical area investigates fundamental processes and properties of terrain and terrestrial materials as affected by the atmosphere and applies this knowledge to solving a broad range of military and civil problems. The range of research topics is broad and involves laboratory experiments, field expeditions, and numerical modeling. Research focuses on environmental physics in such topic areas as electromagnetics, boundary layer processes, fluid flow in porous media, and thermodynamics. These topics include energy exchange with the terrain, transport of gas, water, and vapor in soils and snow, weather effects on sensor performance, ice accumulation, snow and ice mass balance, permafrost degradation, snow metamorphism, and snow, soil, and micrometeorological modeling. Terrestrial surfaces extend to permafrost, glaciers, as well as river, lake, and sea ice covers. At the microscale, this technical area focuses on improving the understanding of the physical processes associated with mass, momentum, and thermal transport in the atmosphere and at the terrain surface. This includes measurements and theoretical developments to improve prediction of processes and integrates our understanding into larger-scale models. Efforts to predict atmosphere-terrain interactions are focused on the impact of short vegetation on thermal and spectral signatures, developing computationally efficient models for very high spatial resolution, identifying terrain features and soil strength with spectral imagery, understanding and modeling impacts of pressure-driven flow on atmosphere-terrain exchange, and modeling freezing rain in complex terrain. Military research on terrain state aims to extend understanding of weather-driven terrain material property changes at tactical-relevant scales.

The Terrain Properties and Processes technical area contributes to Army, DoD, and national capabilities by defining the natural environment and the terrestrial-climate impacts on plans and operations as well as critical infrastructure. A key interest for the Army is the development of tactical decision aids for terrain reasoning and situational awareness. The relevance of the work relies on an ability to predict the state of the environment for any weather, any time of day, and any season. This allows the military to exploit the dynamics of the environment rather than conquer it, allowing the military commander to exercise a terrain advantage. This technical area also contributes to the body of knowledge supporting long range Corps programs in water resources planning and management and aiding other Federal agencies responsible for understanding changes in climate dynamics and its impacts on civilization. The Terrain Properties and

Processes technical area is strongly synergetic with CRREL's Signature Physics Technical Area (CRREL-1).

(Dr. John W. Weatherly, 603-646-4741; Email: john.w.weatherly@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Signature and scene prediction and synthesis for Infrared and the millimeter-wave spectral region

2. Algorithms to recover geophysical products from remote sensing measurements to drive models of surface energy balance and signature prediction

3. Methods to spatially distribute models of snow cover, soil, and vegetation energy and mass interactions in the boundary layer

4. Penetration of energy transfer components into snow

5. Characterization and modeling of weather, obscurants, and terrain conditions related to the spatial winter boundary layer

6. Environmental and atmospheric effects on winter battlefields

7. Physically accurate modeling to produce synthetic scenes and data for a global range of environmental conditions

8. Geophysics of snow, ice, and frozen ground

9. Spatial distribution of snow properties

10. Geological and geophysical processes of permafrost, glaciers, and ice sheets

11. Lunar and planetary analogue site characterization

12. Vapor-driven snow metamorphosis coupling Lattice-Boltzmann air flow with discrete element model of snow

13. Air-sea surface energy exchange and sea ice mass redistribution in the Arctic

14. High resolution sea ice modeling

15. Terrain and cultural factors effecting deterrence planning and operations

C. Biogeochemical Processes in Earth Materials Technical Area (CRREL-3)

The Biogeochemical Processes in Earth Materials technical area focuses on understanding the interaction of biological systems, in particular the establishment, growth, and dynamics of plant and microbial communities, with a variety of earth and engineered materials (i.e., geomimetics). The properties of these materials are studied in situ, in the field and via laboratory experimentation. This technical area spans basic research to applied field demonstrations.

The goal of research in this technical area is to exploit understanding of biological, geological, and chemical interactions to further technology development in environmental remediation and ecosystem restoration, sustainable military training lands and ranges, biosensor development, and terrain reasoning and assessment. A further goal is to understand hierarchical or scalable relationships between the fundamental large-scale biogeochemical processes and smaller scale “drivers” that constrain such processes, i.e., climate and physiography. Understanding the hierarchical linkage between fundamental processes and the drivers characterizing a particular biome or ecoregion can aid in the development of predictive capabilities at the landscape level, e.g., persistence and fate of harmful chemicals or microorganisms in the environment.

Research under this technical area is being impacted and enhanced by the following emerging concepts and technological developments applied to biogeochemical systems and materials:

1. Omics. Spin-offs of genome characterization (genomics), protein and other biomolecule characterization (proteomics), and metabolite and other daughter molecule characterization (metabolomics), will continue to provide new, rapid, high throughput bioanalytical techniques and novel methodological approaches to research in this technical area. This could revolutionize study and assessment of interactions between biological systems and the environment and make feasible real-time analytical and assessment capabilities available to end users.

2. Nanomaterials development. Research in chemistry and materials science on synthesis and properties of small particles (< 0.1μm) with highly reactive surfaces may make possible development of materials that mimic natural geologics and soils (i.e., geomimetics), but exhibit enhanced properties such as mechanical strength, novel catalytic properties, or variable dielectric behavior.

3. Informatics and knowledge management. Advances in informatics and emerging concepts of knowledge management will have a major impact on the ability to analyze large amounts of diverse biological, physical, and chemical data. This field will enable the extraction of new information from datasets using sophisticated statistical, ontological, and reasoning techniques. New paradigms for understanding biological systems when merged with modern digital data processing power will make it possible to field complex, real-time assessment techniques and technologies.

