

USACE R&D - Sustainability Challenges -

Dr. Beth Fleming
USACE Engineer R&D Center

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US Army Corps of Engineers
BUILDING STRONG®



USACE R&D Sustainability Challenges

Outline:

- **USACE transformation to meet sustainability requirements**
- **Additional climate change adaptation challenges**
- **USACE Campaign Plan for sustainable operations**
- **Examples of R&D that underpin sustainable operations – both Civil and Military**
- **Summary**



USACE Sustainability Policy and Strategy

USACE :

- ***A Prominent Federal agency***
- ***A Critical Agency for Design, Construction, and Management of Military and Civil Infrastructure***
- ***Strives to Protect, Sustain, and Improve the Natural and Man-Made Environment***
- ***USACE Sustainability Strategy***
“...to Create and Maintain Conditions Under which Humans and Nature can Exist in Productive Harmony that Permit Fulfilling the Social, Economic, and Other Requirements of Present and Future Generations...”



Transformation of USACE Military Mission Strategic Direction

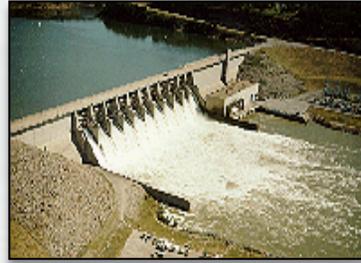
...deliver innovative and sustainable solutions that support military readiness and operations, and national policies and objectives...



- Military Programs → Military Missions
- Commodity → Value
- Sustainability Considerations → Sustainability Drivers
- Change → Innovation
- Service Supplier → Systems Integrator

Transformation of USACE Civil Works Strategic Direction

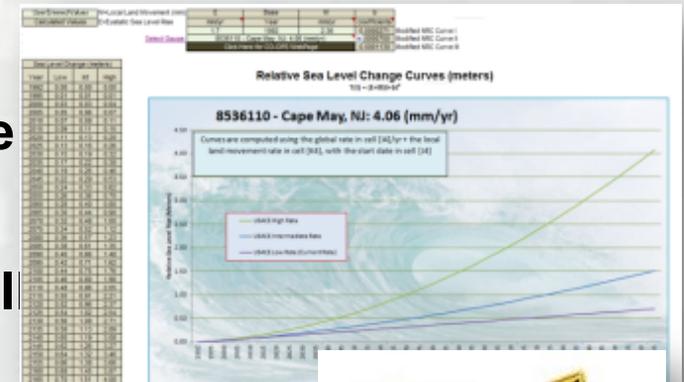
Sustainable Solutions to America's Water Resources Needs
Integrated Water Resource Management



- Project Perspective → Integrated Systems Approach
- Single Objective → Risk-informed, Multi-Objective Decisions
- Plan, Design, Build, Operate → Adaptively Manage
- Follow Standard Procedures → Be creative, consider risk, Think “systems”
- Hold Knowledge → Share Knowledge

- Climate Change - Adaptation Challenges to Implementation

- Non-stationary physical processes
- Multiple scenario approach compatible with streamlined planning
- Clear roadmap for a complex, structured problem with longer planning and adaptation horizons
- Defining levels of analysis appropriate to the decision scale (e.g., time, funds, technical resources)
- Incorporating adaptive management and anticipatory engineering – without an “open checkbook”



Our Campaign Goals

Goal 2

Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders.

Objective 2a:

Deliver integrated, sustainable, water resources solutions.

Objective 2b:

Implement collaborative approaches to effectively solve water resource problems.

Objective 2c:

Implement streamlined and transparent regulatory processes to sustain aquatic resources.

Objective 2d:

Enable Gulf Coast recovery.

Goal 3

Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation.

Objective 3a:

Deliver sustainable infrastructure via consistent and effective military construction & real estate support to customers.

Objective 3b:

Improve protection, resilience and lifecycle investment in critical infrastructure.

Objective 3c:

Deliver reliable infrastructure using a risk-informed asset management strategy.

Objective 3d:

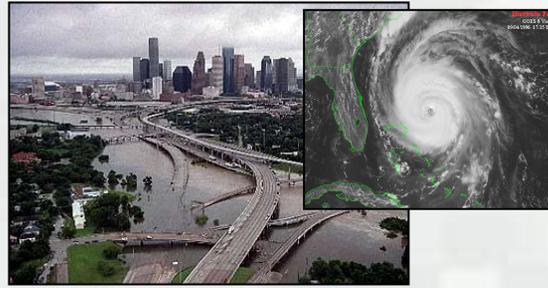
Develop and apply innovative approaches to delivering quality infrastructure.

