

Opportunity for EWN in FRM

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US Army Corps of Engineers
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Value to the Nation

USACE Flood Risk Management

Operates 707 dams, 383 major lakes and reservoirs

- ▶ 376M visitors/yr, \$15B in economic activity, 500,000 jobs
- ▶ 24% US hydropower capacity, 3% of US electricity, \$500M in sales

25,000+ km of levees (some coastal)

100 coastal storm damage reduction and related projects including 650 km of shore protection

Water Supply from 153 projects for cities including Washington, DC

~12 Emergency responses per year

(Electricity, debris removal water/ice distribution, temporary roofing, flood fight...)



At the FRM Crossroads

- Floods cannot be *controlled*
- Damages cannot be *completely prevented*
- Safety comes at a price
- Flood risk management is paramount importance
 - ▶ Including determination of and communication of residual risk

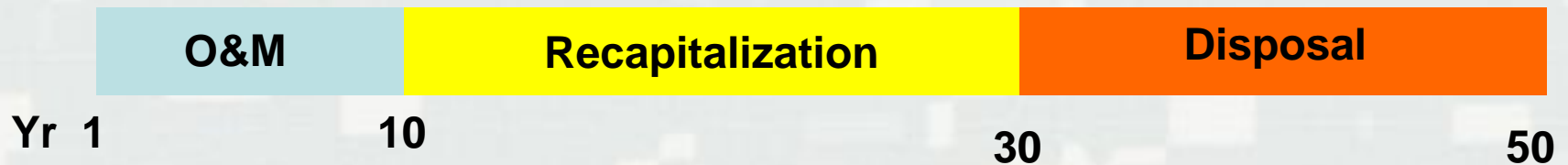


NOLA, 2005

A dynamic risk-based management culture

USACE Project Lifecycle

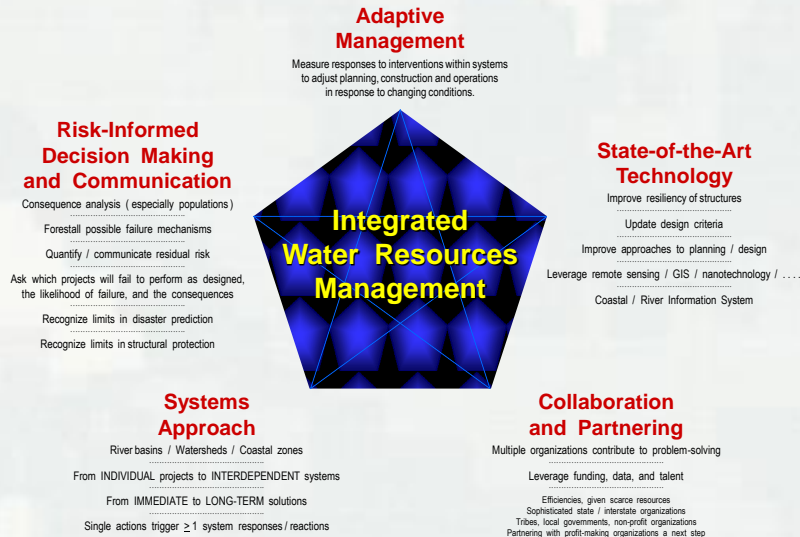
- Planning
- Design
- Construction
- Operation and Maintenance
- Recapitalization
- Decommissioning/Disposal



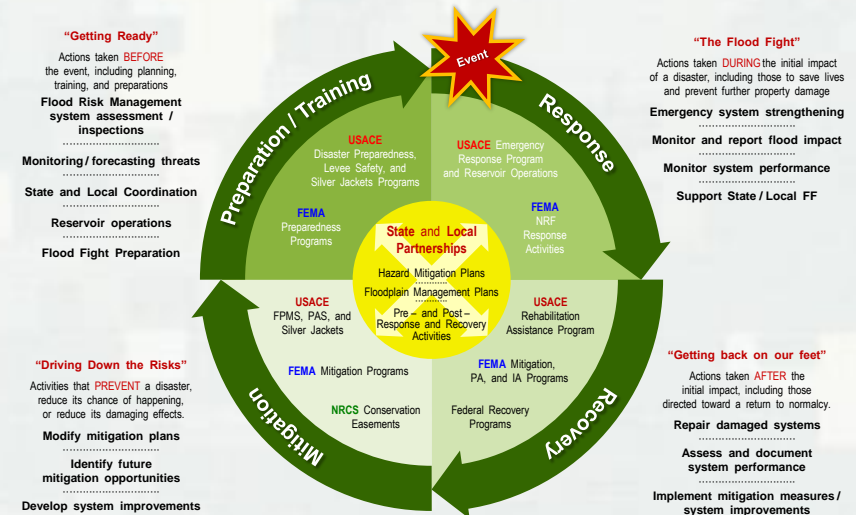
Goal: Develop process to inform investment decisions based on measure of reliability and risk

Flood Risk Management Doctrine

Overarching Approach

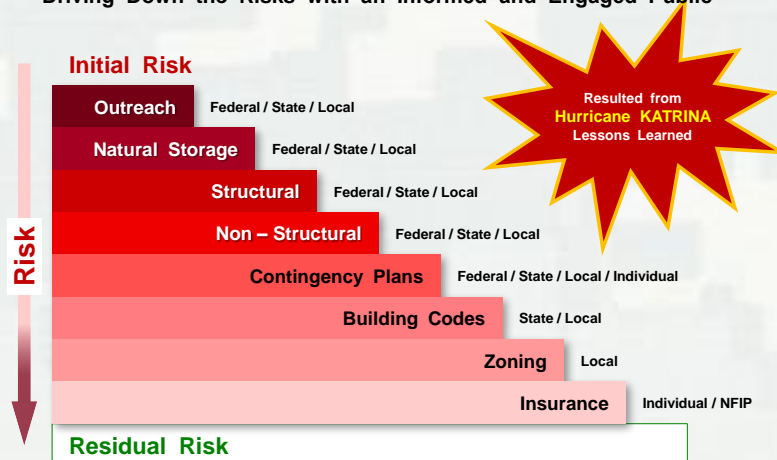


Life-Cycle Risk Management



Shared Disaster Risk Management

“Driving Down the Risks with an Informed and Engaged Public “



All Stakeholders contribute to reducing risk !