4. Computational chemistry and computational biology refer to in silico techniques (i.e., via computer simulation) that make it possible to perform complex and numerous chemicals and biological “virtual experiments”. These computational techniques promise a significant cost savings and increased productivity that will maximize knowledge gained and provide analytical input to future automated risk assessment and reduction applications for end users. Validation by in vitro experimentation will be conducted when appropriate.

(Contact: Mr. Nathan J. Lamie, 603-646-4598; Email: Nathan.j.lamie@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Biological processes affecting the nature and rate of transformation of natural and/or anthropogenic constituents in environmental media (soil, water, air) or on artificial surfaces under environmental conditions

2. Restoration of plant communities at local and landscape scales

3. Plant and plant community adaptation to extreme environmental conditions

4. Behavior of soil microbes or microbial communities under natural or stressed environmental conditions or on artificial surfaces

5. Biogeochemical processes in natural and disturbed ecosystems and terrain to include the impact of disturbance on spatiotemporal patterns

6. Biosensor development employing microbes, microbial physiology, or principles of microbiology for detection of chemical and biological threats or contaminants

7. Application of advanced bioanalytical and omics methods to assess the nature and rate of biogeochemical processes in natural and artificial environments

8. Application of advanced concepts of complexity, computational biology, knowledge management, and related fields to studying and predicting the behavior of microbial and plant communities in a variety of environmental conditions

D. Environmental Fate and Transport Geochemistry Technical Area (CRREL-4)

Basic and applied research aimed at understanding earth surface conditions and associated environmental characteristics that affect the fate and transport of existing and emerging contaminants, military and industrial compounds, and natural substances. With this understanding, appropriate detection, assessment, and sampling technologies

can be developed with specific application to military installations, existing and formerly used training ranges, and civil works projects. Applications target site remediation, restoration, and/or protection. Research in the technical area can be divided into four broad focus areas:

1. Characterization and sampling of energetic and munitions compounds. Research is ongoing on the distribution and fate of military munition explosive residues, propellants, and smokes on training range soils, and on the transport of explosive residues and other military-specific compounds, and their breakdown products, into surface- and ground-waters and into air. Emphasis is placed on the development of innovative analytical methodologies for current and emerging contaminants of concern and sampling techniques for accurate assessments of non-homogenously distributed compounds. This research area produces field sampling protocols and laboratory analytical methods for explosive residues that are broadly accepted within and outside of the DoD.

2. Contaminated site characterization using geophysical methods. Transport of contaminants is difficult to predict in complex geological settings, such as in cold regions where discontinuous permafrost is present. Site investigations using innovative geophysical techniques to include two- and three-dimensional resistivity, electromagnetic instrumentation, ground penetrating or other types of radar, and/or standoff spectroscopic methods, provide the means to more effectively characterize variable site conditions. Combinations of these techniques often results in enhanced one, two, and three-dimensional conceptual site models for use in predict pathways for the movement of surface and groundwater and associated contaminants.

3. Sub-surface investigations of anomaly discrimination using innovative geophysical methods. This research is directed at increasing understanding of the responses heterogeneous subsurface environments produce from surveys with different geophysical methods to enhance target discrimination. This is particularly important in cold regions where freeze-thaw cycling, and the presence of frozen ground can impact soil moisture and other properties that some geophysical methods are particularly sensitive to. Improved numerical modeling that supports signal interpretation to determine size, location, orientation, magnetic permeability, and conductivity of a candidate target is an important facet of this work. Novel seismic and acoustic methods are also of potential application in this technical area.

4. Characterization of trace metals and organic contaminants in groundwater and soils. This area focuses on the development of techniques to assess chemical and biological agents in groundwater and soils, to include aeolian dust and volatile and semi-volatile organic compounds. Research under this technical area will be potentially be impacted and enhanced by the following emerging technologies that are shaping the expectations of how fate and transport data and information is collected, assessed, and conveyed to end users: Recent

advances in the study and manufacturing of micro-electromechanical systems (MEMS), photoreactive bandgap materials (PRBs) and biosensors suggest eventual development of technologies leading to dispersible, active chemical sensors responsive to various environmental conditions or states, and therefore a future capability for geospatially-distributed, remotely-accessed sensing systems for either natural or built environments. Continued advances in robotics will spur demand for the development of a wide variety of on- board instrumentation to analyze soils and other environmental media qualitatively and quantitatively. Real-time, onsite analysis and assessment of munitions and energetics on training ranges and in other hazardous environments may become routine. Advances in the application and analysis of hyperspectral and other EM-sensor imaging data makes conceivable real-time, spatially distributed assessment capabilities for simultaneous determination of environmental parameters and contaminant distributions. And the continuing evolution of concepts in spatial organization and structure coupled with advances in informatics and knowledge management principles, practice, and technology is spurring the development of novel computational approaches in pattern recognition and change detection, which may lead to more holistic and sensitive approaches to environmental risk assessments.