Empowering the Campaign Plan through R&D

Goal 2: Enduring and Essential Water Resource Solutions



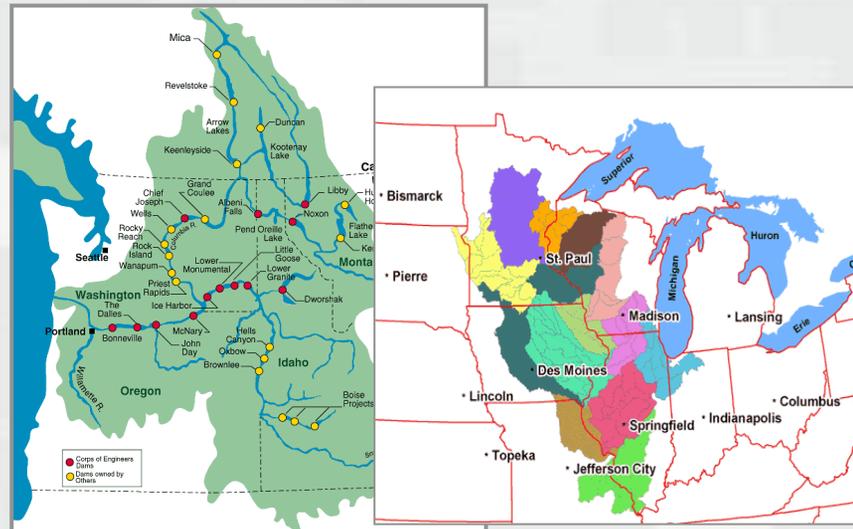
Navigation



**Flood and Coastal Storm
Damage Reduction**



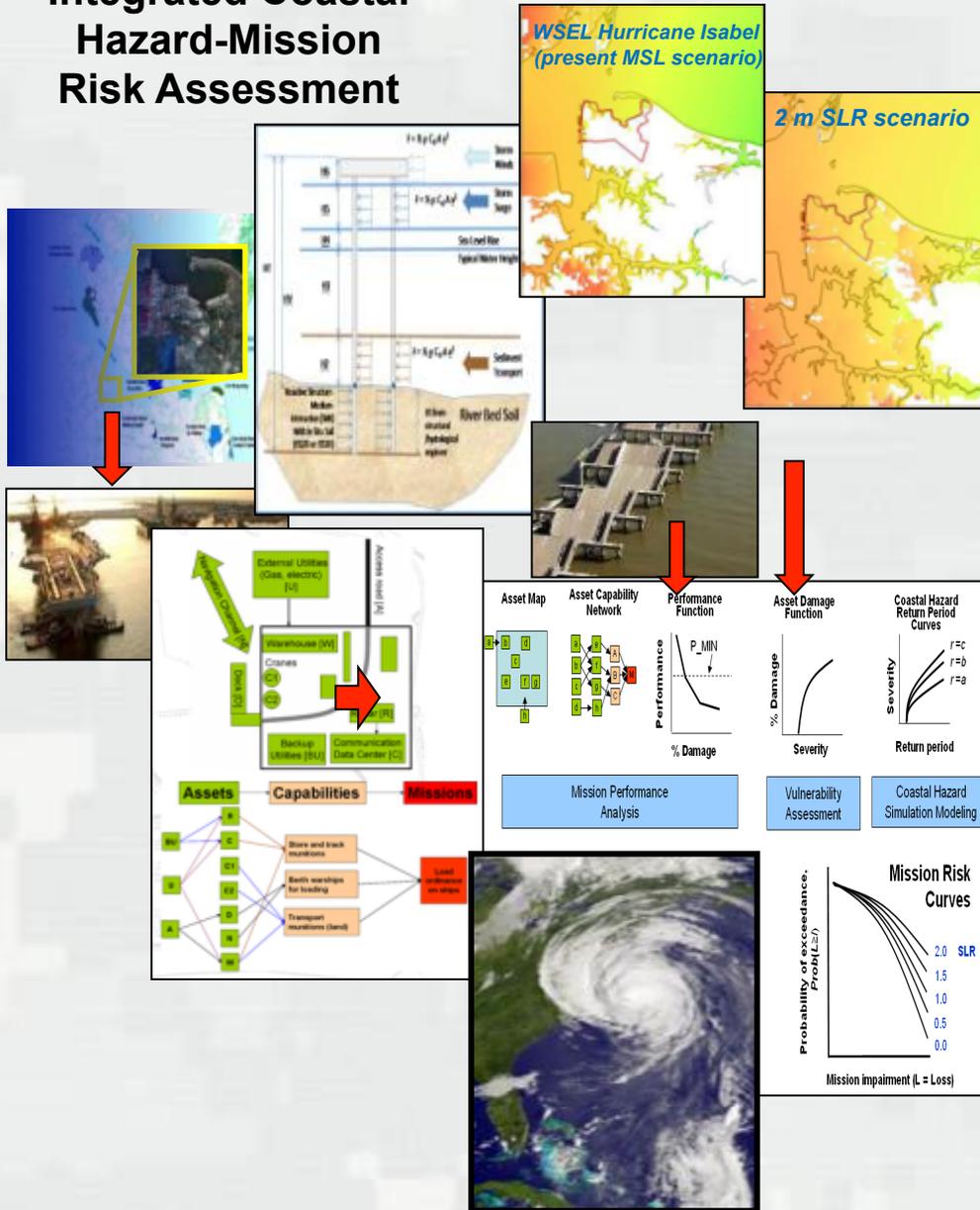
Environment



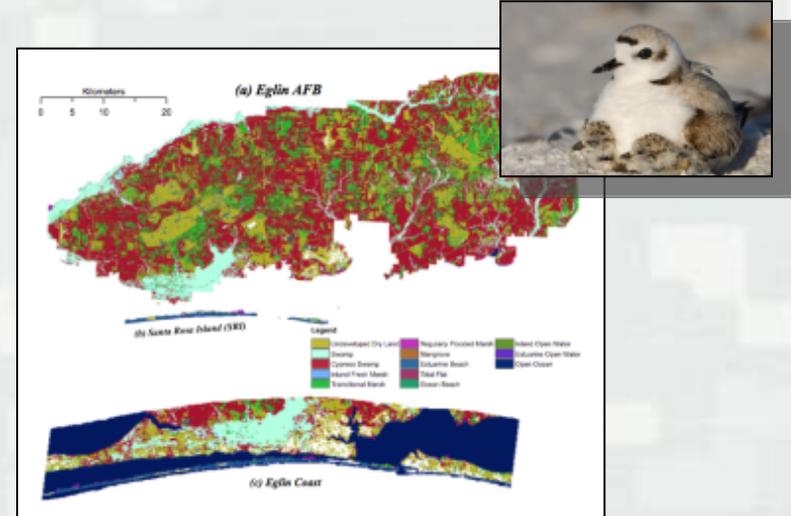
**Regional/Watershed
Solutions**

Climate Change Studies: Coastal

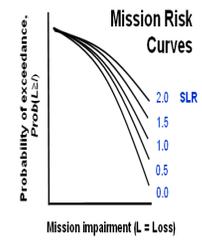
Integrated Coastal Hazard-Mission Risk Assessment



T&E Response to Climate Change and Operational Risks to Mission



Goal : Integrate multi-scale climate, land use, and ecosystem information into a systematic tool set



ENGINEERING WITH NATURE