Risk-Informed Decisionmaking

RISK = expected value of an unwanted event which may or may not occur

Step 1: Screening
Consequences x Step 2: P (Consequence | Threat)
("Threat – Agnostic") x **Vulnerability** x Step 3: P (Threat)
(Internal) x **Threat**
(External)

A rigorous process of:

“Threat-Agnostic” Consequences Prioritization

“Threat-informed” Vulnerability Assessment

Probabilistic Prioritization of Investments

Consistent Analysis of Alternatives

Common Operating Picture

Systems / Portfolio “Mastery”

		Relative Risk Value Matrix (1-5 Matrix)				
		Overall Project Condition Classification				
Consequence Category	Condition	F (1)	D (2)	C (3)	B (4)	A (5)
	Consequence	Failed	Inadequate	Probably Inadequate	Probably Adequate	Adequate
1	High	1	1	2	2	3
2	Medium High	1	2	2	3	4
3	Medium	2	2	3	4	4
4	Low	2	3	4	4	5
5	Minimal	3	4	4	5	5

Life-Cycle Risk Management

“Getting Ready”

Actions taken **BEFORE** the event, including planning, training, and preparations

Flood Risk Management system assessment / inspections

Monitoring / forecasting threats

State and Local Coordination

Reservoir operations

Flood Fight Preparation

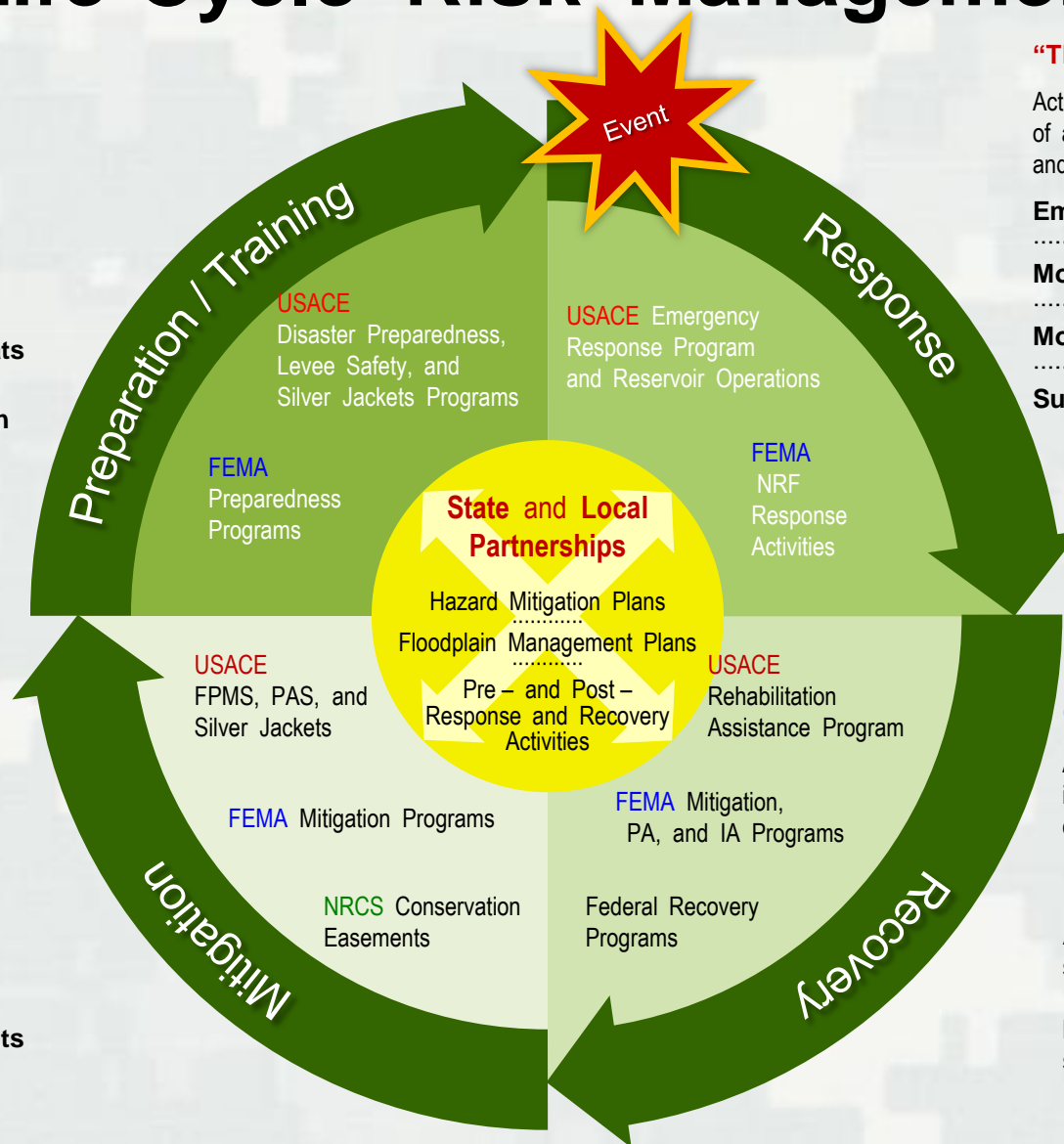
“Driving Down the Risks”

Activities that **PREVENT** a disaster, reduce its chance of happening, or reduce its damaging effects.

Modify mitigation plans

Identify future mitigation opportunities

Develop system improvements



“The Flood Fight”

Actions taken **DURING** the initial impact of a disaster, including those to save lives and prevent further property damage

Emergency system strengthening

Monitor and report flood impact

Monitor system performance

Support State / Local FF

“Getting back on our feet”

Actions taken **AFTER** the initial impact, including those directed toward a return to normalcy.

