Flood Risk Management Newsletter
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OHS Welcomes Seda-Sanabria as Interim Acting Deputy Chief

Katelyn Noland, IWR

The USACE Office of Homeland Security is pleased to welcome Yazmin Seda-Sanabria as the Acting Deputy Chief. Seda-Sanabria is on temporary assignment for the next three months. She will oversee matters related to Flood Risk Management, Emergency Management, and Critical Infrastructure Protection and Resilience.

Seda-Sanabria is the National Program Manager of the Office of Homeland Security's Critical Infrastructure Protection and Resilience Program at USACE Headquarters. In this role, she provides oversight for program development, execution, and implementation of risk management strategies for enhancing the security and resilience of USACE's Civil Works critical infrastructure projects.

In 1994, Seda-Sanabria joined the U.S. Army Engineer Waterways Experiment Station - now U.S. Army Engineer Research and Development Center (ERDC) – as a research structural engineer in the Geosciences and Structures Division, Geotechnical and Structures Laboratory. While at ERDC, she was involved in multiple research and development programs related to

analysis and design of concrete hydraulic structures, as well as rapid load capacity assessment of bridges. She joined USACE Headquarters in 2006 as the Executive Direction and Management, General Expenses Program Manager in the Civil Works Program Integration Division. In 2007, Seda-Sanabria joined the Office of Homeland Security in her current position.

Seda-Sanabria holds a Bachelor's degree and Master's degree in Civil Engineering from the University of Puerto Rico at Mayagüez. She earned a Master of Science degree in Engineering Mechanics from Mississippi State University. In 1998, she received the American Society of Civil Engineers' Young Government Civil Engineer National Award, in recognition of her public and professional service achievements. In 2002, she received the Women of Color Government and Defense Award for Technical Innovation, in recognition for her efforts leading to the development and implementation of innovative technologies for rapid load capacity assessment of bridges. She has authored over 30 publications including peer-reviewed journal and conference papers, invited articles, and technical reports. She is a member of various professional engineering organizations, including the American Society of Civil Engineers, the Association of State Dam Safety Officials, the U.S. Society on Dams, and the Sigma Xi Research Society. (POC: Yazmin Seda-Sanabria, Yazmin.Seda-Sanabria@usace.army.mil)

R&D Program Update: Work Unit IPR Summaries

Cary Talbot & Dinah McComas, CHL

The Flood & Coastal Storm Damage Reduction (FCSDR) R&D program holds an annual In-Progress Review (IPR) wherein research work unit Principle Investigators (PIs) report to the Flood & Coastal Systems Technical Director, Mr. Bill Curtis, and the Program Manager, Dr. Cary Talbot, on the progress of each work unit in meeting milestones and product deliveries. The FCSDR program work units are grouped into five focus areas: Coastal Systems, Risk & Uncertainty/Alternatives Analysis, Watershed Management, Resilient Infrastructure, and Emergency Management. Summaries of each work unit reporting in the FCSDR FY14 IPR are provided below grouped by focus area. For further information about any of work units please contact Dr. Talbot (Cary.A.Talbot@usace.army.mil) or visit the FCSDR page on the ERDCpedia web site: https://wiki.erdc.dren.mil/ERDCpedia (Corp of Engineers only site).

R&D IPR Report – Coastal Systems

AdH Model Development

PIs: Corey Trahan (ERDC-ITL), Matthew Farthing (ERDC-CHL)

The purpose of this work unit is to redesign the AdH model for improved performance, model coupling across 2D/3D domains and other areas. FY14 products include: new version of AdH surface water (SW)-2D; new version of AdH SW-3D; new version of SEDLIB; an independent Verification & Validation (V&V) report; V&V of AdH SW-3D; updated extrusion utility; a host of Python plotting and error calculation utilities; and a Python utility for converting old AdH to new AdH input style.

Independent Review, Testing and Enhancement of the 3D-SW AdH Model

PIs: Chris Massey and Ray Chapman (both ERDC-CHL)

This work unit will assess the operational applicability of AdH as applied to geophysical scale hydrodynamic, sediment and water quality transport projects. The approach is to evaluate fundamental aspects of AdH, and through a cooperative effort, investigate the possibilities of applying AdH as an alternative or complementary addition to CSTORM and the multi-block Geophysical Scale Hydrodynamic Sediment and Water Quality Modeling System (GSMB). The goal is to develop a more knowledgeable and experienced user/developer group for large scale coastal transport modeling.

Boussinesq-Type Numerical Wave Model Development

PIs: Matt Malej and Jane Smith (both ERDC-CHL)

This work unit will produce a new phase-resolving (Boussinesq-type) numerical wave model, advancing the state of the art of the phase-resolving numerical wave models for the Corps. Areas of applicability include: nearshore wind-wave propagation; harbor entrances; nonlinear shoaling; runup & overtopping; land inundation; and tsunamis and ship waves.

CSTORM-MS Coastal Modeling Suite Development

PI: Chris Massey (ERDC-CHL)

This effort continues the development of a system of tightly coupled hydrodynamic models, wave models and a sediment transport model within a user-friendly interface to set up and run the coupled models. FY14 products include: XDMF support for ADCIRC and STWAVE; Phase 3 of ADCIRC + STWAVE + AdH integration; and the initial release of both CSTORM-PS (Production System) and CSTORM-PVz (Production Visualization).

Coastal Resilience Metric

PI: Julie Rosati (ERDC-CHL)

This effort is to complete development of a range of resilience calculation methods for the USACE that are application appropriate. This work has developed USACE concepts and a definition for coastal infrastructure resilience; tested two methods for calculating coastal infrastructure resilience; and developed R&D and implementation needs. The goal is to evaluate coastal community functionality with respect to life-safety, housing, utilities, transportation (evacuation/return); to evaluate the effects of storms on functional performance of infrastructure (housing, utilities, transportation) and life-safety; and to consider strategies and policies (beach nourishment, wetlands, mandatory evacuation) to improve resilience.

Process Based Primary Productivity Algorithm in SEDLIB

PI: Gary Brown (ERDC-CHL)

This work unit seeks to improve SEDLIB, a library of sediment routines for hydrodynamic codes, by implementing a primary productivity algorithm that provides both sufficient robustness to include all of the relevant processes and sufficient generality to allow for expansion and revision of the model. FY14 saw the development, implementation and basic verification of a generic, “soil cohort” module (a “soil cohort” is essentially a bed layer) that casts primary productivity in terms of the production and decay of organic grain classes. Hence, the module is implemented in a manner consistent with the existing SEDLIB framework. The module will be part of the standard SEDLIB package, thus users of codes linked to SEDLIB, including AdH, can

use it and/or collaborate in its further development. The module is being used for wetland evolution modeling for the Delta Management Study by the USACE New Orleans District.

Unstructured Modeling of Coastal Waves

PIs: Jane Smith & Chris Massey (both ERDC-CHL)

This new work unit is developing an updated capability for phase-averaged nearshore wave generation and propagation modeling within the CSTORM-MS framework. The effort is building on an existing tool, WAVEWATCH III (WW3) and the active community development of source terms that is under way. This effort will focus on nearshore wave generation and transformation, efforts that are not being addressed by the community development efforts. The work will focus on Corps project needs, including validation, improvements for nearshore physics, efficiency, tight coupling within CSTORM-MS, and technology transfer to Corps users. FY14 activities included workshops with NOAA's National Centers for Environmental Prediction (NCEP), validation of WW3 in nearshore environments and identification of benchmark test cases and data sets.