(Contact: Mr. Nathan J. Lamie, 603-646-4598; Email: Nathan.j.lamie@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Environmental investigation methods, techniques, and approaches adapted to extreme environmental conditions

2. Physics and chemistry of water and its behavior in cold-region soils and geological settings

3. Physics and chemistry of water and its behavior in extremely arid environments

4. Innovative detection and analysis methods for contaminants in soil, water, and air in situ or in the laboratory

5. Rates and magnitude of fundamental soil, water, and atmospheric processes in extreme environments as they affect the fate and transport of natural substances and contaminants

6. Development of computational approaches to evaluate the nature, reactivity, fate, and transport of trace metals and organic compounds in the environment

7. Development of innovative sampling methods and protocols for contaminants in environmental media (i.e., soil, water, air)

8. Application of informatics and knowledge management principles, practice, and techniques to natural product and contaminant fate and transport assessment and management in the environment

E. Force Projection and Sustainment Technical Area (CRREL-5)

This technical area requires a combination of engineering research and practice to develop innovative technology solutions for challenging problems in a wide variety of environments. These environments include both temperate and extreme cold weather conditions and encompass remote, austere sites, such as those found at the earth's poles. Operations and logistics support in these challenging environments are often expensive, complex and extend beyond the state of current technology. Technologies that optimize mobility in a wide variety of developed and undeveloped terrains is a critical area of focus. This includes optimizing manned and unmanned vehicle performance, understanding all-season terrain mechanics, and developing advanced materials and engineered systems to provide all-season maneuver support. Other research in this technical area focuses on developing the engineering principals that support snow and ice runway construction and sustain operational capabilities when deployed to extreme cold environments.

Current efforts utilize manned and unmanned vehicles to gain an understanding of the complex vehicle-to-terrain and terrain-to-vehicle interactions that occur. The changing landscape of future conflicts also necessitates that research supporting mobility and maneuver include the nonlinear theater and urban environments. Vertical envelopment, inter-modal logistics, and environmental impacts are all critical considerations for real-time military planning. Specific needs include instrumentation for the measurement of porous media - strength and permeability, specialized heavy-vehicle mobility instrumentation, ice adhesion research, development and testing standardization, and extreme cold hardened instrumentation and analyses packages for operations support, to include expeditionary operations.

Models are also needed that accurately represent the interaction/adaptation of vehicles to challenging all-season terrains as well as the adaptation of the terrain (itself) to the vehicle. The presence of snow, ice, permafrost, and the occurrence of multiple freeze-thaw cycles present unique modelling challenges. Developed models should not only predict the performance of "next generation" mobility technologies, but also consider cost/benefits, returns-on-investments and payback schedules when implementing said technologies.

(Contact: Dr. Orian Z. Welling, 603-646-4511; Email: orian.z.welling@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Construction and evaluation of snow airfields and runways

2. All-season mobility modeling and field testing

3. All-season terra-mechanics modeling
4. All-season vehicle dynamics models
5. Vehicle simulation and visualization in complex environments
6. Weather and vehicle interactions
7. Obscured environment (non-weather) and vehicle interactions
8. Cold regions robotic vehicle performance
9. Cold regions equipment design and engineering
10. Robust logistics analyses
11. Polar and austere environment engineering
12. Unpaved airfields
13. Implications of new vehicle technology
14. Advanced materials for cold regions applications (including snow and ice as a construction and/or force protection material)
15. All-season air and ground vehicle operations
16. Manned and unmanned vehicle operations in complex environments
17. Military engineering in austere environments

F. Cold Regions Infrastructure Technical Area (CRREL-6)

The Cold Regions Infrastructure technical area provides Cold Regions research and technology solutions for construction, operations, and maintenance of standard and strategic facilities worldwide. Key issues facing the DoD include 1) strategic national defense facilities will continue to be located in cold climate and remote locations; 2) critical defense facilities in remote locations require highly reliable transportation infrastructure including airfields to sustain all-weather and year-round operations; 3) facilities are frequently one-off adaptations of standard designs and many facilities require unique/prototypical designs, thus, performance criteria must be adapted to provide high reliability; 4) severe climate and lack of local infrastructure add significant costs to design, construct and sustain facilities, airfields and other transportation infrastructure in Cold Regions; and 5) in situ testing of operational facilities is expensive and acceptance criteria difficult to define.

The Cold Regions Infrastructure technical area is an activity with a primary mission of transferring knowledge and capability directly to individual users through technical support. Current focus is on providing services, often in partnership with USACE elements including Alaska District and New York District to agencies planning, constructing, or operating facilities in winter environments. Research opportunities are leveraged with funding from other Federal agencies. Recent efforts have focused on technical support of the design, construction, and operation of missile defense facilities in Alaska and National Science Foundation facilities in Antarctica and the Arctic. Significant operational issues are solved, and value engineering impacts related to building envelopes and airfields/pavements are realized. Other key military facility design and construction efforts have benefited from CRREL's Cold Regions infrastructure support in recent years. This has included work on military hospitals, flight simulators and strategic communications and surveillance facilities in cold regions where high interior humidity is required by users but presents substantial building operational challenges in cold regions.

In addition, this technical area evaluates coatings and materials for low ice adhesion applications in locks and dams, aviation, maritime operations, and utility installations. In addition to testing the adhesion of ice to freshly prepared surfaces, weathering tests to verify the durability of a broad range of coatings are also performed. CRREL has a versatile set of ice adhesion testing methods that can both serve as an index test for comparing a set of samples during the R&D phase of a project or as a more quantitatively rigorous measurement on promising candidate coatings for low ice adhesion applications. These include: the current industry standard, the Zero Degree Cone Test, which is widely used as an index test for screening the adhesion of freshwater ice to coatings under development, the Double Lap Shear Test, which is an ASTM standard test index test configured to assess a flat test coupon (planar interface), and the more advanced Peel Test, which uses an open planar configuration and can be used with saline spray ice and accretion ice in addition to freshwater polycrystalline ice. Furthermore, the Peel Test can be configured for either Mode I tensile or Mode II shear loading. By gaining a better understand of the effects of ice adhesion on both military and civilian structures, advances can be made towards the development of a variety of preventive surface coatings and deicing methods.