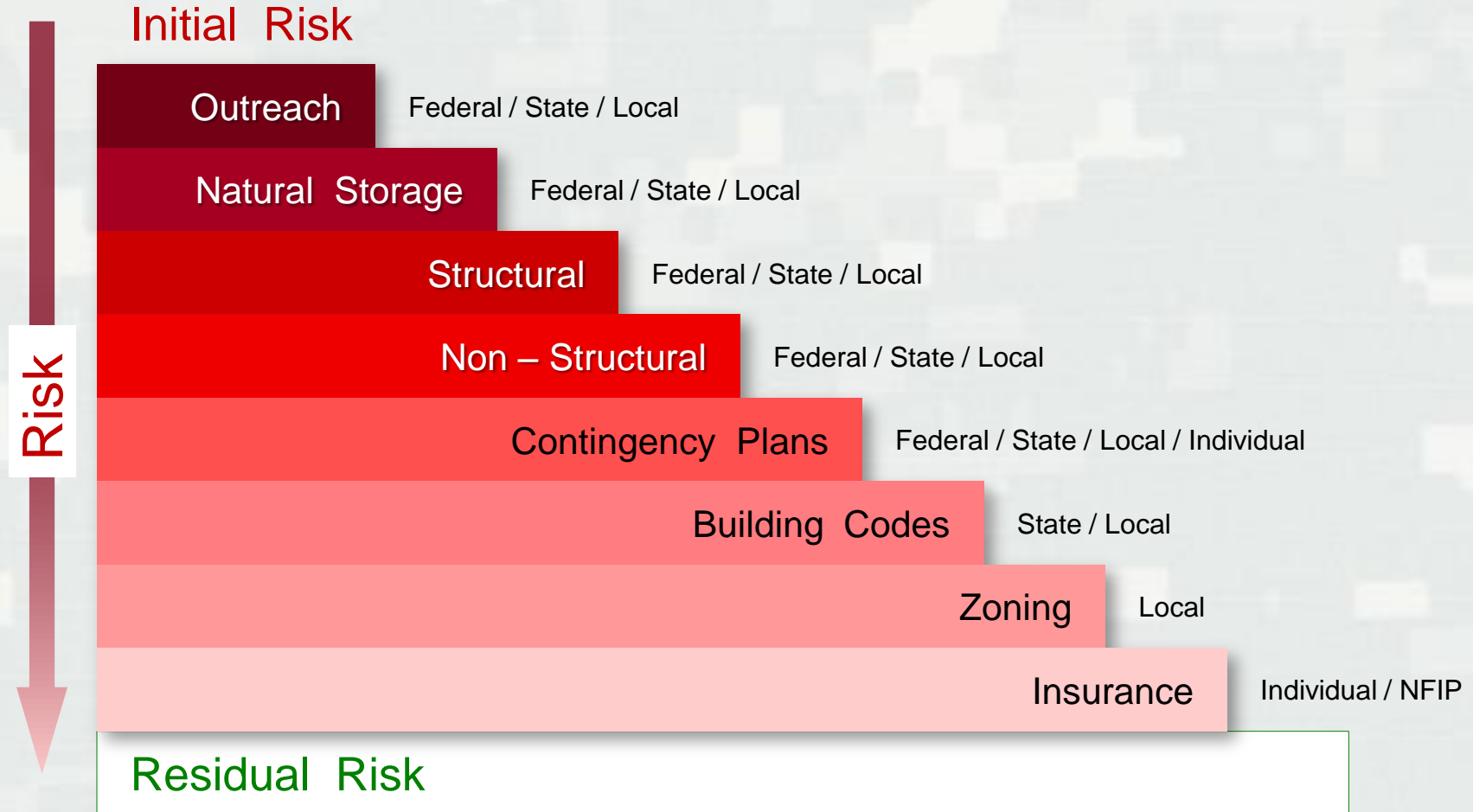
Repair damaged systems

Assess and document system performance

Implement mitigation measures / system improvements

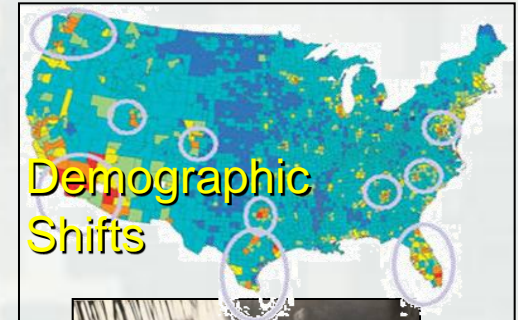
Shared Disaster Risk Management

“ Driving Down the Risks with an Informed and Engaged Public “



All Stakeholders contribute to reducing risk !

National Water Resource Challenges



National Challenge: Flood-Prone Areas

- Development continues to increase
- Rapid growth in at-risk coastal areas
- Investments decreased by ~70% in real terms over past 3 decades.
- Over \$15 billion awaiting construction

Greenville, MS, Matfield



Bolivar Peninsula, TX

National Challenge: Aging Water Infrastructure

- Many infrastructure projects 50+ years old
- Investments in water resources infrastructure declining in real terms
- Result: more frequent closures for repairs, decreased performance & costly delays

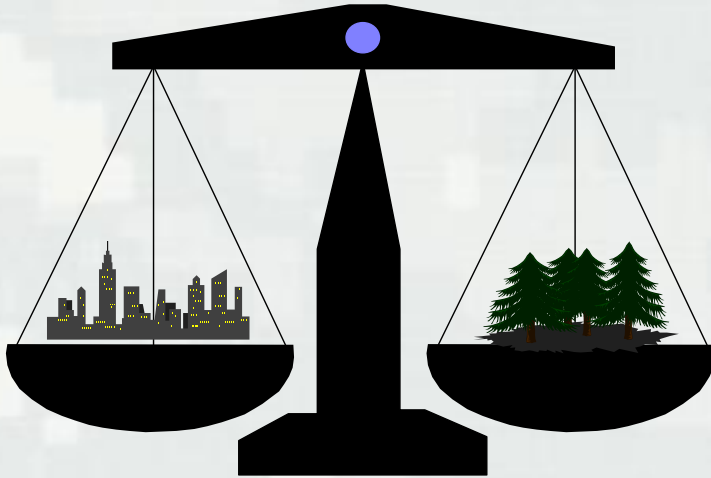


National Challenge: Asset Management & Infrastructure Recapitalization

- Deliver reliable infrastructure through use of risk-based assessments
- Risk-informed strategy applied to budget process
- Optimize use of limited resources across multiple business lines



National Challenge: Environmental Sustainability



- Balance between economic development, environmental stewardship
- Water quality threatened on 8% of nation's rivers and streams
- Corps has authority and programs for ecosystem restoration.



National Challenge: Integrated Water Resources Management

- Planning based on watershed/
regional approach
- Ecosystem restoration
- Environmental sustainability
- Interagency coordination
- Involve all stakeholders



Severe Weather –
Midwest
Mar 2012

Key 2011/2012 Responses

Japan EQ & Tsunami -
Mar 2011



FEST Deployments
Jan – Mar 2011 &
OEF/OND



Queensland, Australia
Flood - Jan 2011



Christchurch, New Zealand
Earthquake - Feb 2011



Northeast Snow Storm
Oct 2011



Derecho Storms
JUN-JUL 12



Tropical
Storm Lee
Sep 2011



MS Floods
May 2011

Kootenai River Basin
2012

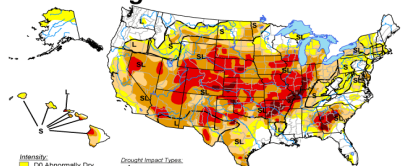


Hurricane
Irene
Aug 2011



U.S. Drought Monitor

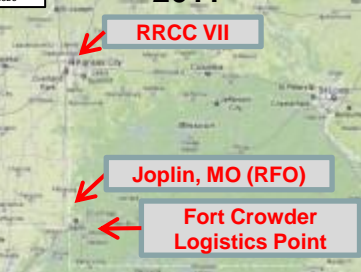
July 24, 2012



2012 Drought

Released Thursday, July 26, 2012
by: Richard Heim, NOAA/NWS/NCEP

Joplin, MO
Tornado - June
2011



MO River
Flood
Jun/Jul 2011

Souris River
Flood
Jun/Jul 2011



Duluth, MN Flood



Pakistan Siachen
Glacier SME
Support
April 2012



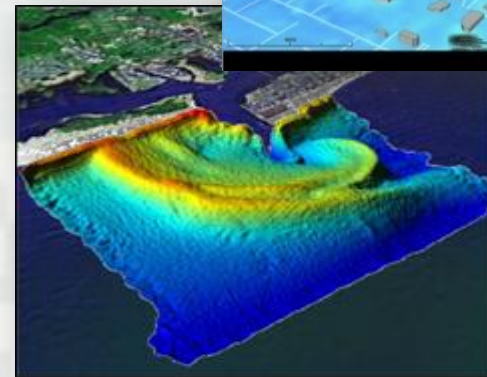
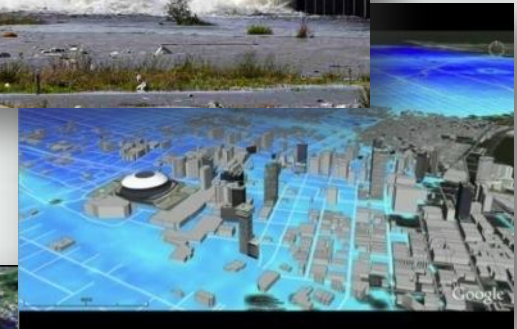
Thailand Flood - Nov 2011