Wave Dissipation by Vegetation

PIs: Jane Smith, Mary Anderson, Chris Kees (all ERDC-CHL)

FY14 is the concluding year of this effort to develop techniques and guidance to describe wave dissipation by natural features that complement traditional coastal protection and maximize ecological benefits. A numerical wave flume was also developed and validated. This work will result in an update to the Coastal Engineering Manual (CEM), and has already produced numerous journal papers, conference presentations, and Technical Reports. Results are also being incorporated into the Coastal Engineering PROSPECT Class.

R&D IPR Report – Risk and Uncertainty/Alternatives Analysis

Coastal Hazards System

PI: Jeff Melby (ERDC-CHL)

This effort is developing coastal storm statistical analysis tools and fielding a web-based coastal storm data resource. This system makes available a coastal storm hazard data resource that combines processes and statistics, reduce the costs of quantifying coastal storm hazards, provide a generalized set of statistics methodology and tools for coastal storm analysis and reduce the cost of data analysis and formatting for risk assessment. The effort is leveraging federal regional coastal modeling studies, and provides the following: long-term storage of, and public access to, measured and high-fidelity modeled coastal storm data; well-vetted data; easily accessible data available to search, browse, and visualize; and contextual data products and tools that support federal decision making.

Coastal Storm Damages Prevented

PI: Susan Durden (IWR)

Concluding in FY14, this effort developed a methodology to quantify the damages prevented due to wave, inundation, and erosion. This metric will be used to calculate the annual national economic damages prevented by Corps' coastal damage reduction projects, a value which is reported to Congress. The Coastal Storm Damages Prevented (CSDP) tools include: Data Processing Tool; Erosion Damage Assessment Tool; Wave Damage Assessment Tool; and Inundation Damage Assessment Tool. A CSDP User Manual has also been developed. The method is being field tested and applied in various coastal Districts.

HEC-FIA Development

PI: William Lehman (IWR-HEC)

HEC-FIA (Flood Impact Analysis) is designed to be the go-to tool for estimating life loss for the Dam and Levee Safety Program. It provides data suitable for after action reports, real time water management, and evaluation of economic consequences, agriculture loss, and direct and indirect losses. HEC-FIA development focuses on creating the primary USACE tool for life cycle analysis of economic and life loss consequences to assist in evaluation of consequences from both riverine and coastal flood events. Also being developed is a data service for the National Structure Inventory, accessible at https://maps.crrel.usace.army.mil/apex/nsi_dev.vm2.map.

Risk and Uncertainty of Snowmelt Runoff

PI: Steven Daly (ERDC-CRREL)

Runoff from snowmelt can be a significant component of flood flows and reservoir inflows. There is no consistent guidance for estimating the risk and uncertainty associated with this runoff. This new work unit will develop guidance on assessing this risk and uncertainty, resulting in updates to EM 1110-2-1406, Runoff from Snowmelt.

Quantification of H&H Model Uncertainty

PI: Brian Skahill (ERDC-CHL)

Hydraulics and hydrology (H&H) model uncertainty is a critical component for conducting project studies and comparing project alternatives in a risk analysis framework. This concluding work unit has produced several software updates, and two ERDC Technical Notes. A Markov Chain Monte Carlo algorithm is being deployed for use in H&H software tools such as GSSHA and HEC-HMS.

Watershed Analysis Tool (HEC-WAT) Development

PI: Penni Baker (IWR-HEC)

The purpose of this work unit is to provide software to the field that fully encompasses USACE risk analysis (assessment) requirements and expectations. Software applications developed under this work unit attempt to address recommendations made by the National Research Council regarding USACE risk analysis tools and methods, and carries significant and enduring

implications for flood risk management in the United States. HEC-WAT (Watershed Analysis Tool) is software that allows a Project Delivery Team to perform an integrated study across multiple disciplines while meeting USACE's Planning Transformation 3x3x3 goals. The FRA compute option allows HEC-WAT to perform system-wide benefit analyses assessing risk & uncertainty in complex, interdependent systems and with a life-cycle approach. HEC-WAT and FRA development for FY14 included many innovative capabilities that allow USACE users to perform water resources decision-making in a systems-based approach.

Flood Damage Reduction Analysis (HEC-FDA) Development

PIs: Robert Carl, Lea Adams (both IWR-HEC)

The purpose of this work unit is to modernize HEC-FDA, e.g., address the Field and NRC recommendations by creating a standard GUI interface, integration with HEC-WAT, and various algorithm refinements. HEC-FDA is the Corps' primary software tool for integrating hydrologic and economic analyses in support of flood risk management (FRM) decisions. It provides the risk analysis functionality required by ER 1105-2-101 for evaluation of FRM measures.

HEC-HMS Watershed Uncertainty Analysis Development

PI: Bill Scharffenberg (IWR-HEC)

The Corps' implementation of a risk-based framework for flood damage reduction project evaluation and project safety evaluation means that hydrologic simulation tools that produce probabilistic outputs are needed. Extending existing, widely used tools provides the lowest cost and quickest path to meet this important mission need. This effort will provide enterprise software to the Corps of Engineers for watershed hydrology simulations for dam and levee safety studies, flood damage reduction studies, real-time operations, and general planning studies. It will also provide hydrology simulation software with an integrated uncertainty assessment capability. HEC-HMS is fully integrated into the PROSPECT training schedule. It is certified by FEMA for floodplain studies using event or continuous simulation techniques and certified by FERC for dam safety screening studies.

New River Hydraulic Analysis Capabilities for HEC-RAS

PI: Gary Brunner (IWR-HEC)

This effort seeks to improve hydraulic modeling techniques and capabilities in HEC-RAS and quantify hydraulic model uncertainties in HEC-RAS in order to perform integrated risk and uncertainty analysis. One task is to develop a standalone uncertainty analysis capability within HEC-RAS in order to quantify hydraulic uncertainty in the form of rating curves with uncertainty bands at all computation points. Another task is integrating HEC-RAS uncertainty analysis capabilities within the HEC-WAT framework in order to perform system-wide risk and uncertainty analysis, propagating uncertainly analysis all the way to floodplain mapping.

R&D IPR Report – Resilient Infrastructure

3-D Analysis of Piping Through Levees and Dams

PI: Hwai-Ping (Pearce) Cheng (ERDC-CHL)

USACE Dam and Levee Safety Programs use risk-based analyses to evaluate public safety. Seepage and internal erosion are primary dam failure modes. 2-D modeling has been used to evaluate seepage/internal erosion, but geologic and hydro-geologic complexities may limit applicability of 2-D models. This effort evaluated 2-D and 3-D model applicability and limitations and illustrating how 3-D modeling may be more appropriate in certain situations to simulate groundwater flow adequately.