New requirements will stem from the necessity to adapt to climate variability in the polar Regions. Thawing frozen ground in the Earth's Arctic Regions will be a formidable infrastructure challenge in the coming decades. Most current infrastructure design requirements are dated and no longer produce serviceable design lives for foundations, transportation facilities, and structures in these dynamic environments. Much of the technology adapted for use in the oil and gas industry in the 1970's is outdated. Virtually all new infrastructure projects need development of new requirements documents and technically advanced designs that operate well above the current minimum standards.

(Contact: Dr. Melisa Nallar,603.646.4264; E-mail: melisa.nallar@usace.army.mil)

Specific research efforts are requested in the following areas:

1. All-season airfields and pavements models
2. All-season geomaterials modeling and stabilization
3. All-season pavement testing and evaluation
4. Building envelopes in Cold regions facilities
5. Environmental loads and design criteria for facilities
6. Utilities and heat storage in Cold regions facilities
7. Permafrost engineering
8. Polar engineering
9. Low temperature concrete admixtures and placement
10. Novel materials for Cold regions infrastructure
11. Energy efficient systems and conservation techniques for remote and cold region facilities
12. Snow and ice (as construction materials) airfields and roads pavement design, testing, and evaluation
13. Ice adhesion testing, mitigation techniques and preventive surface coatings or materials

G. Water Resources Geospatial Applications Technical Area (CRREL-7)

The Water Resources Geospatial Applications technical area conducts research to improve data collection, analyses, and decision support through appropriate use of remote sensing and geographic information systems (GIS) technologies and applications. Research in this technical area results in the development of software tools and methods to improve the use of geospatial technologies across all Corps business areas to effectively manage water resources, emergency situations, real estate, environmental restoration, regulatory, navigation and operations projects and programs and support to the warfighter and Intelligence Communities (IC).

These technologies are being used to support stability, reconstruction, and homeland security operations, develop sound water resources solutions, and enhance life-cycle infrastructure management. The dedicated, highly technical staff has

multidisciplinary expertise, which has allowed them to develop advanced hardware and software resources to provide around-the-clock database and application support. These developments have led to geospatial tools for data management and decision support for USACE Enterprise GIS, the Corps Water Management System, the Formerly Used Defense Sites Program, The Geospatial Repository and Data management system (GRiD), Emergency Management (EngLink), the Wetlands Regulatory Program, the National Levee Database, and the Defense Installation Spatial Data Infrastructure Strategic Viewer. Customer breadth and satisfaction with these products is demonstrated by steadily increasing funding for this research area, projects of larger scope, and an expanding customer base (e.g., moving from primarily Civil Works Corps of Engineers applications to larger DoD, IC, and other nationwide projects). The approach of this technical area has led to a demonstrated unique capability to develop and deliver operational geospatial information systems, which are fully extensible and transferable across functional areas.

Contact: Mr. David C. Finnegan, 603-646-4106; Email: David.Finnegan@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Geostatistical methods for accuracy assessment of derived geospatial information

2. Real-time precipitation and snowmelt runoff prediction through integration of remote sensing and GIS technologies

3. Advanced remote sensing methodologies for quantifying change

4. Algorithm development to support remote sensing analysis through the use of Machine Learning (ML) and Artificial Intelligence (AI)

5. GIS technologies for environmental and water resources applications

6. Geospatial decision support systems

7. Advanced methods for 3D terrain geospatial management and analytics.

H. Hydrology and Hydraulics Technical Area (CRREL-8)

Research activities in the Hydrology and Hydraulics technical area address the fundamental aspects of cold regions hydrology and hydraulics. Specifically, this area includes direct and reimbursable research characterizing winter impacts on operation and management of Corps structures; ice jam mitigation measures and emergency operations; geospatial distribution and water equivalent estimation of snow pack; volume and timing of snowmelt soil infiltration and runoff; water quality, ecosystem restoration and environmental remediation in cold regions; and watershed and basin

water management, hazard mitigation, and methodologies for regional watershed/water resources management systems in regions affected by seasonal dynamics.

Products in this technical area directly support USACE water resources, environment, homeland security, and warfighting missions through support of flood damage reduction, navigation, ecosystem restoration, water supply, recreation, hydroelectric power, shore protection, regulatory, and environmental stewardship. This technical area has demonstrated a unique ability to align snow and ice science and engineering with operational needs to develop effective tools for direct operational use in both civil and military applications. The Hydrology and Hydraulics technical area is a unique niche within DoD and includes national and international experts in snowmelt hydrology, ice engineering, combined with extensive experience in hydrologic analyses and regional watershed and basin management.

(Contact: Mr. David C Finnegan, 603-646-4106; Email: David.Finnegan@usace.army.mil)

Specific research efforts are requested in the following areas:

1. Hydraulics, hydrology, and sediment transport in Cold Regions
2. Runoff and sediment yield of glacierized basins
3. Rapid flood control structure assessment
4. Ice scour around bridge piers
5. Cold regions coastal shoreline protection
6. Ice forces on riverine and coastal structures

GEOSPATIAL RESEARCH LABORATORY (GRL) TOPOGRAPHY, IMAGERY AND GEOSPATIAL (TIG) RESEARCH DIVISION

I. Introduction

The Geospatial Research Laboratory (GRL) conducts research related to providing rapid collection, calibration, registration, processing, analysis, integration, compression, visualization, analysis, and dissemination of remotely sensed geospatial data acquired from various manned and unmanned sources to derive high fidelity spatiotemporal information. Multi-modal data is used to create integrated and tiered geospatial products for enhanced situational understanding based on forms and methods tailored toward dissemination to Warfighters and Civil Works applications.