FRM and R&D Nexus

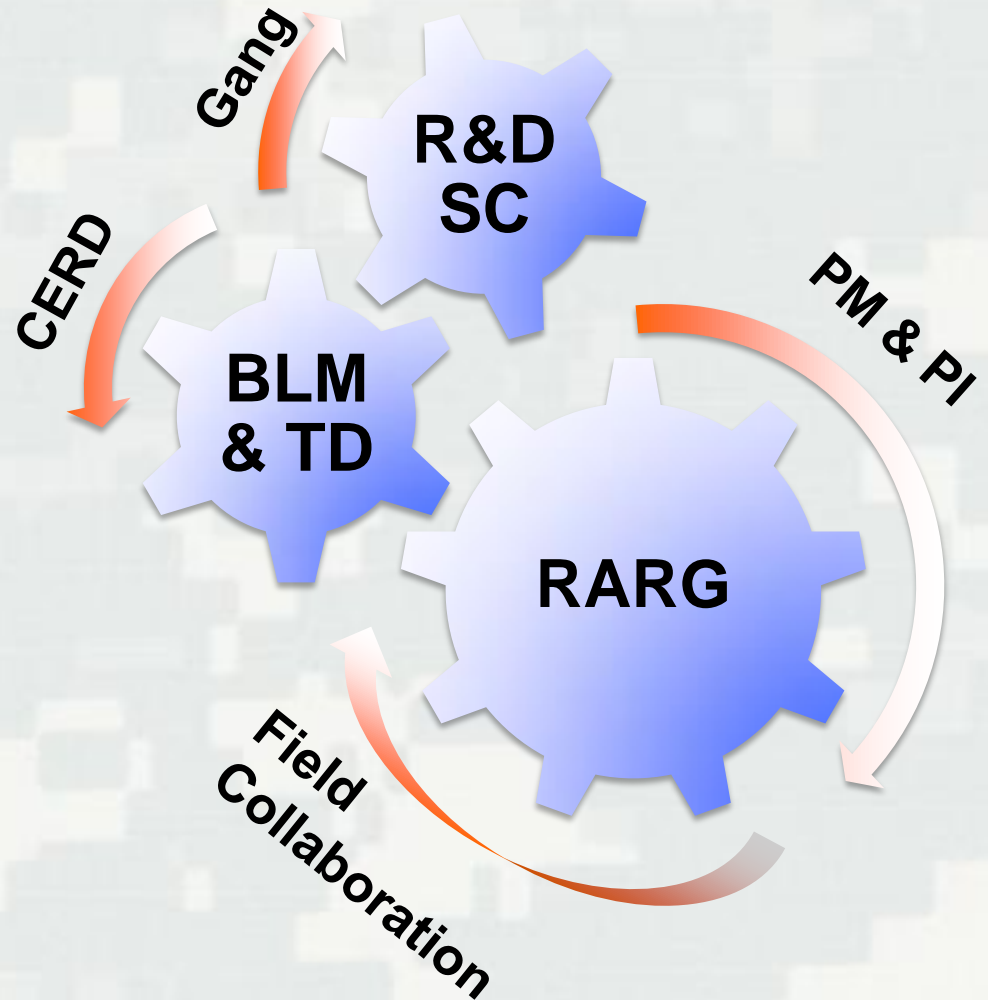
Strategic Needs & Priorities

- Determine Risk & Uncertainty for Project Alternatives Evaluation & Performance
- Optimize Design & Management of Resilient Coastal & Estuarine Resources
- Assess Comprehensive & Multidisciplinary Management of Watersheds
- Improve Flood Risk Management & Water Control Infrastructure Resiliency & Reliability
- Enable effective disaster preparation, response & recovery
- *Engineering with nature to enhance ecosystem and processes, benefits and services*
- *Deliver sound engineering and scientific solutions that meet Planning Modernization guidelines*



Civil Works R&D Process

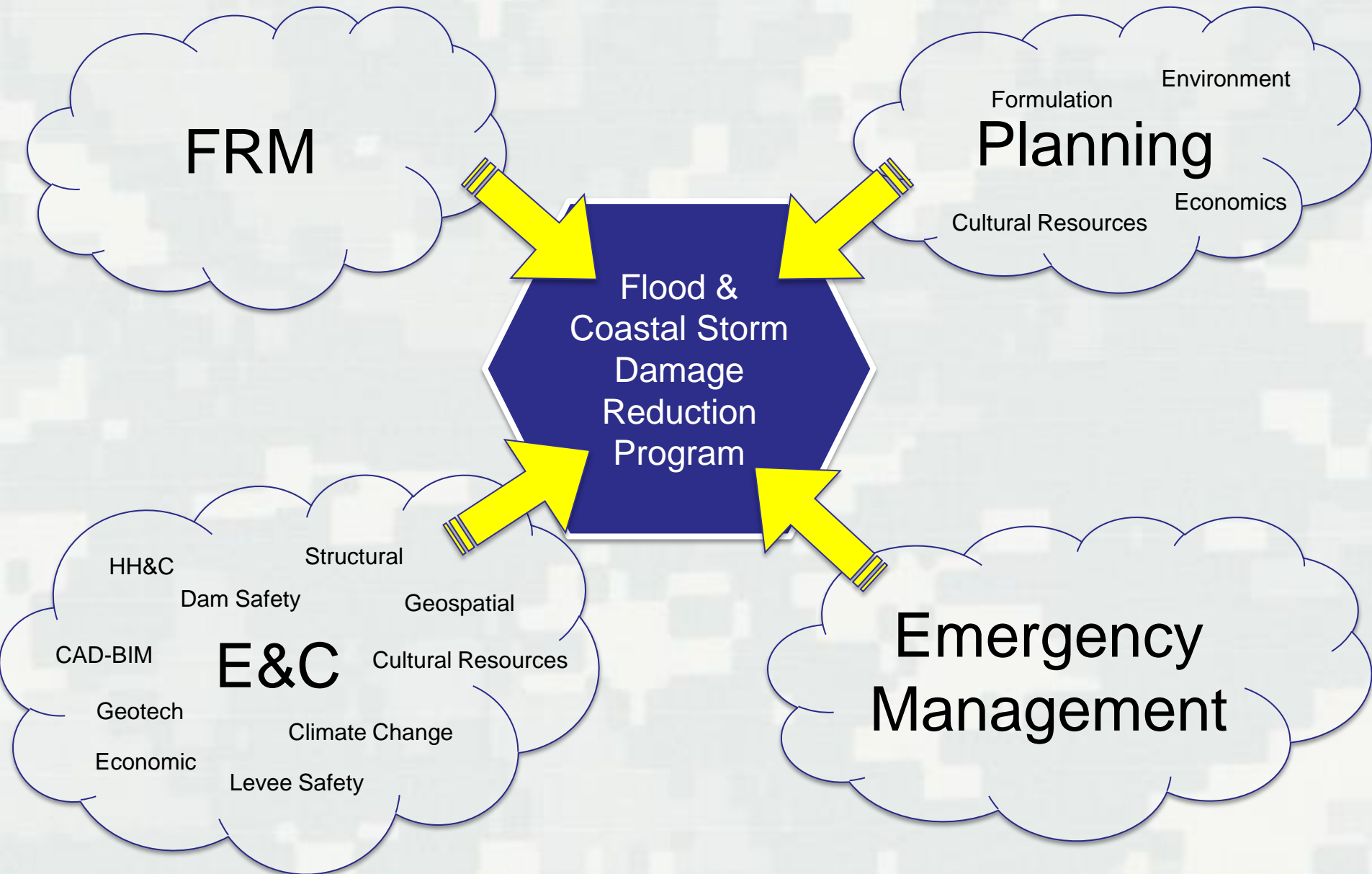
- Produces requirement-driven program
- Short-term requirements
- Strategic requirements
- Leverages other Corps programs
- Collaborate with field and others
- Documentation: SOP