Transient Seepage Levee Instrumentation at Buck Chute Bayou

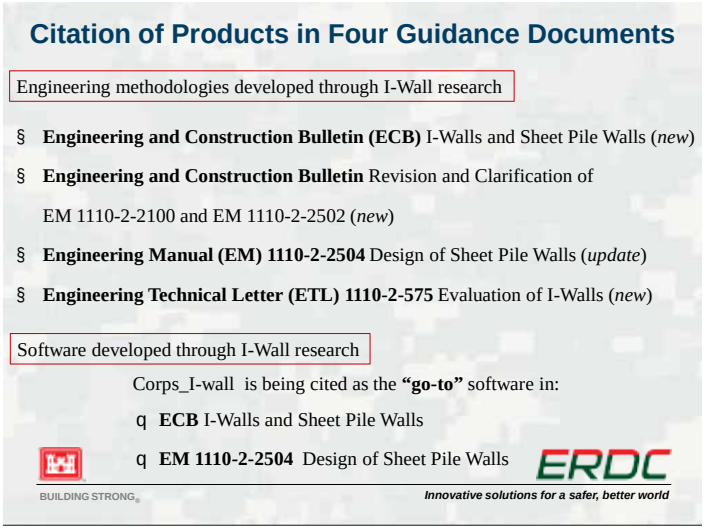
PI: Ghada Ellithy (ERDC-GSL)

As part of an ongoing study on transient seepage through levees by the ERDC, tensiometers and volumetric moisture content (VMC) sensors were installed to collect data required to understand the moisture retention behavior of the levee soil and how it corresponds to phreatic surface and precipitation. A weather station was also installed and used to record atmospheric parameters. The study area consists mainly of clayey soils and is within the right of way of the levee at Buck Chute Bayou, MS. Instruments will be placed in the vicinity of current Vicksburg District piezometers. Data are needed during various river stages, so the proposed timeframe of this study will be throughout 2014 and will continue until a high water event has been recorded.

I-Wall Analysis Development

PI: Bob Ebeling (ERDC-ITL)

Gap formation is a critical I-Wall design deficiency that was identified after the I-Wall failures in New Orleans during Hurricane Katrina. This deficiency may lead to seepage and global instability under flood loading. This research addresses the lack of suitable software that fully evaluates I-Wall design and subsequent performance analyses. Products from this work include a database of Complete Soil-Structure Interaction (SSI) analyses of I-wall movements and gap initiation/propagation analyses in various soil types and easy-to-use, PC-based deterministic or probabilistic software for USACE District engineers involved in the design or analysis of I-Walls – *Corps_I-Wall Version 1.0* (for floodplains and coastal environments with level ground surfaces) and *Corps_I-Wall Version 2.0* (for riverbanks, levees, and coastal environments with non-level ground surfaces). These software packages are cited in USACE EM 1110-2-2100, EM 1110-2-2502, EM 1110-2-2504, ETL 1110-2-575 and an ECB on I-Walls and Sheet Pile Walls.



Improved Levee Resilience Through Soil Application of a Natural Organic Polymer

PIs: Maureen Corcoran (ERDC-GSL) and Steven Larson (ERDC-EL)

This work is currently a screening-level program that seeks to develop technologies that address current and anticipated challenges associated with innovative and cost-effective operation and maintenance of levees and dams. Several evaluations and test efforts were begun, including two proof-of-concept studies – *Reduced Severity of Sand Boils with Biopolymer Augmentation* and *Shrink-Swell Behavior of Biopolymer Amended Clay Soils*.

Remote Monitoring, Sensing, and Testing of Earthen Structures

PI: Joe Dunbar (ERDC-GSL)

This research addresses the need for innovative sensor and data collection methods to improve dam and levee safety. Efforts will identify and promote new inspection and monitoring methods for aging civil works infrastructure and levees; incorporate in-situ sensors into levees to support transient seepage modeling for geotechnical evaluation of soil structure interaction in flood control structures; evaluate the use of geophysical monitoring (resistivity and/or electromagnetic imaging) of known problem levee areas for levee underseepage and sand boils; and monitor revetments and I-wall movements with new generation smart sensors. Unmanned aerial vehicle (UAV) monitoring of sand boil activity has already proven its ability to identify sand boils during flooding as well as to produce rectified images for site characterization and generate elevation models (DEM) for geotechnical analysis.

Best Practices for Transient Seepage Analysis in Geotechnical Engineering

PIs: Fred Tracy (ERDC-ITL), Ghada Ellithy & Bryant Robbins (both ERDC-GSL)

This research is developing a series of best practices for transient seepage analysis and validating the developed procedures and numerical solutions using field data from full-scale embankments. A high performance computing (HPC) program has been developed to compute nomographs and sensitivity analysis which uses geometry and soil properties of a levee, generates a mesh, applies boundary conditions, solves both the steady-state and transient problem, and assembles the results. The program delivers thousands of different levee scenarios in less than an hour. Another tool developed is the Levee Seepage Tool. It is designed to provide the user with quick analyses for both transient and steady state seepage. The inputs include levee geometry, hydraulic conductivity, hydrograph, moisture

content, volumetric compressibility, and van Genuchten parameters. The output computes flow rates and exit gradients after creating a levee profile and mesh.

Study of the Development and Occurrence of Sand Boils

PI: Julie Kelley (ERDC-GSL)

This effort is two-fold. One effort is evaluating the primary factors responsible for the many 2011 Mississippi River flood sand boil incidents, including levee design, geologic conditions, blanket thickness, soil type, engineering soil properties, and gradients. The other effort seeks to identify the most likely units to emerge as sandboil ejecta beyond the toe of the seepage berm. This effort will select target strata (units) and determine geometric constraints.

R&D IPR Reports – Watershed Management

Enhancement and Testing of Factors Affecting Snowmelt Runoff Simulations with the Hydrologic Simulator GSSHA

PIs: Chuck Downer, Mike Follum (both ERDC-CHL), and Steve Daly (ERDC-CRREL)

This work unit is developing tools for simulation of snow accumulation, melt, runoff and associated frozen soil processes. Various capabilities within GSSHA have been improved, including the capability to account for topographic and vegetation features when simulating snow, radiation calculations and other aspects.

Improved GSSHA Calibration Capability

PIs: Brian Skahill, Chuck Downer (both ERDC-CHL)

This work unit has developed several tools and utilities for improving the process of automated hydrologic model calibration. These tools have been fielded in GSSHA and their use and applicability are described in two ERDC Technical Reports, two Tech Notes, a GSSHA tutorial and will be incorporated in the upcoming GSSHA PROSPECT course.

Sediment Transport Development in HEC-RAS

PIs: Stan Gibson, Gary Brunner, Matt Fleming (all IWR-HEC)

This work is improving the sediment transport capabilities within HEC-RAS, adding unsteady sediment transport, reservoir flushing and routing and BSTEM (Bank Stability and Toe Erosion Model) capability.

Scaling Issues in Hydrologic Modeling

PI: Chuck Downer (ERDC-CHL)

This effort has explored how to best simulate fine scale features in large-scale watershed models for application in GSSHA. The resulting products provide the hydrologic modeling community with information and guidance on simulating small-scale features in large watershed, along with useful tools that allow the ideas to be easily implemented. One FY14 product is the Best Management Practices (BMP) Calculator, a simple stand alone hydrologic model that includes a library of point models that can be used to help select BMPs for small projects, such as low impact development (LID) construction, allowing a soft design to meet EISA 438 Low Impact Develop requirements.