Additional interest includes methods for terrain-based techniques for alternative positioning, navigation, and mapping capabilities in GPS-denied environments for mounted and/or dismounted units. GRL research efforts explore the incorporation of novel materials for tagging, tracking, and locating; explores emerging lidar technologies, and the advancement of hardware and software systems related to geospatial intelligence.

Effective proposals will include conceptual descriptions; technical methods, tools, and techniques to be used; references to prior work and example data sources or collection plans; metrics that characterize how the proposed idea will measurably advance beyond current approaches; and validation and documentation plans.

II. Research Areas:

A. Novel photon-counting LIDAR software and hardware development (GRL-1)

The objective of this research area is to conduct investigations into new methods of collecting and processing photon-counting point cloud data through novel signal and image processing techniques. These techniques can focus on Geiger-mode LiDAR data, single photon LiDAR data, or any other emerging single photon-sensitive LiDAR sensing modality. Proposals concerning software and processing should focus on the differences between the proposed methods and the current state of the art. Hardware proposals can include modifications or improvements to existing GFE photon-counting LIDAR sensors or maturation/demonstrations of emerging capabilities. Successful proposals concerning hardware development or maturation will explicitly state the advantages of the proposed hardware configuration over existing capabilities.

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

B. Photogrammetry & Rectification Software Tools and Techniques (GRL-2)

The objective is to conduct research and develop techniques to perform automated or semi-automated rectification and subsequent extraction of terrain data

from frame, scanner, and video imagery. Techniques can be based on single or multiple sources. If using multiple sources, fusion issues should be addressed. A goal of this topic is to improve spatial fidelity and geometric accuracy through new alignment techniques.

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

C. Intelligent Spatiotemporal Analytics (GRL-3)

Proposals are sought for technologies that will help analysts efficiently and effectively interpret spatiotemporal data, support sense-making and help Army personnel to make better decisions in near real time. Analysts across the Department of Defense rely heavily on spatiotemporal analytics to derive critical, timely information for decision-making. As multidomain operations are planned and executed, analysts need to quickly and thoroughly consider data that spans through interdisciplinary fields and gain a comprehensive knowledge of data implications when applied to work across different domains. Objectives for this topic include both how to process complex data more effectively and how to efficiently support analyst sensemaking.

We are soliciting proposals that fit within one of the following research directions

1. Advanced methods and sensor agnostic tools which enable fusion of heterogeneous spectral-temporal sensors for terrain understanding and navigation under denied conditions and difficult to map areas.

2. Techniques to combine unstructured text and imagery into meaningful semantic contexts.

3. Methods or techniques to automatically generate unbiased training data for deep learning applications and scene understanding of multiresolution remote sensing data. Specific interest includes architectures that can learn from a continuous stream of new data in real time

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

D. Assured Position, Navigation and Timing and Visual Terrain Reference Navigation (GRL-4)

The Geospatial Research Laboratory (GRL) is seeking novel research and development proposals and solutions in the area of Assured Position, Navigation and Timing (APNT) in support of program research in the application of geospatial data (especially 3D data) to the derivation of navigation terms in GPS/GNSS denied or degraded areas and dense urban areas. Visual Terrain Reference and Navigation or VTRAN is an area being researched by GRL to use EO and other sensors (active and passive) in the development of solutions for inertial measurement systems in order to re-set and accurately drive state estimations of air and ground vehicles.

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

E. Advanced Terrain Analytics in Complex Environments (GRL-5)

The objective of this research area is to investigate and develop models and tools for semi-automated/automated intelligence preparation of the battlefield (IPB) using multi-sensor, multi-modal, and multi-temporal remotely sensed data. Geospatial workflows will advance techniques for mobility and maneuver support in complex landscapes, including, urban environments, densely vegetated terrain, and arctic/subarctic regions. Methods can incorporate 2D and 3D geospatial layers acquired from terrestrial, airborne, and space-borne assets. Tools developed in this research area will provision feature foundation data as well as enhanced, multi-scale terrain products to support commander's critical information requirements. Geospatial data processing and terrain analysis techniques will leverage machine learning and geo-statistical algorithms, as well as reduce computational time and storage. Proposals to this research area should aim to be as sensor-agnostic as possible and include methods for quantitative accuracy and uncertainty estimates.

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

F. Advanced Cyber Geospatial Science (GRL-6)

The objective of this research area is to investigate and mature methods, algorithms, systems, database technologies, and collaborative platforms (both hardware and software) that advance computational and data intensive geospatial problem-solving challenges inherent to Army transformation. Additional touchpoints include semi- and fully- autonomous methods for monitoring and mapping terrain features and characteristics. Proposals to this research area should aim to be scalable across various degrees of distributed computing infrastructure with various degrees of network constraints.

(Contact: Mr. Vijay Acharya, 703-428-6295; Email: Vijay.P.Acharya@usace.army.mil)

PART II

PRE-PROPOSAL PREPARATION AND EVALUATION

This part is intended to provide information needed in preparing research pre-proposals for submission to ERDC.

Organizations or individuals interested in submitting research proposals to ERDC are encouraged to make preliminary inquiries as to the general need for the type of research effort contemplated before expending extensive effort in preparing a detailed research proposal or submitting proprietary information. Points of contact are listed with the specific research areas for each laboratory.

A. All submissions initially submitted in response to this BAA will be considered pre- proposals. Should ERDC evaluation indicate a need for a full proposal, one will be requested from the offeror.

B. In preparing pre-proposals and proposals it is important that the offeror keep in mind the characteristics of a suitable proposal acceptable for formal evaluation, including the focus on scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding. It should include all the information specified in this announcement in order to avoid delays in evaluation.