Research Area Review Group Roles & Responsibilities

- Communicate R&D needs and requirements
- Evaluate proposed R&D products and review their development
- Oversee beta applications of initial R&D products
- Serve as an advocate for infusing completed R&D products into practice
- Advise wrt balance of tactical and strategic R&D investment
- Review program status
- Engage in technology transfer
- Discuss and prioritize R&D needs for program development

Program CoP Input



<https://technology.erdcdren.mil>

US Army Engineer Research and Development Center

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These tools are used for ERDC Technology Transfer & Infusion. Click on each to access directly.



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latest in USACE R&D.

Modular Protective System
Optimized, scalable structure of structure against worst case
scenario attacks including suicide bombs.
Devin Shatt, Ron Nelson, and Nick Boone

MILITARY ENGINEERING
ERDC provides innovative technologies and capabilities to the soldier in
order to enable force protection and maneuver.

<https://wiki.erdc.dren.mil>



US Army Corps of Engineers

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ERDCpedia



Welcome to the Engineer Research & Development Center Wiki [\[edit\]](#)

This wiki, called **erdcpedia**, is part of a knowledge management initiative to help USACE employees connect with the research efforts of ERDC. Through this wiki, you should be able to find all the products, services and research efforts currently ongoing at ERDC. We tell you what products and services we offer, what they do, how to get them, and points of contact for each. The wiki is organized through categories, and each product and service should be listed in several to provide different routes to find the particular product or service you are seeking. Get started through the link below.

ERDC: Who We Are [\[edit\]](#)

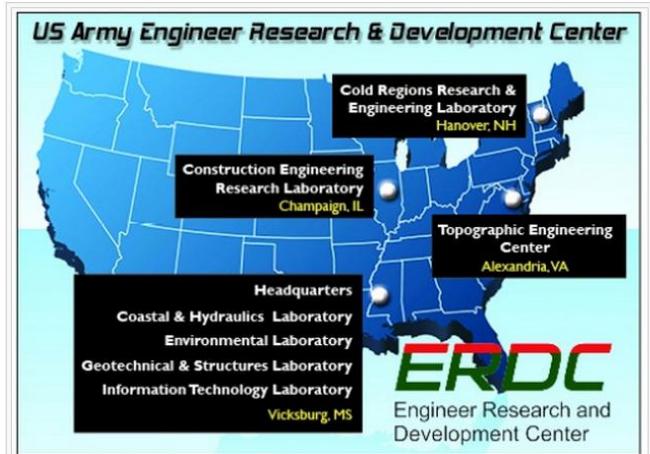
The [Engineer Research and Development Center \(ERDC\)](#) is one of the premier engineering and scientific research organizations in the world. As the research organization of the [US Army Corps of Engineers \(USACE\)](#), ERDC conducts research and development (R&D) in support of the Soldier, military installations and civil works projects (water resources, environmental missions, etc.) as well as for other federal agencies, state and municipal authorities, and with U.S. industry through innovative work agreements. ERDC – Innovative solutions for a safer, better world.

ERDC is composed of seven laboratories in four states:

- [Construction Engineering Research Laboratory \(CERL\)](#) in Champaign, Ill.;
- [Cold Regions Research and Engineering Laboratory \(CRREL\)](#) in Hanover, N.H.;
- [Topographic Engineering Center \(TEC\)](#) in Alexandria, Va.; and
- [Coastal and Hydraulics Laboratory \(CHL\)](#), [Geotechnical and Structures Laboratory \(GSL\)](#), [Environmental Laboratory \(EL\)](#), and [Information Technology Laboratory \(ITL\)](#) in Vicksburg, Miss.

ERDC has a staff of approximately 2,500 federal employees and contractors, and an annual research program exceeding \$2 billion. ERDC projects touch all seven continents and the Arctic, with sites in more than 130 countries and all 50 states. ERDC's presence is diverse and worldwide.

Mkittrell my talk my preferences my watchlist my contributions log out



ERDC has seven laboratories in four states

FRM & Engineering With Nature

Mississippi River Example

>70M souls in the MS River Basin

12M homes on the river

Comprehensive public works to
provide
flood protection following 1927 flood

\$123B investment in H₂O control
infrastructure

27 locks and dams between MO and
MN that alter flow



Mississippi River (Cont'd)

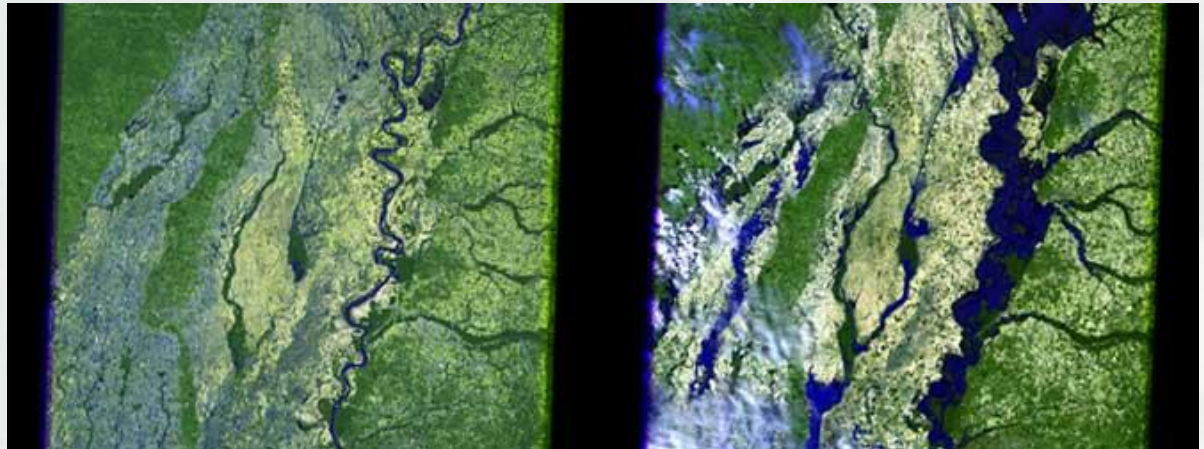
MS named one of “America’s Most Endangered Rivers” for 2011 – American Rivers

Repeated catastrophic flooding including 2011

Criticism: Outdated FRM measures/strategies

Criticism: Over-reliance on levees

35M acres of wetland/floodplain in upper MS cut off by levees



FRM Opportunity?