Engineering With Nature is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

Guiding Principles

- Holistic
- A systems approach
- Sustainable
- Science-based
- Collaborative
- Efficient and cost effective
- Socially responsive
- Adaptive

Engineering With Nature: *The Progression*

Inputs and Outputs
'Degree of'

System Resilience

Efficiency

Stronger Benefits Stream

Outcomes

Inputs

Communications and Technology Transfer

Technical Understanding

Innovation and Creativity

Diversity of Skills and Expertise

Stakeholder Engagement



Business
as Usual

Understanding
Natural
Processes

Aligning
Processes

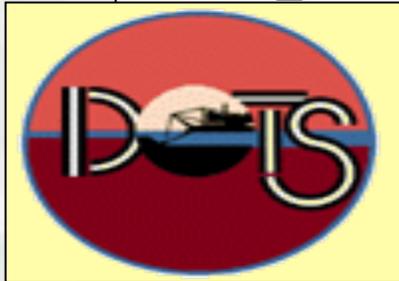
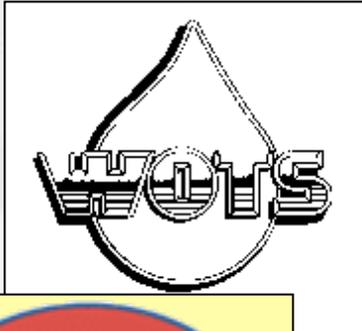
Expanding
Benefits