C. Pre-proposals shall not exceed five (5) pages and shall reference the Topic Number for the specific research area (e.g., CHL-1, CRREL-10, CERL-15) under which they are being submitted.

D. Pre-proposals may only be submitted under **"ONE"** specific topic area.

E. Pre-proposals should contain the following:

1. A title descriptive of the research to be performed.

2. The name and address of the individual, company or educational institution submitting the pre-proposal (to include the email address).

3. The name and phone number of the principal investigator or senior researcher who would lead the project.

4. The duration of the project.

5. The rough order of magnitude cost

6. Statements describing the objective(s) or goal(s) of the working

hypothesis to be proved or disproved, if appropriate.

7. Statements describing the abstract or summary of the technical approach to be taken in the course of the research. If experimental, it should include a description of the scope of the testing program. If analytical, it should include key assumptions to be made, the scientific basis for the analysis, and the numerical procedures to be used.

8. Statements describing the potential military and/or civil payoffs that might ultimately derive from the proposed research to the Corps of Engineers.

9. A one-page curriculum vitae of the principal investigator.

10. If a cooperative agreement or grant is contemplated by the offeror, a description of how the principal purpose of the research effort supports or stimulates a public purpose and, if applicable, the substantial involvement by the government. See Part IV, General Information, Section D - Type of Award.

F. A preliminary review will be conducted on all pre-proposals submitted in response to this BAA and will undergo a technical review, as received, using the following factors/criteria:

1. The overall scientific and/or technical merits of the proposal, including how the proposal meets the FAR requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding, rather than focusing on a specific system or hardware solution.

2. The potential contributions of the effort to the ERDC mission.

3. Available funding.

G. Pre-proposals will be responded to within 60 days of receipt, either encouraging submission of a full proposal or advising the offeror of the unfavorable review. Offerors of pre-proposals receiving favorable initial review will be encouraged to submit a more detailed full proposal (in the format outlined in Part III). Pre-proposals that do not have sufficient scientific merit or relevance to the Army's needs, or those in areas for which funds are not expected to be available, may be declined.

PART III

FULL PROPOSAL PREPARATION AND EVALUATION

This part is intended to provide information needed in preparing research proposals for submission to ERDC.

A. An invitation to submit a full proposal based off a favorable pre-proposal review will be submitted directly to the offeror from the ERDC Contracting Office.

B. In preparing full proposals it is important that the offeror keep in mind the characteristics of a suitable proposal acceptable for formal evaluation, including the focus on scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding. It should include all the information specified in this announcement in order to avoid delays in evaluation.

C. Full proposals must reference the Topic Number for the specific research area (e.g., CHL-1, CRREL-10, CERL-15) under which they are being submitted.

D. Full proposals must contain the following:

TECHNICAL

The technical portion of the proposal will contain the following and any other information the offeror considers necessary to address the evaluation criteria mentioned below:

1. A complete discussion stating the background and objectives of the proposed work, the approaches to be considered, the proposed level of effort, and the anticipated results/products, to include the proposed reports and deliverables to be furnished.

2. A recommended Quality Assurance Surveillance Plan, which includes proposed methods for the Government to evaluate performance and determine that the deliverables (results/products/reports, etc.) are properly executed.

3. The names, brief biographical information, experience, and a list of recent publications of the offeror's key personnel who will be involved in the research.

4. The names of other agencies to which the full proposal has also been submitted.

5. A brief description of offeror's organization, to include name, address, phone numbers, and email address.

6. Past performance information to include the name, address, point of contact, phone number, email address, contract identification number, contract award date and amount for a minimum of three (3) customers for whom the offeror has performed similar services in the last three years.

7. A one-page Executive Summary, revised as appropriate from the pre-proposal submission, describing the background, scope of work, deliverables, and total proposed price (no cost breakdown is required in the Executive Summary). The Executive Summary shall not contain any sensitive data or proprietary information.

8. If a cooperative agreement or grant is contemplated by the offeror, a description of how the principal purpose of the research effort supports or stimulates a public purpose and, if applicable, the substantial involvement by the government. See Part IV, General Information, Section D - Type of Award.

9. If a cooperative agreement or grant is contemplated by the offeror, a data management plan that describes which data generated through the course of the proposed research will be shared and preserved, how it will be done, or explains why data sharing or preservation is not possible or scientifically appropriate, or why the costs of sharing or preservation are incommensurate with the value of doing so. It must include the following considerations:

a. The types of data, software, and other materials to be produced.
b. How the data will be acquired.
c. Time and location of data acquisition, if scientifically pertinent.
d. How the data will be processed.
e. The file formats and the naming conventions that will be used.
f. A description of the quality assurance and quality control measures during collection, analysis, and processing.
g. A description of dataset origin when existing data resources are used.
h. A description of the standards to be used for data and metadata format and content.
i. Appropriate timeframe for preservation.
j. The plan may consider the balance between the relative value of data preservation and other factors such as the associated cost and administrative burden. The plan will provide a justification for such decisions.
k. A statement that the data cannot be made available to the public when there is national security or controlled unclassified information concerns (e.g., “This data cannot be cleared for public release in accordance with the requirements in DoD Directive 5230.09.”)

COST

The cost portion of the proposal will contain a cost estimate for the proposed effort sufficiently detailed by element of cost for meaningful evaluation. The estimate will be detailed for each task of the proposed work and should include the following:

1. A complete detail of direct labor to include, by discipline, hours or percentage of time and salary.

2. Fringe benefits rate and base.

3. An itemized list of equipment showing cost of each item.

4. Description and cost of expendable supplies.

5. Complete detail of travel to include reason/need for travel, destination, airfare, per diem, rental car, etc.

6. Complete detail of any subcontracts.

7. Other direct costs (reproduction, computer, etc.).

8. Indirect cost rates and bases with an indication whether rates are fixed or provisional and the time frame to which they are applied.