Beneficial Functions of Floodplains

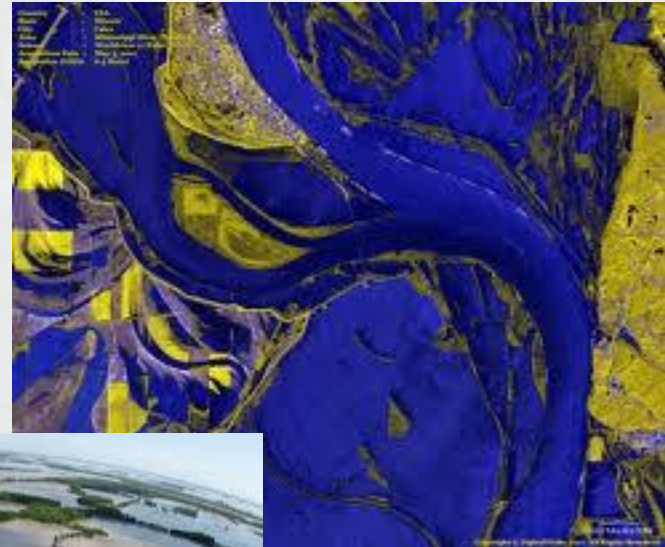
Floodplain benefits to name a few...

Storage: 1 acre x 1' depth =
330k gallons

Conveyance

Water quality/
sedimentation

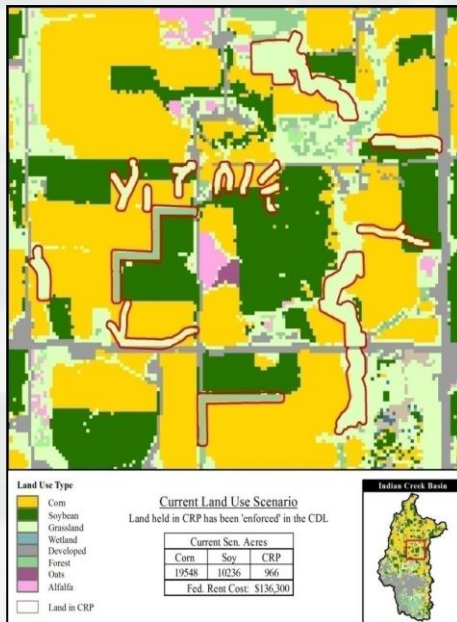
Habitat



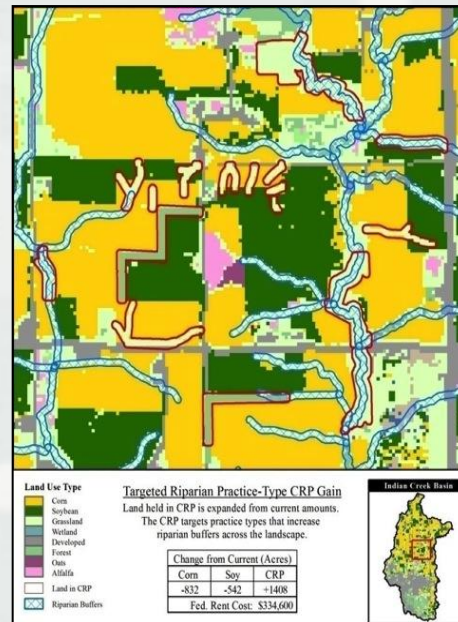
FRM Opportunity?

CRP in Urbanized Watersheds

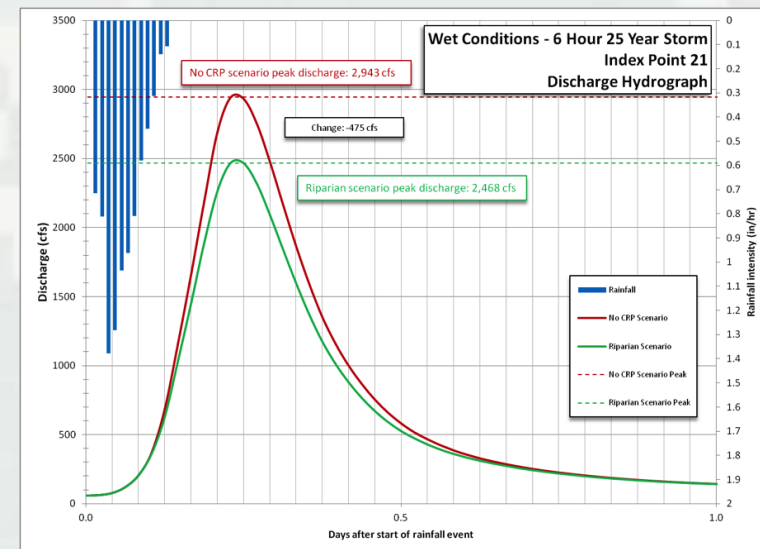
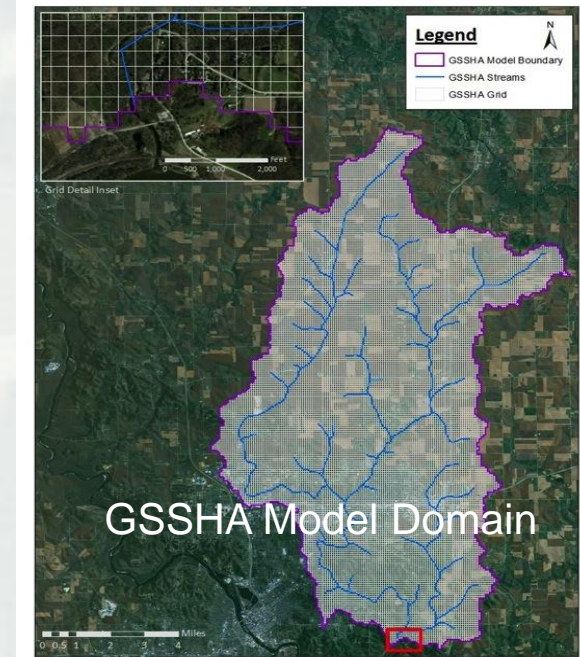
Indian Creek Basin, IA



Current Land Use



Targeted Riparian CRP Gain



FRM Opportunity? Policy

WRDA'07 called for new Principles and Guidelines for all federal water resource projects

New standards must protect the environment by:

Maximizing sustainable economic development

Avoiding unwise use of floodplains

Protecting & restoring natural systems (i.e., floodplains)

Incorporate non-structural measures



“Room for Water”

“Living with Water”

“Room for the River”

...

Widen floodplains

Lower floodplains

Structural overtopping

Diversions

Channel deepening

Storage areas



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FRM Opportunity?