Enabling
Self-Sustaining
Benefits

STAGES

Technology Transfer

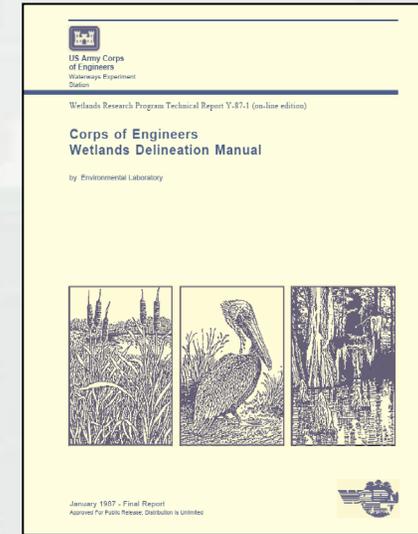
Navigation Tech Transfer



Flood & Coastal Tech Transfer



Environment Tech Transfer

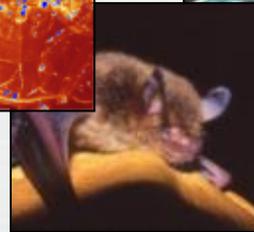
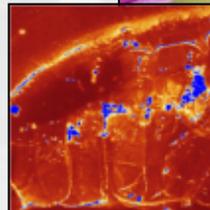
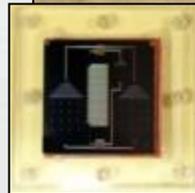


Goal 3: Operationalizing Sustainability

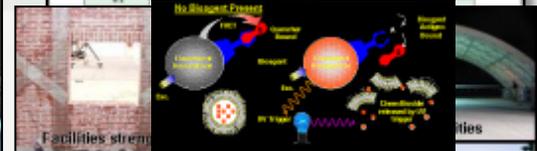
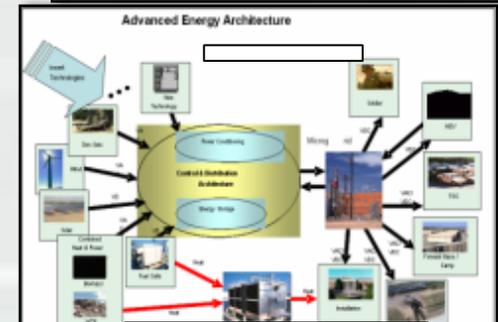
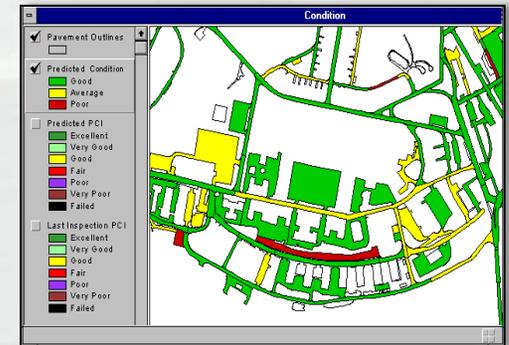
Sustainable Ranges and Lands



Materials in the Environment



Adaptive, Resilient Installations and Systems



Endangered Species Research Supporting Soldier Access to Training Lands

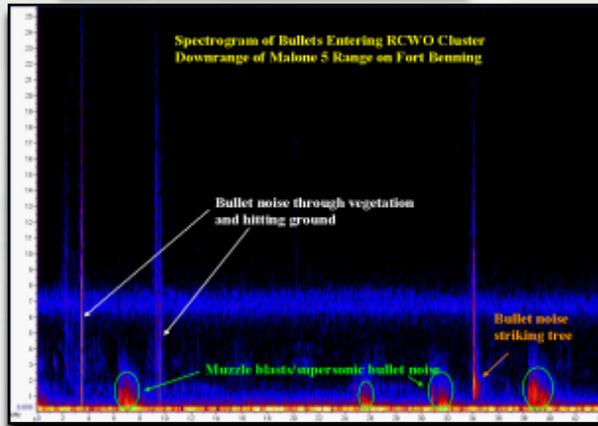
Monitoring Technologies to Avoid Listing

Mohave Ground Squirrel (Petitioned for Listing)