9. Proposed fee, if any. If a cooperative agreement or grant is contemplated by the offeror, fee or profit is an unallowable cost.

10. Any documentation which supports the above.

11. Offerors will furnish the name and telephone number of their Defense Contract Audit Agency (DCAA) office, if known.

Proposals should include details on expected use of the DoD High Performance Computing (HPC) Center systems.

Proposals submitted under the BAA should clearly identify within the proposal any research that is expected to be fundamental in nature as defined in National Security Defense Directive 189. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

Note that no funds available to the Department of Defense may be provided to any institution of higher education that either has a policy of denying or that effectively prevents the Secretary of Defense from obtaining, for military recruiting purposes, entry to campuses or access to students on campuses or access to directory information pertaining to students.

SUBCONTRACTING PLAN

1. For proposed contract awards exceeding $750,000, large businesses and non-profits (including educational institutions) shall provide a Subcontracting Plan that contains all elements required by FAR 19.704 and DFARS 219.704.

2. Subcontracting Plans will be reviewed for adequacy, ensuring that the required information, goals, and assurances are included. FAR 19.702(a)(1) requires an apparent successful offeror to submit an acceptable Plan. If the apparent successful offeror fails to negotiate a Plan acceptable to the contracting officer within the time limit prescribed by the contracting officer, the offeror will be ineligible for award.

3. Subcontracting plans are determined to be acceptable or unacceptable based on the criteria established at FAR 19.705-4, DFARS 219.705-4, and AFARS 5119.705-4. Goals are established on an individual contract basis and should result in realistic, challenging, and attainable goals that, to the greatest extent possible, maximize small business participation in subcontracting for Small Business, Small Disadvantaged Business (SDB), Woman-Owned Small Business (WOSB), Service-Disabled Veteran-Owned Small Business (SDVOSB), Veteran-Owned Small Business (VOSB), and Historically Underutilized Business Zone (HUBZone) Small Business.

4. Subcontracting goals should result in efficient contract performance in terms of cost, schedule, and performance and should not result in increased costs to the Government or undue administrative burden to the prime contractor.

NOTES: Small businesses are exempt from this requirement to submit a Subcontracting Plan.

Small Business Subcontracting Plan requirements do not apply to assistance instruments.

ADDITIONAL PROPOSAL REQUIREMENTS FOR GRANTS AND COOPERATIVE AGREEMENTS

1. SF 424 Research and Related (R&R) – Application for Federal

Assistance

2. Research & Related Senior/Key Person Profile, including:
   a. Biographical Sketch
   b. Disclosure of Current and Pending Support:
      i. A list of all current projects the individual is working on, in addition to any future support the individual has applied to receive, regardless of the source.
      ii. Title and objectives of the other research projects.
      iii. The percentage per year to be devoted to the other projects.
      iv. The total amount of support the individual is receiving in connection to each of the other research projects or will receive if other applications are awarded.
      v. Name and address of the agencies and/or other parties supporting the other research projects.
      vi. Period of performance for the other research projects.

3. SF-LLL Disclosure of Lobbying Activities (if proposed value exceeds $100,000.00)

E. Scientific peer reviews will be conducted for each full proposal submitted in response to this BAA and will be evaluated, as received, using the factors/criteria listed below.

Scientific and technical merit is the most important; the other factors/criteria are of equal importance to one another. All evaluation factors/criteria other than cost, when combined, are significantly more important than cost or price. The evaluation factors/criteria are as follows:

1. The overall scientific and/or technical merits of the proposal, including how the proposal meets the FAR requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding, rather than focusing on a specific system or hardware solution.

2. The potential contributions of the effort to the ERDC and DoD mission.

3. The offeror's capabilities, related experience, facilities, techniques, or unique combinations of these, which are integral factors for achieving the proposal’s objectives.

4. The qualifications, capabilities, and experiences of the proposed principal investigator, team leader, and other key personnel who are critical to achievement of the proposal’s objectives.

5. The reasonableness and realism of proposed costs and fee, if any, and the availability of funds.

6. Past Performance

7. Subcontracting Plan (when required)

PART IV
GENERAL INFORMATION

A. PRE-PROPOSAL AND PROPOSAL SUBMISSION:

All offerors must be registered and active in the System for Award Management (SAM) at https://sam.gov/content/home prior to submission of offer.

Pre-proposals shall be submitted electronically at www.erdcwerx.org/u-s-army-engineer-research-and-development-center-broad-agency-announcement

If requested to submit a full proposal package, the submission should include the detailed proposal as discussed in Part III. In addition, a signed and dated SF-33 may be required. The SF-33 is available at http://www.gsa.gov/portal/forms/download/116254

For grants and cooperative agreements, the submission should include the detailed proposal along with a signed and date the SF-424 (R&R) located at https://www.grants.gov/web/grants/forms/r-r-family.html

Additional Representation made by the SF-424 (R&R):

PROHIBITION ON CONTRACTING WITH ENTITIES THAT REQUIRED CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS – REPRESENTATION:

> Agreement with the representation below will be affirmed by checking the "I agree" box in block 17 of the SF424 (R&R) as part of the electronic proposal submitted via Grants.gov. The representation reads as follows:
> By submission of its proposal or application, the applicant represents that it does not require any of its employees, contractors, or subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting those employees, contractors, subrecipients from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a federal department or agency authorized to receive such information.
> *Note that: Section 743 states that it does not contravene requirements applicable to SF 312, Form 4414, or any other form issued by a federal department or agency governing the nondisclosure of classified information.