RhEPS for Levee Slope Stability

Transition biopolymer technology from MIL R&D to CW levee and dam applications

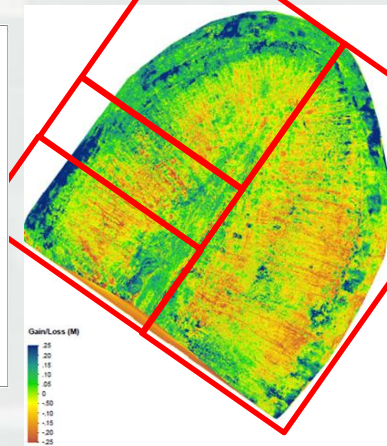
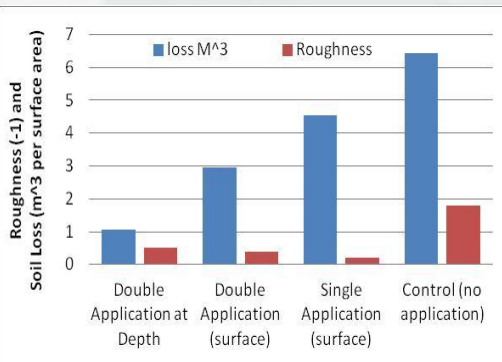
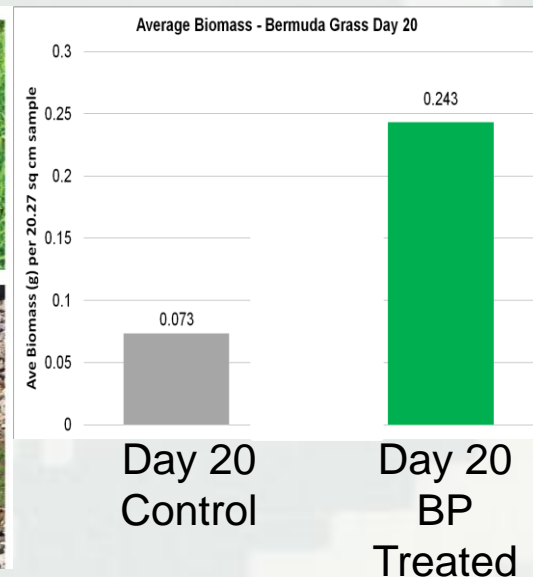
Immediate benefit of improved cohesion of soil particles

Long-term benefit of rapid, full vegetation of soil cover



Day 20
BP
Treated

Day 20
Control



FRM Opportunity?

RhEPS Sand Boil Mitigation Concept

Field Studies have shown Bio-sealing to reduce flow rates by 5-20 times



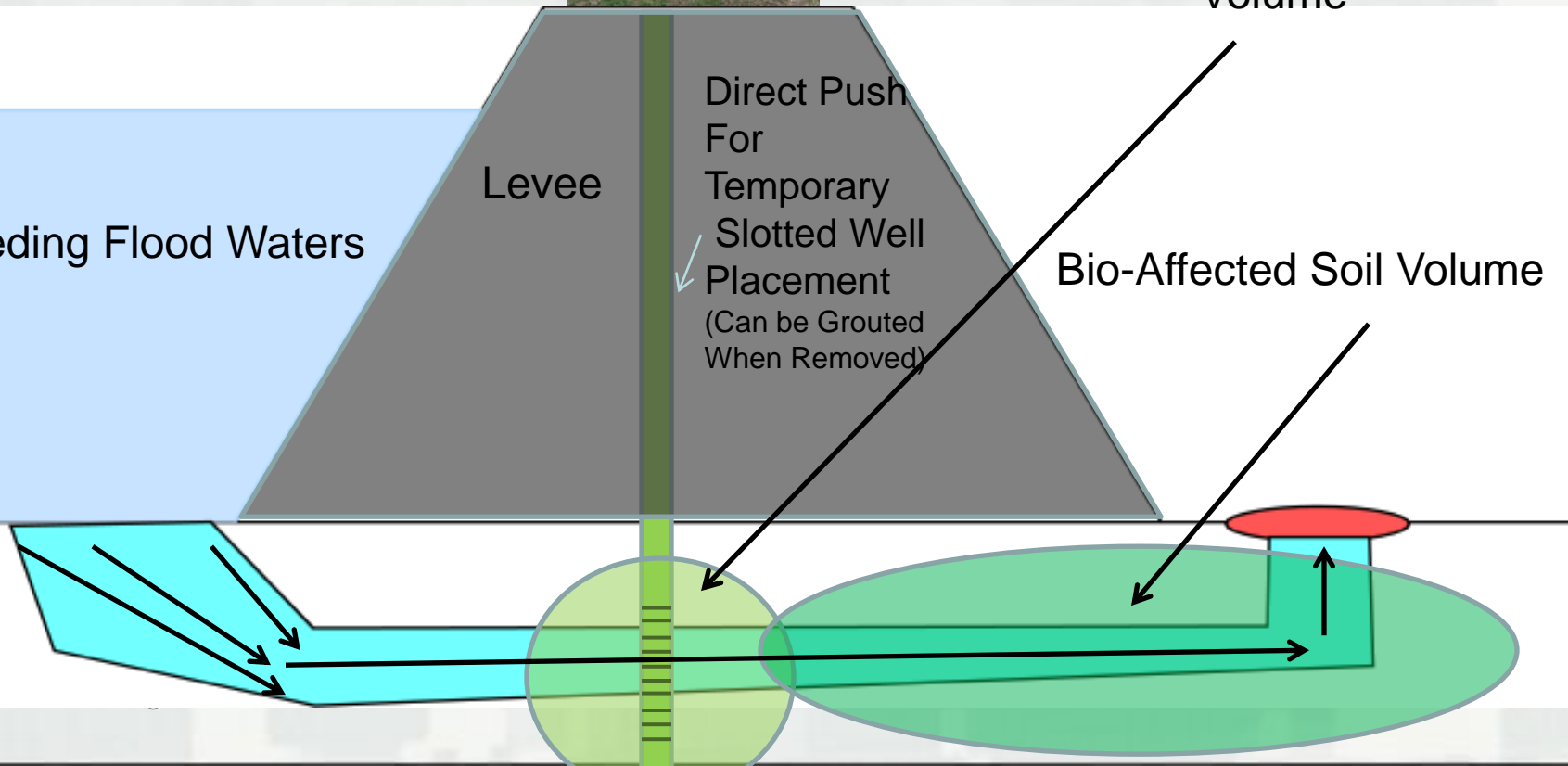
Nutrient and Microbial Consortia Placement Volume

Receding Flood Waters

Levee

Direct Push For
Temporary
Slotted Well
Placement
(Can be Grouted
When Removed)

Bio-Affected Soil Volume



FRM Opportunity?