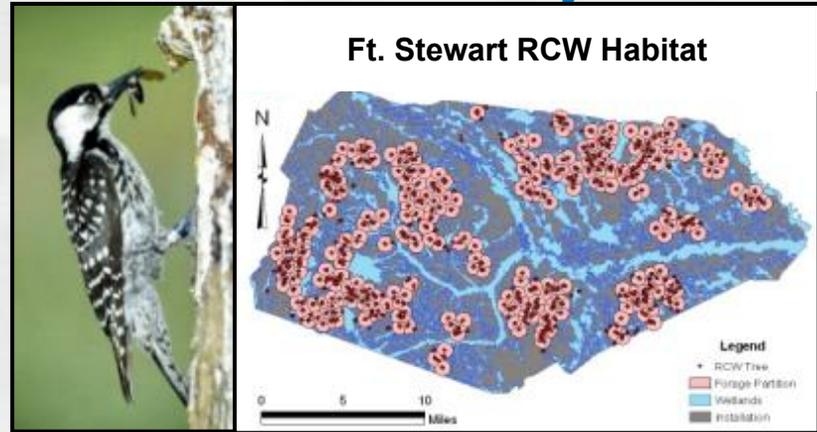


MGS Home
Range &
DoD Installations
Mohave Desert

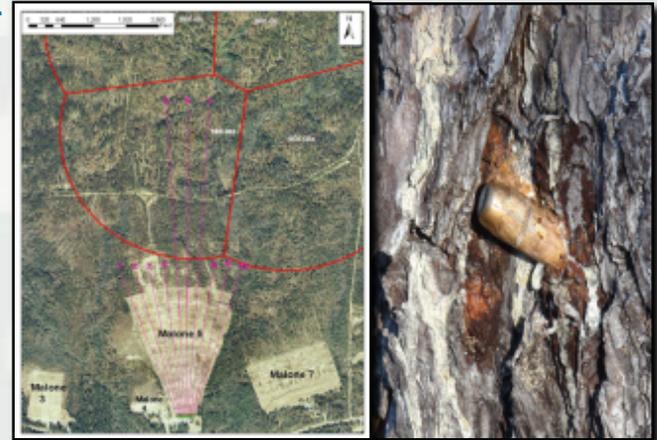
Acoustic
detection of
bullet impacts



Reduced Red-cockaded Woodpecker Restricted Habitat by 60%



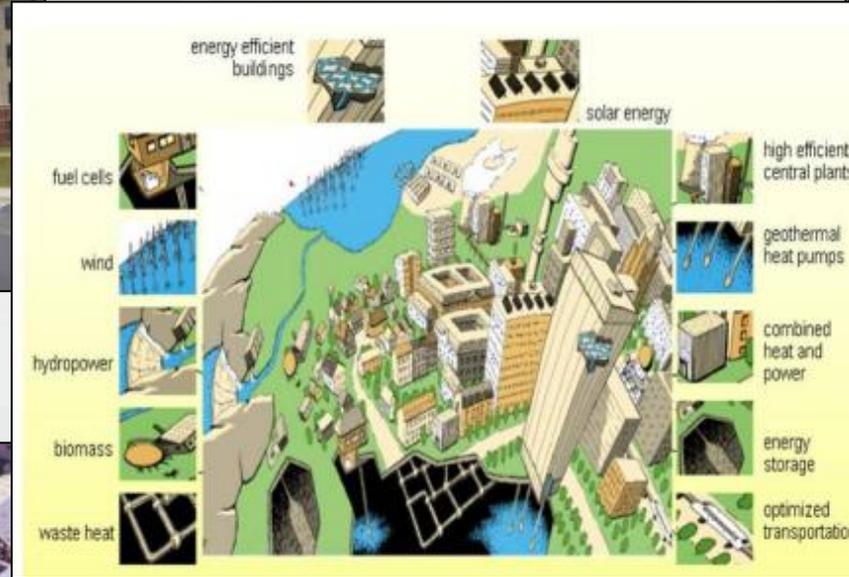
Endangered
species habitat
and bullet
damage Ft.
Benning



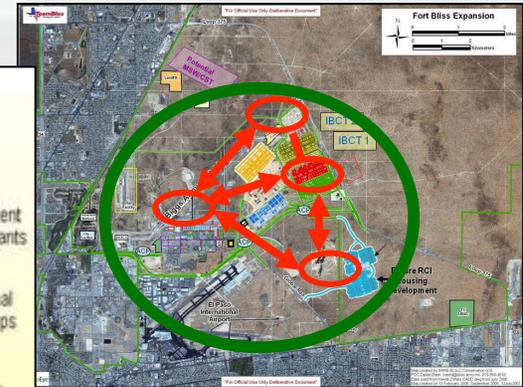
Net Zero Energy (NZE) Installations



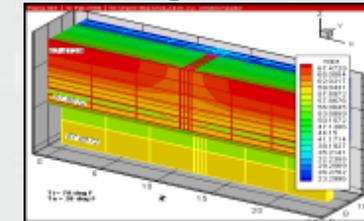
**Energy Conservation
(New & Existing Facilities)**