Sediment Dispersion Flume Study

PIs: Stanford Gibson (IWR-HEC), Ronald Heath, David Abraham, Jeremy Sharp (all ERDC-CHL)

Sediment flume studies were conducted to parameterize the advection and dispersion coefficients for bedload transport in ADH and HEC-RAS. Journal publications describing the results along with incorporation of coefficients in numerical model simulation tools are being produced.

HEC-HMS Surface Erosion

PI: Bill Scharffenberg (IWR-HEC)

Surface erosion estimates become a boundary condition to a wide variety of channel sediment studies for bridge scour, channel stability, fish habitat, etc. Surface erosion is also a component in reservoir sedimentation studies of storage capacity. These estimates often include a high degree of uncertainty; using physically-based models may result in lowered uncertainty. This work unit will integrate more advanced erosion algorithms into HEC-HMS, which will allow the leveraging of all of existing hydrology models built for planning studies and real-time operations by making it possible to add sedimentation simulation. A broadly applicable analysis tool for surface erosion, channel sediment transport, and reservoir sediment settling as an integral part of watershed studies will be developed, providing a range of capabilities from simple models with few data requirements to detailed models with matching data requirements.

R&D IPR Reports – Emergency Management

Expedient Hurricane Inundation Prediction

PIs: Jeff Melby, Jane Smith, Bernard Hsieh (all ERDC-CHL)

This research is developing expedient hurricane inundation prediction tools which leverage the Coastal Hazards System (CHS) high-fidelity modeling and utilize surrogate modeling

techniques. This effort, together with its companion effort in the Risk & Uncertainty/Alternatives Analysis focus area, is developing coastal storm data resource, hosting the results on the web, and developing coastal storm statistical analysis tools. The CHS is an archive, database, data repository, and web application with extremal statistics of peak responses and storm characteristics for expedient high-fidelity storm response prediction. CHS stores a large suite of basis hurricane scenarios that covers a statistical range of events for tracks and landfall locations; hurricane characteristics (min. central pressure, forward speed, radius of max. winds, etc.); and regional high-fidelity wave and surge response (e.g. coupled ADCIRC-STWAVE). CHS will also use basis scenarios as support for surrogate model to rapidly and accurately predict inundation for any new hurricane scenario. StormSim is the accompanying statistical analysis software that computes probabilistic characterization of storm occurrences, parameters and responses.

MICA Mobile Information Collection App – Real-time Data Collection and Decision Support Using Mobile Devices

PI: Robert Walker (ERDC-ITL)

The MICA goal is to create a single application/architecture that can be adapted to collect data for multiple mission types. The new MICA Self-Service Forms allow users to build custom forms for any mission, are integrated directly within MICA Folders, and the data is saved as XML stored in appropriate user mission folder.

During the Hurricane Sandy response Team members have taken over 9,100 data points including photos, videos, and form data of debris, damage, real estate, etc. In addition to Hurricane Sandy response, FY14 MICA deployments include: Detroit District– Muskegon River waterway inspections; Galveston District – Dam Inspections; New Orleans District – Spring Floods; Omaha District – Flood Inspections; US Bureau of Reclamation; and Federal Highways.

Regional Flood Risk Management Strategy Would Improve Upper Mississippi River System

Michael Tarpey, MVR

The Upper Mississippi River watershed has recently experienced more frequent flooding with higher stages, particularly in the last ten years with major floods occurring in 2008, 2010, 2011, 2013 and 2014. In Quincy, Illinois, alone, four of the top five record crests have happened in the last twenty years. In addition to the challenges of increased flooding, the Upper Mississippi River watershed also lacks a regional flood risk management strategy comparable to the

Mississippi River and Tributaries project on the Lower Mississippi River. As a result, the Upper Mississippi River Comprehensive Plan (UMRCP) team, a joint effort by the U.S. Army Corps of Engineers St. Paul, Rock Island, and St. Louis Districts, is working collaboratively with the states and local communities to develop a systemic and sustainable strategy that would reduce the risks and consequences of flooding.

The Upper Mississippi River System (UMRS) comprises the Upper Mississippi River Basin drainage area above Cairo, Illinois, at the confluence of the Mississippi and Ohio rivers exclusive of the Missouri River Basin. The UMRS encompasses approximately 185,000 square miles and includes the states of Minnesota, Wisconsin, Iowa, Illinois and Missouri. It covers approximately 1,200 miles of navigable river on the Upper Mississippi and Illinois rivers. The UMRS and associated environments have a rich record of human history spanning more than 12,000 years and is one of the most archeologically and historically significant regions in the country. In modern times, the UMRS has assumed a significant role in the development and prosperity of the Midwestern economy and way of life. The river system is both a source of prosperity and of challenges. The waters of the UMRS create a nationally significant ecosystem and a nationally significant transportation system, but also bring flooding.

Sand levee "Push-up" of mainstem levee during record 2008 flooding

When the levees and reservoirs of the UMRS were built, using both federal and non-federal resources, they were not constructed in accordance with any overall strategy or consistent design basis. These facilities have a wide variety of structural integrity and provide varying levels of flood risk management for similar land uses. The majority of the structures were federally constructed or improved. Most were planned, designed and built incrementally and under various authorities, resulting in differing levels of risk reduction. The average age of the agriculture systems on the Upper Mississippi and Illinois rivers is 75 years. Additionally, in accordance with the project authorizations, these structures are now operated and maintained by the local sponsor.

Due to a lack of regional flood risk management strategy, the risks remain high. The Flood of 1993 provided a vivid demonstration of the vulnerabilities. Forty-seven deaths were attributed to that flood as well as nearly $15 billion of damage. The social disruption was beyond measure, with more than 70,000 homes damaged or destroyed and approximately 74,000 people evacuated.

In response to the Flood of 1993, the UMRCP was authorized by the Water Resources Development Act (WRDA) of 1999, Section 459, was to collaboratively evaluate a broad range of flood risk reduction alternatives. The legislation directed the development of a plan to reduce flood damages and requested recommendations on management plans and actions to be carried

out by the responsible Federal and non-federal entities. It also requested recommendations to authorize construction of a systemic flood control project for the Upper Mississippi River, including recommendations for Federal action where appropriate and recommendations for follow-on studies for problem areas for which data or current technology did not allow immediate solutions.

Completed sand levee "push-up" during record 2008 flooding

In 2008, a report from the UMRCP determined that a system of Federal levee raises would not be economically justifiable, but it did recommend Federal, state, and local actions that would greatly improve the preparedness, performance and resiliency of flood risk management structures and communities. Since that time, the UMRCP regional team has sought to continue working on this forward-looking, watershed authority in order to develop a collaborative, integrated regional strategy that includes a risk decision-making framework that will be adaptively managed to adjust to changing events and uncertainties.

The frequent floods experienced on the UMRS require extraordinary measures and exorbitant federal, state and local resources to ensure the safety and security of lives and businesses. Currently, during flood events, the flood fighting activities are conducted without a complete understanding of the impact actions have on adjacent communities. One measure that many agricultural levee systems use to prevent levee overtopping is "pushing up" the backside of their sand levees to increase the levee height. While "pushing up" often prevents levees from over-topping, it increases the risk of levee failure and transfers the risk to other areas. Citizens remain concerned about future flooding and continue to call for Federal action to develop a comprehensive regional flood risk management strategy.