Stream/Bank Restoration



- In-stream flow and vegetation dynamics
- Floodplain functionality

- Climate uncertainty



- Stream bank stability and vegetation/revegetation

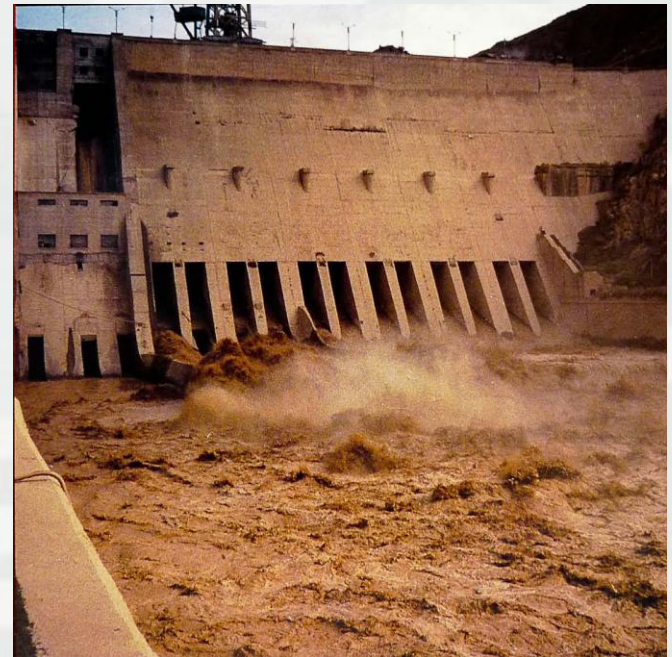


FRM Opportunity?

Reservoir Sediment Management



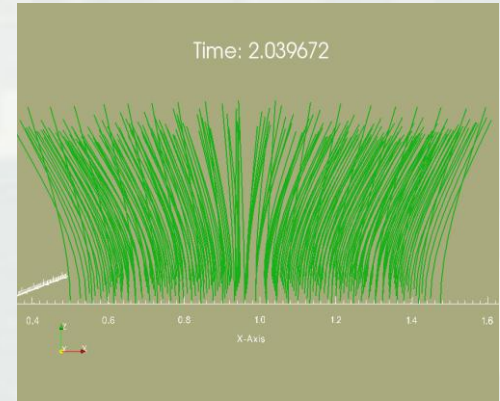
Delta Formation
Tuttle Creek Reservoir, KS



Passing Sediment
Sanmenxia Dam, Yellow River,

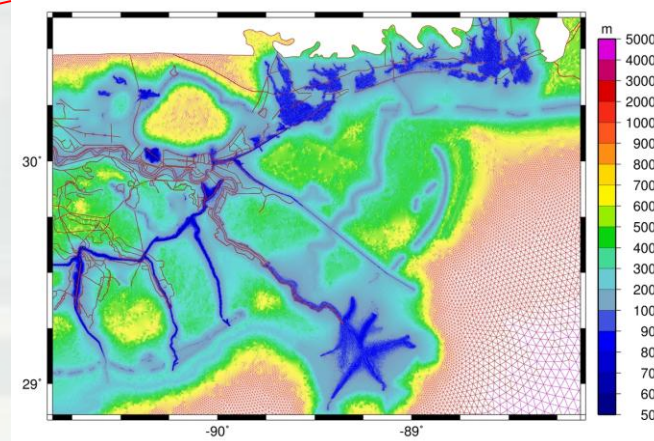
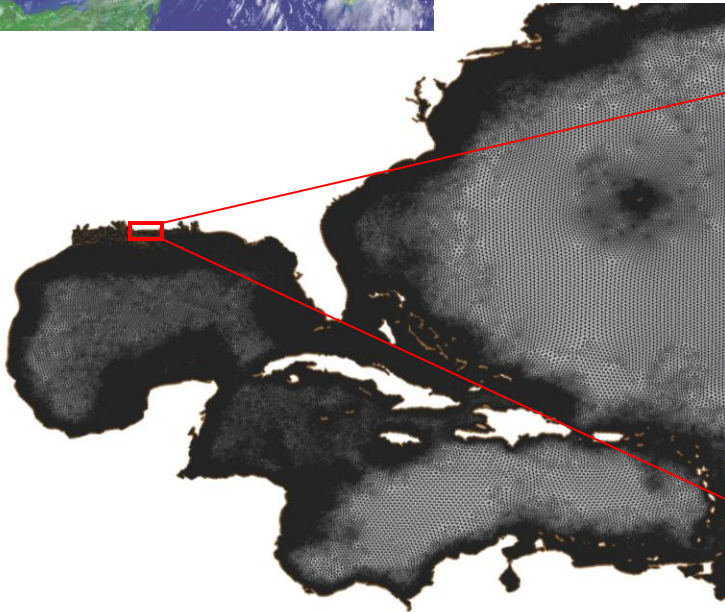
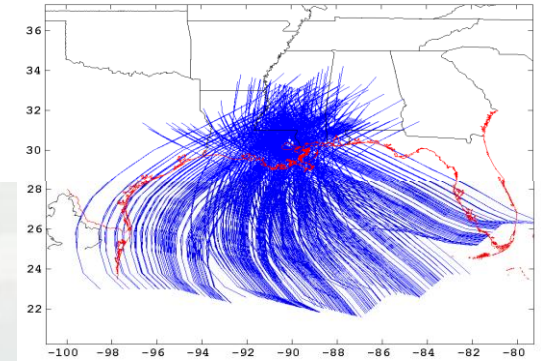
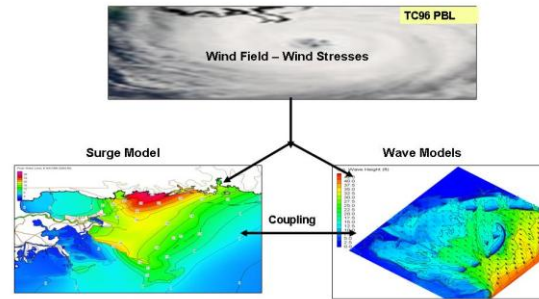
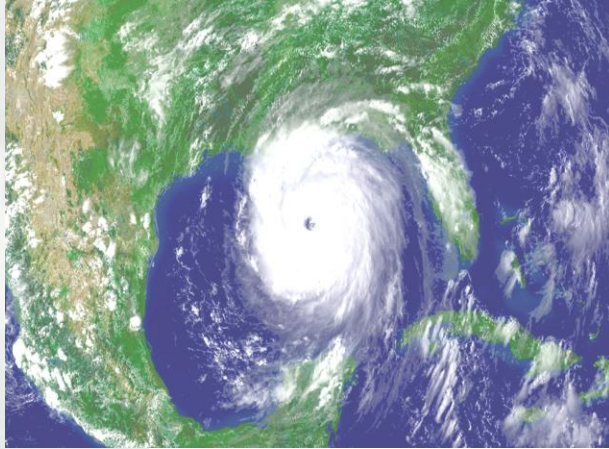
FRM Opportunity?

Wave Dissipation by Vegetation



- Guidance to describe wave dissipation by natural features, and engineering tool development
- Complement traditional coastal protection
- Maximize ecological benefits and services

Coastal Storm Modeling System (CSTORM-MS)



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**If Mother Nature bats last,
shouldn't we put her in the lineup?**



Where do we go from here?



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