Holistic NZE Installation



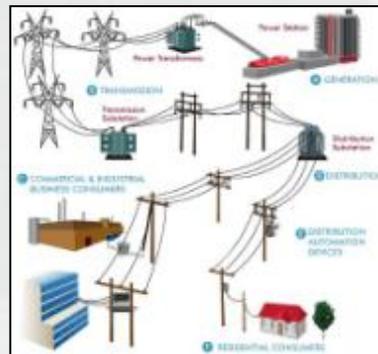
Modeling & Simulation



Renewable Power Production



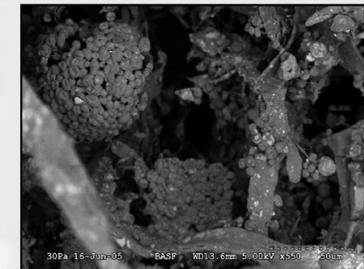
Technology Demonstrations



**Power & Energy
Architecture & Controls**



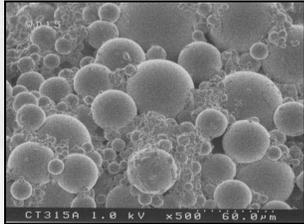
**Operational Issues
Humidity & Mold**



Phase change materials

Corrosion Prevention and Control

Self Healing Coatings



Tank Washrack Water pipe
Fort Bragg, NC



Deluge Tank for fire
suppression at Fort
Campbell Army
Airfield, KY

Sustainable Materials



4.7 ton load limit



70-plus ton load limit



Reactive Vitreous-
Coatings on
Reinforcement Steel

Electro-Osmotic Pulse

Before

After



2010 Army R&D Award Winner



Remote Structural Health
Monitoring and Corrosion Rate
Modeling of Bridges



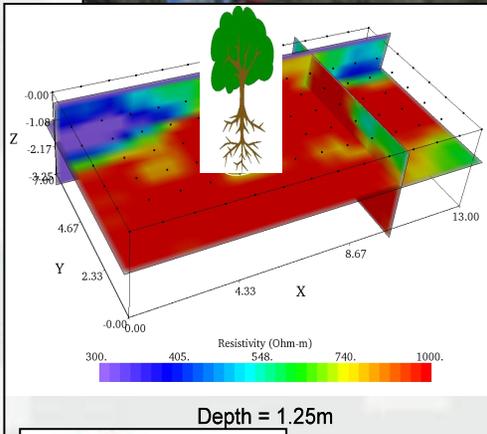
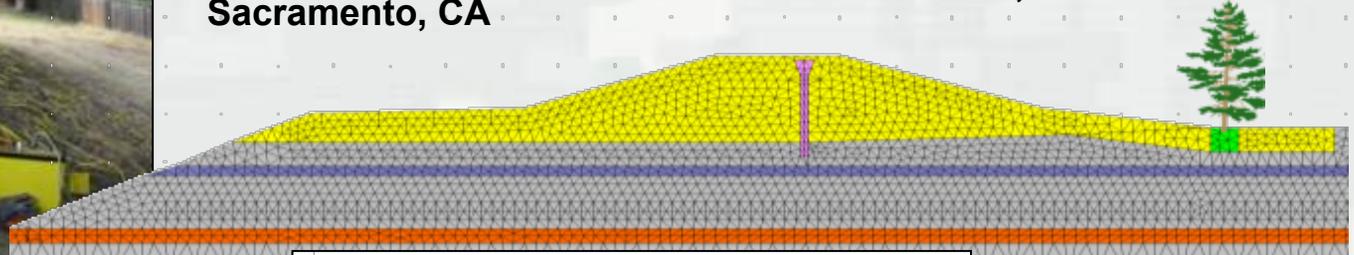
2010 FLC and
R&D 100 Award
Winner