Full proposals shall be submitted electronically to the following:

> 1. Full proposals for CERL shall be submitted via email to CERL-CT-Quotes@usace.army.mil. For inquiries, please contact Ms. Andrea Thomas via email at CERL-CT-Quotes@usace.army.mil or phone at 217-373-6746.
>
> 2. Full proposals for CHL shall be submitted via email to CHL-

BAA@usace.army.mil. For inquiries, please contact Ms. Christine Wilson via email at CHL-BAA@usace.army.mil or phone at 217-552-5258.

3. Full proposals for CRREL shall be submitted via email to CRREL-BAA@usace.army.mil. For inquiries, please contact Ms. Melodie Fisher via email at CRREL- BAA@usace.army.mil or phone at 601-634-4687.

4. Full proposals for EL shall be submitted via email to EL-BAA@usace.army.mil. For inquiries, please contact Ms. Sonia Boyd via email at EL-BAA@usace.army.mil or phone at 601-634-3251.

5. Full proposals for GRL shall be submitted via email to GRL-BAA@usace.army.mil. For inquiries, please contact Ms. Lashanda Areghan via email at GRL-BAA@usace.army.mil or phone at 601-497-7771 ext 1636.

6. Full proposals for GSL shall be submitted via email to GSL-BAA@usace.army.mil. For inquiries, please contact Ms. Allison Hudson via email at GSL-BAA@usace.army.mil or phone at 601-634-5337.

7. Full proposals for ITL shall be submitted via email to ITL-BAA@usace.army.mil. For inquiries, please contact Ms. Christy Love via email at ITL-BAA@usace.army.mil or phone at 601-634-3445.

The following information must be included in the body of the e-mail when submitting the proposal electronically:

1. Laboratory Name and Topic number (Spell out the complete name of the laboratory. Do not use the acronym.). Each submission shall only address one topic.

2. Vendor name and Address

3. Proposal Title

4. Total Dollar Amount

****Proposals SHALL NOT be submitted directly to Lab Personnel****
(i.e., technical personnel)

B. AWARDS:

With the submittal of all required information as described herein and the favorable evaluation of your proposal, the Government may unilaterally make award; therefore, it is in the Contractor's best interest to review all requirements listed within. Note that contract clauses are self-deleting; therefore, there is neither a requirement nor

need for a modification to the award if any clause is found not applicable. Performance after the receipt of an award signed by the Contracting Officer indicates your full acceptance of all terms and conditions within the award.

Awards will be made electronically on SF-33, SF-26, DD-1155, or other document as appropriate. Contract awards will consist of all applicable FAR/DFARS clauses and shall be in accordance with the Uniform Contract Format (UCF).

Award of a grant or cooperative agreement is subject to applicable terms and conditions of 2 CFR 200, 2 CFR 1104, DoD Grant and Agreement Regulations (DoDGARs), and DoD Research Terms and Conditions.

C. REPORT REQUIREMENTS:

The number and types of reports will be specified in the award document. The reports will be prepared and submitted in accordance with ERDC report procedures, which will be provided to the awardees.

D. TYPE OF AWARD

Selection of the type of contract is based upon various factors, such as the type of research to be performed, the contractor's experience in maintaining cost records, and the ability to detail and allocate proposed costs and performance of the work. This BAA affords the offeror the option of submitting proposals for the award of a contract, grant, or cooperative agreement. However, the type of agreement may change based on the nature of the effort and as a result of negotiation. Applicants should familiarize themselves with these instruments and applicable regulations prior to submitting a full proposal.

The following are brief descriptions of the possible award instruments:

Procurement Contract: A legal instrument reflects a relationship between the Federal Government and a State, a local government, or other recipient when the principal purpose of the instrument is to acquire property or services for the direct benefit or use of the Federal Government.

Contracts awarded by ERDC will contain, where appropriate, detailed special provisions concerning patent rights, rights in technical data and computer software, reporting requirements, equal employment opportunity, etc.

Contracts are primarily governed by the following regulations:

a. Federal Acquisition Regulations (FAR)
b. Defense Federal Acquisition Regulations (DFARS)
c. Army Federal Acquisition Regulation Supplement (AFARS)

A type of contract commonly used because of its suitability in supporting

research is a cost- reimbursable type contract. It permits some flexibility in the redirection of efforts due to recent research experiment results or changes in Army guidance.

Fixed-price contracts are used when the research projects costs can be estimated accurately, the services to be rendered are reasonably definite, and the amount of property, if any, is fixed. The negotiated price is not subject to any adjustment on the basis of the Contractor's cost experience in performing the contract.

Grant: A legal instrument that is used to enter into a relationship in which:

a. The principal purpose is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law or the United States, rather than to acquire property or services for the Department of Defense's direct benefit or use.

b. Substantial involvement is not expected between the Department of Defense and the recipient when carrying out the activity contemplated by the grant.

c. No fee or profit is allowed.

Cooperative Agreement: A legal instrument that is used to enter into a relationship in which:

a. The principal purpose is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law or the United States, rather than to acquire property or services for the Department of Defense's direct benefit or use.

b. Substantial involvement is expected between the Department of Defense and the recipient when carrying out the activity contemplated by the cooperative agreement.

c. No fee or profit is allowed.

Grants and cooperative agreements are primarily governed by the following:

a. Federal statutes
b. Federal regulations
c. 2 CFR Part 200
d. DoD Grant and Agreement Regulations
f. DoD Research and Development General Terms and Conditions