Dumping additional sand on mainstem levee during record 2008 flooding

The UMRCP team's next step is the development of a geo-referenced hydraulic model for the Mississippi and Illinois rivers. The UMRS lacks a unified hydraulic model – each agency currently uses its own model. The UMRCP model will be collaboratively developed by the Corps of Engineers and states and will become the 'backbone' for building a regional risk management strategy. The UMRCP-developed model will replace the multiple models currently in use, lowering costs for all agencies, improving floodplain management, and increasing consistency in regulatory actions. The model will support flood fighting activities by allowing real-time river forecasting and inundation mapping.

For the UMRCP team to be successful in creating a regional flood risk management strategy to protect human safety and reduce escalating economic losses, Federal collaborative leadership will need to work with the states and local governments involved in the UMRS. The strategy

would be a long term, iterative effort to break the cycle of flood-respond-repair and would provide guidance on structural and non-structural measures, a risk-making decision framework, and policy change recommendations. Ultimately, the Federal investment in regional flood risk management strategy development would be leveraged by state and local implementation of the strategy. (POC: Michael Tarpey, PE, PMP, Michael.J.Tarpey@usace.army.mil)

National Flood Barrier Testing and Certification Program

Randall L. Behm, NWO & National Nonstructural Flood Proofing Committee

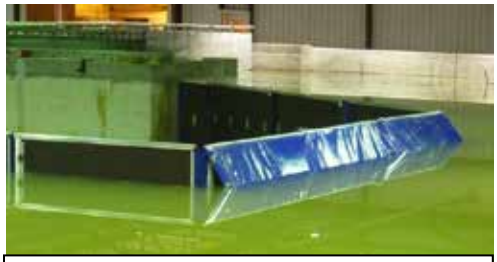
Imagine you are standing waist deep in snow which has been piling up for several months. As far as you can see this white wonderland extends off into all directions. Now, if you will, imagine bright sunshine, rapidly warming temperatures, and melting snow.

That is one common scenario which brings a chill to those who engage annually in the snowmelt springtime flood cycle. With the knowledge that small rivulets of melting snow will soon turn to raging rivers, you plan for the defense of homes, businesses, and whole communities. The hydrologists forecast the peak discharge from this rapid snowmelt, and the hydraulic engineers calculate the anticipated stages to come from this icy thaw.

With the ground frozen and unwilling to be molded into emergency berms and levees, you call for sand, sandbags and an endless army of volunteers to shovel, fill, and place those bags before the damaging waves of water arrive.

Wave testing of perimeter barrier

In the midst of this emergency response activity, you and local and state officials are being persistently dogged by salespeople representing manufacturers of new and innovative temporary flood barriers, which they insist will “prevent all flood damages from occurring.” What do you do? Do you choose a barrier based on the sales pitch, the cost, or the color? Or do you consider the ramifications of deploying a product which may fail the instant flood waters come into contact with it. Is there any liability or, at a minimum, technical responsibility in recommending manufacturer’s products for flood fight activities? Do you deploy an untested product to protect a community’s most critical and vital facilities?



Perimeter barrier

The Association of State Flood Plain Managers (ASFPM) in partnership with FM Approvals and the US Army Corps of Engineers National Nonstructural Flood Proofing Committee (NFPC) has initiated implementation of a National Program of testing and certifying temporary flood barrier products used for flood proofing and flood fighting. This program

currently tests barrier products in two broad categories, Temporary Flood Barriers and Closure Devices.

This National Program provides an unbiased process of evaluating flood barrier products in terms of resistance to water forces, material properties, and consistency of product manufacturing. This is accomplished by standardized testing of the product against water related forces in a laboratory setting, against material forces in a laboratory setting, and periodic inspection of the manufacturing process for product consistency. When a product meets the consistency of manufacturing criteria and the established standards for the material and water testing, it receives certification. However, since the testing is conducted in a controlled laboratory setting, not all natural forces and potential impacts can be tested.

Closure Barrier

Product certification will reflect, in terms of flood proofing, the suitability and performance of the product based on the product deployment literature, the durability and reliability of the product, and the consistency of the product. All products are examined and evaluated on a model by model, type by type, plant by plant, and manufacturer by manufacturer basis.

For more information regarding this National Program for testing and certifying temporary flood barriers and closure devices, and a list of certified products, visit the program website at: www.nationalfloodbarrier.org. (POC: Randall L. Behm, Omaha District and National Nonstructural Flood Proofing Committee, Randall.L.Behm@usace.army.mil)

USACE Presence at Coastal Conferences

Emily Vuxton & Lauren Leuck, IWR

In the fall of 2014, U.S. Army Corps of Engineers staff participated in a pair of coastal conferences to highlight the coastal and environmental work currently being conducted. USACE employees from the Institute for Water Resources (IWR), the Engineer Research and Development Center (ERDC), Headquarters, and various districts attended the American Shore and Beach Preservation's (ASBPA) 2014 National Coastal Conference in Virginia Beach, VA, from 14-17 October as well as the 7th National Summit on Coastal and Estuarine Restoration in National Harbor, MD, from 1-6 November.

Presentations at ASBPA's National Coastal Conference focused on the latest findings in coastal engineering, geology, planning, and policy. Coastal resilience was a popular topic of the conference and Dr. Julie Rosati (ERDC) presented during the plenary session on USACE's work on developing metrics for coastal resilience. LTG Bostick, Chief of Engineers, had requested the Coastal Engineering Research Board (CERB) develop a strategy and identify research and development needs for conducting resilience assessments in the USACE. Dr. Rosati provided an update on the development of a roadmap to address these needs through the examination of different tiers of resilience and policy analyses. There were also a number of presentations on the

North Atlantic Coast Comprehensive Study (NACCS), a collaborative effort that is bringing together governmental, academic, and non-governmental experts in coastal planning, engineering and science to develop a risk reduction framework for the 31,000 miles of coastline within the North Atlantic Division that were affected by Hurricane Sandy. Roselle Henn (NAD) provided an overview of the NACCS, identifying the primary goals of the study to (1) provide risk reduction strategies to subjected vulnerable coastal populations, and (2) promote coastal resilient communities to ensure a sustainable and robust coastal landscape system, considering future sea level rise and climate change scenarios, and to reduce risk to vulnerable population, property, ecosystems, and infrastructure. The NACCS report is due to Congress in January 2015. A presentation on the development of a framework within the NACCS to support the evaluation and implementation of Natural and Nature-Based Features (NNBF) to achieve coastal risk reduction and resilience was given by Emily Vuxton (IWR). Other topics that generated a great deal of conversation included sea level rise, regional sediment management, beach nourishment and shore protection, and funding strategies for coastal projects.

At the 7th National Summit on Coastal and Estuarine Restoration, Paul Wagner (IWR) presided over a panel which explored natural infrastructure in areas affected by Hurricane Sandy. Lawrence Smith (SPL) presented a poster on the Upper Newport Bay Ecosystem Restoration Project. The Upper Newport Bay Ecosystem Restoration Project was a multi-year project led by the US Army Corps of Engineers to more effectively manage sediments deposited within the bay, with the objective of reducing the frequency of dredging projects while also enhancing habitat values within the upper bay and slowing the detrimental impacts of sediment accumulation on the fish and wildlife habitats.