Vegetation on Levees



Resistivity survey around tree on levee Sacramento, CA

Finite Element Mesh of typical levee Sacramento, CA



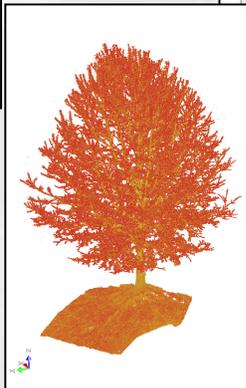
3-D Resistivity profile of root ball



2-D modeling of slope stability including effects of tree

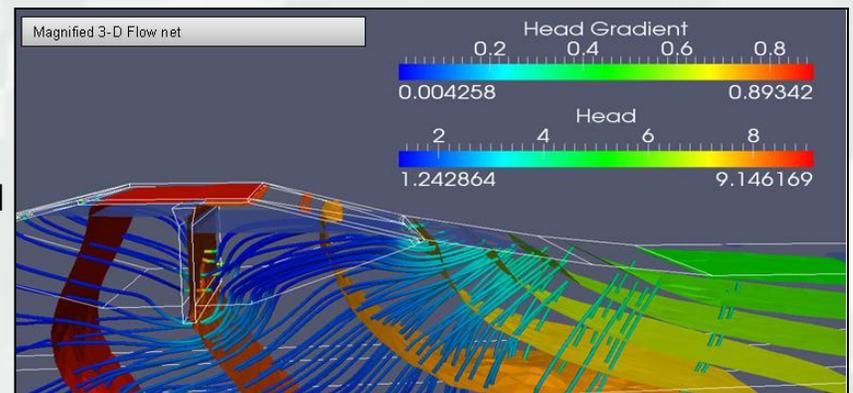


Collecting typical soil levee properties



Lidar scan of tree and roots

3-D seepage modeling

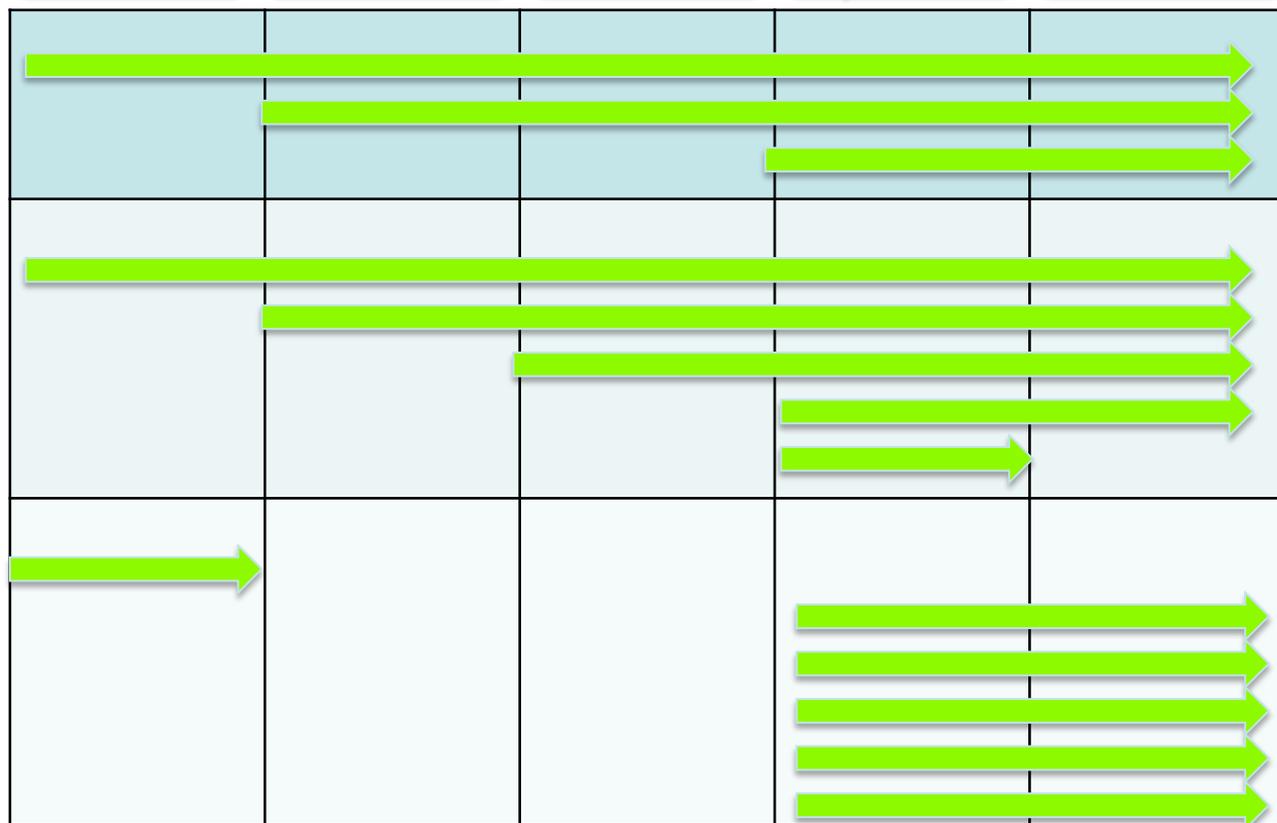


Military Environmental Objectives

Provide science based solutions that ensure the Army's capability to:

- ▶ Strengthen Army operational capability by reducing our environmental footprint through more sustainable practices
- ▶ Meet current and future training, testing, and other mission requirements by sustaining land, air, and water resources
- ▶ Minimize impacts and total ownership costs of Army systems, materiel, facilities, and operations by integrating the principles and practices of sustainability
- ▶ Enhance the well-being of our soldiers, civilians, families, neighbors and communities through leadership in sustainability
- ▶ Use innovative technology and the principles of sustainability to meet user needs and anticipate future Army challenges

Technology Life Cycle



Large scale

Small Scale



Large scale

Technology life-cycle understanding is an Army focus

Predictive

Computational Chemistry
Computational Toxicology

Climate Change

Proactive

Effects Assessment
ENG-Waste stream Management
Material and chemical analysis
Fate and Transport
Sensor Development

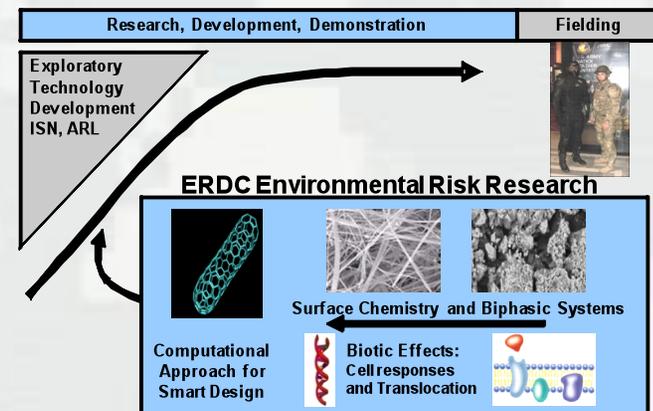
Active

Materials Analysis
Cleanup and Remediation
Effects Assessment
Fate and Transport
Hazardous Waste management
Material and chemical analysis

Nanotechnology Design

Integrating Design with Sustainability Objectives

- **Problem:** Potentially high payoff for technologies using engineered nanomaterials may be offset by environmental risks
- **Purpose:** Meet environmental sustainability objectives by proactively integrating physical, chemical, and biological attributes of nanomaterials into soldier technology development
- **Payoff:**
 - ▶ Enable soldiers to fielding safe technology
 - ▶ Significant cost savings from proactive integration of environmental attributes of nanomaterials into technology development at the exploratory level
- **Products:**
 - ▶ Quantitative relationships to characterize surface chemistry in the fate and transport of nanomaterials with environmental media
 - ▶ Role of nanomaterial solid-phase chemistry in the uptake, translocation and biotic reactivity of nanomaterials
 - ▶ Computational approach for the smart design of nanomaterials: integrating empirical solid-phase chemistry into exploratory technology development



Green Range Technologies

- **Problem:** Impact areas are expanding in size and use; more and different weapons are being considered which increases the amount of MC in the landscape; greater concentrations and larger extent of MC increases risk of MC exceeding regulatory guidelines, migration of MC offsite, and potential for incorporation into ecological systems
- **Purpose:** Assess future MC contamination problems on impact areas and evaluate management options for maintaining impact area use under anticipated increased live-fire training activities
- **Payoff:** Allow range managers to anticipate future contamination problems from changes in training scope and magnitude, assess performance of green remediation approaches on contaminate levels, and expand available range management options to extend the life and scope of valuable impact areas
- **Products:**
 - ▶ Computational tool kit that provides an integrated approach to range design and contaminant management
 - ▶ Environmentally sustainable “green” remediation approaches will be developed to assess future MC concentrations resulting from an expanded impact area mission and extent
 - ▶ Identification/evaluation of existing and innovative approaches to manage impact area contamination including in situ bioreactors, transgenic plants and sediment berms
 - ▶ A computational toolkit capable of detailed evaluation of the change in MC as a function changing impact area operations and implementation of green remediation technologies
 - ▶ Ability to integrate different range management options up to reworking of surface topography so that long term MC concentrations can be evaluated and management strategies identified

USACE R&D

Sustainability Challenges

Summary:

- Achieving sustainability requires committed transformation of military and civil agencies to:
 - ▶ Integrated systems approaches
 - ▶ Use of risk-informed, multi-objective decision making
 - ▶ Adaptive management
 - ▶ Innovation
- The complex challenge of incorporating climate change must be included in future analyses to achieve true sustainability
- To achieve transformation, new technologies and methodologies must be found through R&D



USACE R&D Sustainability Challenges

QUESTIONS?