More information on two of these studies can be found at
North Atlantic Coast Comprehensive Study - http://www.nad.usace.army.mil/CompStudy.aspx
Upper Newport Bay Ecosystem Restoration Project -
http://www.newportbeachca.gov/index.aspx?page=115

SR 530 Oso, WA Landslide – Spring 2014

Kayla Stull, NWS

Douglas Weber and COL Bruce Estok evaluating the damage on SR 530 caused by the Oso Landslide

On 22 March 2014, a massive landslide swept across State Route 530 blocking the north fork of the Stillaguamish River near the town of Oso, WA. Responders deemed the event the worst natural disaster to occur in decades. The dirt and debris plowed through 59 lots in the impact area killing 43 people and devastating the local community.

Immediately, Snohomish County requested technical assistance from Seattle District (NWS) after reports from the National

Weather Service indicated flooding was possible both upstream and downstream on either side of the river. During the initial response phases, Washington Governor Jay Inslee declared an emergency, and the Federal Emergency Management Agency (FEMA) took the lead in recovery, issuing mission assignments to the Corps. NWS took on 7 FEMA missions and a PL 84-99 emergency response project with a team of 50 people over a 35 day period providing Engineering Support for damage, vulnerability, and cost assessments; debris removal; and onsite construction assistance.

The debris wall measured 1 square mile and was 15 to 40 feet deep in some areas. Ongoing rainfall over the impact area made debris removal dangerous for responders. Additionally, water levels were rising due to flooding in the upstream pool formed by the landslide mass. Following the Presidential Declaration of Emergency, NWS assisted Snohomish County and the State of Washington with construction of a temporary levee and with a dewatering mission requested by FEMA. Construction of the 3000 LF berm was completed in mid-April and took 23,000 tons of material to build allowing for the start of the dewatering mission. This permitted search and recovery teams to continue their efforts in the most unreachable area of the impact zone.

An aerial view of the Oso Landslide aftermath

Despite facing persistent rainfall and having to deal with another coastal emergency, NWS was able to successfully collaborate with other agencies and internal teams to accomplish the overarching mission. NWS continues to play a role in the flood contingency planning and the long term recovery from this historic event. (POC: Kayla.M.Stull@usace.army.mil)

Are Federal Agencies Enabling Responsible Decisions Around Flood Risk Management?

Review of a Shabman and Scodari IWR Report

Stacy Langsdale, IWR

Leonard Shabman and Paul Scodari developed their report, “From Damage Reduction to Flood Risk Management: Implications for U.S. Army Corps of Engineers Policy and Programs,” to promote awareness and stimulate dialogue across our agency about our role in Flood Risk Management. FRM certainly has had cultural shifts in our organization, reflected by changes in naming this business line, from *Flood Control* to *Flood Damage Reduction* and now *Flood Risk Management*. So, are these changes keeping us on the right path?

The report raises important questions about USACE’s role, and our partner federal agencies roles, in FRM. As a public agency, is it sufficient to simply communicate the character of risk, or is it in our – and the public’s – best interest to “nudge” them to action to reduce their risk and

mitigate negative consequences? And, what is the goal for our country's use of floodplains? Is it to "reduce the adverse consequences of flooding" or to "foster economically efficient uses of floodplains?" Shabman and Scodari note that Gilbert White promoted this "Risk Informed, Cost Responsible" concept in a 1966 task force report, so it need not be a surprise.

Chapter 2 of the report provides a valuable historical review of programs and perspectives of USACE and federal flood risk management since the Civil War. Chapter 3 makes the case for a USACE and federal policy framework to promote risk informed and cost responsible (RICR) decision making by communities and individuals with respect to their choices on floodplain location and use and the adoption of risk reduction and management actions. This means that USACE's role would include:

- Developing and communicating risk information to those who realize the benefits of floodplains;
- Assuring that floodplain communities and individuals assume responsibility for the risks and costs of using the floodplain; and
- Continuously review USACE programs and their influence on choices by communities and individuals, particularly related to economic efficiency and social equity.

The authors did not stop at principles but provide a range of specific actions that could be taken to implement this RICR framework. Chapter 4 recommends actions that USACE could take, sorted into the three categories listed above. Shabman and Scodari presented the major tenets of their report in the October 2014 Flood Risk Communication webinar series. The slides and audio recording are available at: http://corpsriskanalysisgateway.us/lms/webinars.cfm.

The major portion of the report is an accessible 50 pages. Additionally, there are useful resources in the appendices, including a vocabulary of terms (A), past federal reports on a unified national FRM program (B), how individuals and communities make decisions (C), and descriptions of USACE FRM Programs (D). The entire report can be found at: http://library.water-resources.us/pubsearchR.cfm. *(Search Report number 2014-R-02, to find all 5 files).* (POC: Stacy Langsdale, Stacy.M.Langsdale@usace.army.mil)

Climate and Natural Resources Priority Agenda

Kate White, HQ, and Rachel Grandpre Bruscoe, IWR

In response to Section 3 of Executive Order 13653, Preparing the United States for the Impacts of Climate Change, the administration released a report, *Priority Agenda: Enhancing the Climate Resilience of America's Natural Resources.* The agenda, developed through an interagency working group in which USACE participated, identifies four priority strategies to make the Nation's natural resources more resilient to a changing climate:

1. Foster climate-resilient lands and waters,
2. Manage and enhance U.S. carbon sinks,
3. Enhance community preparedness and resilience by utilizing and sustaining natural resources, and

4. Modernize Federal programs, investments, and delivery of services to build resilience and enhance sequestration of biological carbon.

For each strategy the Agenda documents significant progress and provides a roadmap for action to move forward. While the strategies most closely linked with the Flood Risk Management Program are the last two, each action has components applicable to flood risk management, including investing in coastal salt marsh restoration, investing in natural infrastructure, launching an urban conservation initiative, reducing flood risk in Puget Sound, and restoring forests in the Lower Mississippi Delta.

The day before the agenda was published Secretary of the Interior Sally Jewell announced that the U.S. Fish and Wildlife Service and the American Littoral Society had made a $1.9 million agreement to restore 1.5 miles of shoreline at Reed Beach, a coastal salt marsh in New Jersey. This $1.9 million coastal salt marsh restoration investment is part of a $15 million investment to restore New Jersey coastal salt marshes.

The investment of over $10 million from the Open Space Institute (OSI) towards land purchases and easements, particularly for lands that can reduce the possible risk of flooding, is one approach to increasing the use of nature-based infrastructure for flood resilience. USACE is also tasked with working together with DOI, USDA, NOAA, DOD, and EPA to identify programs for resilience evaluation, developing resilience metrics and evaluating whether investments produce resilience benefits for the resources and surrounding communities. USACE, FEMA, NOAA, USGS, and other agencies will work together to develop tools to support smart development decisions within floodplains and along coasts.

USACE will also be working with others in 2015 to address performance measures and benefits assessment challenges associated with natural infrastructure. In the future, USACE, NOAA, and other relevant Federal agencies will provide resources and technical assistance to state, tribal, local, and private sector partners to enhance the use of natural infrastructure to address storm surge, sea-level rise, and other stressors on coastal communities and ecosystems. POC: Kate White, Kathleen.D.White@usace.army.mil, or Rachel Bruscoe, Rachel.N.Grandpre@usce.army.mil.

Library and References Links Reminder

Public Access to the ERDC Library

The ERDC Library's ongoing digitization project has resulted in making available to the public 9,500 ERDC and pre-ERDC publications. This includes technical reports, miscellaneous papers, special reports, technical notes, etc., that are approved for public release. These materials can be found in the Library's online catalog at http://acwc.sdp.sirsi.net/client/default. You can search by keyword(s) or click on ERDC DIGITAL REPORTS on the left side of the page for a listing by laboratory or program. Library materials not available electronically can be requested on loan but the request must be made through a local library. The ERDC Library will not loan directly to individuals.

Official USACE Publications

The official repository of Corps of Engineers Publications – Engineer Regulations (ERs), Engineer Circulars (ECs), Engineer Technical Letters (ETLs) and Engineer Manuals (EMs) – is http://www.publications.usace.army.mil/. Most documents are available electronically.

Coastal Engineering Manual (CEM)

The CEM is available at the link above. The CEM, EM 1110-2-1100 – Parts I-VI, Appendix A and Glossary, provides extensive guidance on coastal engineering issues. All parts are available only electronically. Users should note some sections may require long download times.

CHETNs

Coastal and Hydraulics Technical Notes (CHETNs) are concise research results aimed at helping Corps field offices with particular problems. Available at http://chl.erdc.usace.army.mil/chetn, they cover various coastal and hydraulics issues.

New Publications of Interest

The ERDC library recently posted ERDC/CHL TR-14-7, *North Atlantic Coast Comprehensive Study Phase I: Statistical Analysis of Historical Extreme Water Levels with Sea Level Change*, by Norberto C. Nadal-Caraballo and Jeffrey A. Melby.

The study summarized in this report was conducted as a task within the North Atlantic Comprehensive Coastal Study (NACCS) and encompasses the coastal region from Virginia to Maine. The main objective of this effort is to obtain first-order estimates of storm-induced water level statistics at locations along the U.S. North Atlantic coast. Statistics were computed based solely on verified water level measurements provided by the National Oceanic and Atmospheric Administration's (NOAA) National Oceanic Service Center for Operational Oceanographic Products and Services, excluding any kind of high-resolution hydrodynamic modeling. Tropical and extratropical storms were treated as a single population. Water level distributions were computed using Monte Carlo methods with and without sea level change scenarios. The report is available at http://acwc.sdp.sirsi.net/client/search/asset/1040568. (POC: Jeff Melby, Jeffrey.A.Melby@usace.army.mil)

A Design Manual for Engineering With Nature Using Native Plant Communities by Dr. Pamela Bailey, ERDC EL, has recently been published.

Plant communities in the built environment can provide structure, function, and natural processes to create a sustainable landscape. Managed lands provide many native plant communities. Incorporating these plants into design features can reduce construction and maintenance costs while increasing benefits to the environment. Plants are often “keystone” species – important for many ecological processes and holding entire ecosystems together. Using plant communities is a shift in emphasis, away from a fixed design held at a static moment, to a dynamic design allowing for these communities to grow and mature over time. Plant communities not only

survive, but are adaptable to changing environmental conditions. This design manual identifies and documents the use of native plants to provide engineered design elements that consider the diverse range of Corps' water resource projects. The goal of this manual is to describe how to utilize plant communities within the built environment to create sustainable landscapes. Design and scientific components are blended together into a holistic approach, so this manual is accessible to people with varied professional backgrounds. (POC: Pamela Bailey, Pamela.Bailey@usace.army.mil)

Other Links – Information, Newsletters, Fun Stuff

The USACE 2014 Climate Change Adaptation Plan was officially cleared for release on 31 October 2014 by OMB and CEQ. A news story and link to the document are available at http://www.iwr.usace.army.mil/Media/NewsStories/tabid/11418/Article/547619/usace-2014-climate-change-adaptation-plan-released.aspx.

FRM Statements of Need: Submitting "Statement of Need" is the first step in the process of a concept becoming a requirement for research and development. If USACE District personnel have problems or situations they feel should be addressed by research, the Flood Risk Management Gateway, http://operations.usace.army.mil/flood.cfm, is the place to submit these research Statements of Need (SoNs).

Past issues of this newsletter, various links, news items, and presentations, are all available on the Flood Risk Management Gateway, http://operations.usace.army.mil/flood.cfm. Check it out!

Climate Change Newsletter: An online newsletter produced by the U.S. Army Corps of Engineers as an unofficial newsletter under the provisions of AR 360-1, to provide information about USACE climate change adaptation issues, policies, tools, and methods. It is available at http://www.corpsclimate.us/cca.cfm. Click on the 'Latest News' in the left column, then look in the right-hand column for the newsletter link.

CIRP Newsletters are available at http://cirp.usace.army.mil/ in the "Publications" drop-down.

The Silver Jackets website, with newsletters – http://www.nfrmp.us/state/.

Flood Risk Management Program (FRMP) – http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram.aspx.

CEIWR-HEC newsletter - http://www.hec.usace.army.mil/newsletters/HEC_Newsletter_Summer2014.pdf.

The National Ocean Council's portal for data, information and tools supports planning for the future of the ocean, our coasts, and the Great Lakes. This site hopes to become a one-stop hub to support planners and to provide useful information to the public – http://www.data.gov/ocean.

The U.S. Department of Interior periodically releases its newsletter, "Newswave." The Summer issue was released in September, http://www.doi.gov/pmb/ocean/news/Newswave/index.cfm. The site also contains archived issues. All are available on the DOI Ocean, Coasts & Great Lakes Activities homepage at the above link.

SELECT FY15 PROSPECT COURSES

FY15 Prospect Courses		
Streambank Erosion and Protection	Vicksburg, MS	23-27 March 2015
Risk Analysis for Flood Damage Reduction Projects	Davis, CA	26-30 January 2015
Dam Safety	Grenada, MS	2-5 February 2015
	Grenada, MS	2-5 March 2015
	Grenada, MS	30 March-2 April 2015
	Branson MO	4-7 May 2015
	Royal, AR	8-11 June 2015
Wetland Development and Restoration	Apalachicola, FL	23-26 February 2015
Coastal Project Planning	Duck, NC	27 April-1 May 2015
	Duck, NC	4-8 May 2015
Risk Communication and Public Involvement	Huntsville, AL	21-23 April 2015
Wetland Stream Ecology Basic	Kalispell, MT	17-20 August 2015
Wetland Development and Restoration	Olympia, WA	31 August-2 September 2015
Wetland River Function/Ecology	Kalispell, MT	6-9 October 2015

FY15 Purple Book course listings and schedules – http://ulc.usace.army.mil/

Calls for Abstracts

National Hydrologic Warning Council – 16-18 June 2015 – Indianapolis, IN

The need for hydrologic information and decision-making tools is growing. The National Hydrologic Warning Council (NHWC) holds a biennial conference focused on these needs with the next being held 16-18 June 2015 in Indianapolis from June. This is the largest conference of its kind in the United States, devoted specifically to real-time hydrologic warning systems and how these systems and associated technologies assist local officials with hydrologic hazard preparedness, emergency response, recovery, and mitigation. Abstracts and biographies must be submitted by 23 **January 23 2015** online at www.hydrologicwarning.org/abstracts. Authors will be notified of their acceptance by the NHWC agenda committee no later than 15 February 2015. NHWC is a non-profit professional member association dedicated to assisting emergency and environmental management officials on the use of real-time, high quality hydrologic information from automated remote data systems, with the goals of protecting lives, property, and the environment.

PIANC-COPRI ASCE – Dredging 2015 – Moving and Managing Sediments
19-22 October 2015 – Savannah, GA

Continuing the tradition of excellence, PIANC USA and the Coasts, Oceans, Ports and Rivers Institute of ASCE (COPRI) are proud to offer the next installment of the successful conference series on dredging and dredged material placement. Dredging 2015 is a four-day technical specialty conference which will bring together professionals and practitioners from all parts of the world to discuss a broad spectrum of topics related to dredging. The theme for Dredging 2015, Moving and Managing Sediments, encourages presentations on all types of dredging projects from navigation channel deepening and maintenance to environmental restoration to the development of new ports and marinas. Deadline for abstract submissions is **15 January 2015**. On-line abstract submission is required, at http://pianc.sites.usa.gov. Simply follow the instruction on the site. Each abstract must be written in English and is limited to 300 words (should NOT include graphics/figures). Only the conference presentation is required. Papers are not necessary and will not be requested.

Conferences

This listing is for information only and is not a complete list of FRM-related meetings. These meetings are not endorsed by the Corps of Engineers unless specifically stated. If we have failed to list a conference/meeting/symposium that would be of interest to the Flood Risk Management community, please forward the conference details to us.

4-8 January 2015 – American Meteorological Society – Phoenix, AZ - http://annual.ametsoc.org/2015/index.cfm/registration/

13-14 January 2015 – International Conference of Flood Resilience – ICFR – 2015 – Zurich, Switzerland - https://www.waset.org/conference/2015/01/zurich/ICFR

4-5 February 2015 – ASDSO Emergency Action Planning for Dam Safety – Phoenix, AZ – http://www.damsafety.org/conferences/?p=2c64e9da-f8ea-4af7-bb3c-0351c0108865

23-25 February 2015 – International LiDAR Mapping Forum – Denver, CO – http://annual.ametsoc.org/2015/index.cfm/registration/

27-28 February 2015 – 7th World Water Forum – Gyeongju, Republic of Korea – worldwaterforum7.org

2-5 March 2015 – 2015 Tropical Cyclone Research Forum (TCRF)/69th IHC – Charleston, SC

2-6 March 2015 – IEEE/OES 11th Current, Waves and Turbulence Measurement Workshop (CWTM) – St. Petersburg, FL - http://www.cwtm2015.org/index.cfm

6-8 March 2015 – 5th International Conference on Water and Flood Management – Dhaka, Bangladesh - http://forum.susana.org/forum/categories/21-events/8413-5th-international-conference-on-water-and-flood-management-6-8-march-2015-dhaka-bangladesh

23-24 March 2015 – National Flood Determination Association – 18th Annual Conference – Scottsdale, AZ - http://www.nfdaflood.com/conferences-events/

30-31 March 2015 - 3rd IMA International Conference on Flood Risk – Swansea, Wales, UK - http://physicsworld.com/cws/event/2015/mar/30/3rd-ima-international-conference-on-flood-risk

30 March - 2 April 2015 – 2015 National Hurricane Conference – Austin, TX – http://hurricanemeeting.com/

19-23 April 2015 – SEDHYD 2015 – 10th Federal Interagency Sedimentation Conference & 5th Federal Interagency Hydrologic Modeling Conference – Reno, NV - http://www.sedhyd.org/2015/

27-28 April 2015 – Global Water Summit: The Water Value Revolution – Athens, Greece – http://www.watermeetsmoney.com/

4-7 May 2015 – Offshore Technology Conference – Houston, TX - http://2015.otcnet.org/

11-14 May 2015 – Coastal Sediments 2015 – San Diego, CA – http://coastalsediments.cas.usf.edu/

12-14 May 2015 – 2nd National Adaptation Forum – St. Louis, MO – http://ecoadapt.org/programs/awareness-to-action/national-adaptation-forum

17-20 May 2015 – National Flood Conference – Washington, DC – http://pcievents.cvent.com/events/national-flood-conference/event-summary-a9531dd9e9e7459b8409e3442669a1db.aspx

18-21 May 2015 – MTS/IEEE Oceans 2015 – Genova, Italy - http://www.oceans15mtsieeegenova.org/index.cfm

20-22 May 2015 4th International Conference on Disaster Management and Human Health: Reducing Risk, Improving Outcomes – Istanbul, Turkey – http://www.wessex.ac.uk/15-conferences/disaster-management-2015.html

31 May – 4 June 2015 – 2015 Society of Wetland Scientists: Changing Climate; Changing Wetlands – Providence, RI - http://www.sws.org/

31 May – 4 June 2015 – Canadian Meteorological and Oceanographic Society – CMOS 2015 – Whistler, British Columbia, Canada - congress.cmos.ca

31 May – 5 June 2015 – Association of State Floodplain Managers – Atlanta, GA – http://asfpmconference.org/

3-5 June 2015 – 10th International Conference on Ecosystems and Sustainable Development – Valencia, Spain – http://www.wessex.ac.uk/15-conferences/ecosud-2015.html
15-17 June 2015 – Water Resources Management 2015 - 8th International Conference on Sustainable Water Resources Management, A Coruña, Spain – http://www.wessex.ac.uk/15-conferences/water-resources-management-2015.html

15-18 June 2015 – NHWC 2015 Training Conference & Exposition – Indianapolis, IN – http://hydrologicwarning.org/content.aspx?page_id=22&club_id=617218&module_id=148677

17-19 June 2015 – River Basin Management 2015 – 8th International Conference on River Basin Management - A Coruña, Spain – http://www.wessex.ac.uk/15-conferences/river-basin-management-2015.html

7-9 July 2015 – Coastal Cities 2015 – International Conference on Coastal Cities and their Sustainable Future – New Forest, UK – http://www.wessex.ac.uk/15-conferences/coastal-cities-2015.html

15-17 July 2015 – Water and Society 2015 – 3rd international Conference on Water and Society – A Coruna, Spain – http://www.wessex.ac.uk/15-conferences/water-and-society-2015.html

9-11 September 2015 – Coastal Structures '15 – Boston, MA – TBA

13-15 October 2015 – Meteorological Technology World Expo 2015 – Brussels, Belgium – http://www.meteorologicaltechnologyworldexpo.com/

19-22 October 2015 – MTS/IEEE Oceans '15 – Washington, DC - http://oceans15mtsieeewashington.org/

21-23 October 2015 – Marine Technology 2015 –Novorossiysk, Russia - http://www.wessex.ac.uk/15-conferences/marine-technology-2015.html

17-22 July 2016 – 35th International Conference on Coastal Engineering (ICCE) – Istanbul, Turkey – http://www.icce2016.com/en/

September 2020 – 37th International Conference on Coastal Engineering (ICCE) – Sydney, Australia

Subscribe – Unsubscribe – Feedback

To subscribe/unsubscribe: *http://operations.usace.army.mil/flood.cfm*

We would love your input – recommended article length is ½ to 1 page. Articles should be submitted to Doyle L. Jones, Canvassing Editor, Doyle.L.Jones@usace.army.mil.

We would also appreciate your feedback. Contact Dinah McComas, Managing Editor, Dinah.N.McComas@usace.army.mil or Doyle Jones.