

U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

BACKGROUND

The research and development (R&D) laboratories of the U.S. Army Corps of Engineers (USACE) have served the Corps, the Army, and the Nation with technical accomplishments in a variety of engineering and scientific fields for almost 80 years. From its beginnings in 1929 as a small hydraulics laboratory established in Vicksburg, MS, to assist in developing a comprehensive plan for flood control of the Mississippi River, the Engineer Research and Development Center (ERDC) has evolved into a world-class R&D organization with the expertise needed to solve complex civil engineering and environmental science challenges for the Corps. ERDC is headquartered in Vicksburg, MS, and offers a centrally managed center of seven unique laboratories located in Illinois, Mississippi, New Hampshire, and Virginia.

At the close of FY 2008, ERDC had 1613 full-time permanent employees of whom 998 are highly trained engineers and scientists. The full-time permanent professional staff encompassed 279 Ph.D. and 421 Master's degrees.

In FY 2008, ERDC executed a Civil Works program totaling \$103 million. Of this total, \$ 70.5 million was executed in direct-allotted programs, with \$40 million in R&D programs and \$30.5 million in data acquisition, demonstration, study, and technical support programs. The remaining \$32.5 million was executed in support of USACE District and Division offices.

LABORATORIES

The diverse civil engineering and environmental quality R&D center consists of seven centrally managed laboratories located at Alexandria, VA; Champaign IL; Hanover, NH; and Vicksburg, MS. With world-renowned expertise and facilities, each laboratory adds a unique perspective and set of capabilities to the overall ERDC team. Following are brief descriptions of the ERDC laboratories.

Coastal and Hydraulics Laboratory

The Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS, is the Nation's center for engineering and scientific R&D in the coastal, hydraulic, and hydrologic engineering and sciences. CHL conducts research and supports the Corps of Engineers in conducting its navigation, flood and coastal storm damage reduction, environmental restoration, and military engineering missions. CHL is comprised of nationally and internationally recognized experts that perform research and site-specific investigations in the fields of erosion control design; navigation engineering; channel design; fisheries engineering; sediment transport; estuarine engineering; dredging; hydrodynamics; groundwater, watershed, surface water, coastal, and ocean modeling; coastal storm and flood damage protection; harbor design and modification; coastal and hydraulic structures; physical processes associated with water resources; environmental problems; military logistics-over-the-shore; wave climatology; and hydroinformatics.

Cold Regions Research and Engineering Laboratory

The Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH, maintains the finest research and engineering staff and facilities in the world for the study of cold regions science and technology. CRREL is recognized for its internationally known experts in the field of ice jam flooding and ice-hydraulics; ice control at locks, dams, and other navigation channels; snowmelt modeling and simulation; and other areas ranging from geotechnical aspects of frozen ground to new admixtures for placing concrete in the winter. CRREL's specialized research facilities include a complex of cold rooms, an Ice Engineering Facility housing three special-purpose research areas, a large low-temperature towing tank, a refrigerated flume for modeling rivers, and a large hydraulic model room. CRREL is also home to the U.S. Army Corps of Engineers Center of Expertise for Civil Works Remote Sensing/Geographic Information Systems.

Construction Engineering Research Laboratory

The Construction Engineering Research Laboratory (CERL), Champaign, IL, provides construction research to address the entire spectrum of issues within military construction. This research supports sustainable military installations and encompasses construction, operations, and maintenance as well as environmental and safety concerns. These technologies have universal application and are of value in the Civil Works arena as well. Civil Works efforts are in the areas of corrosion control, high-performance protective coatings (including overcoating of lead-based paint), management tools for Operation and Maintenance optimization, environmental compliance, and environmental sustainment.

Environmental Laboratory

The Environmental Laboratory (EL), Vicksburg, MS, is the problem solver for the Corps and the Nation in environmental science and engineering research and development in support of environmental systems. The staff supports the environmental missions of the U.S. Army, the Department of Defense, and the Nation through research, development, special studies, and technology transfer. EL research includes a network of expertise and facilities from the ERDC Laboratories, other government agencies, academia, and private sector.

The laboratory conducts multi-disciplinary research in environmental quality and ecosystem restoration. EL's research activities consist of evaluating and projecting the consequences of water resources development, navigation, and dredging on the environment; assessing and restoring wetlands; evaluating and modeling inland and oceanic water quality; guiding stewardship of natural resources; developing tools for cleanup of contaminated groundwater and soils; developing techniques to improve stream and riparian restoration; accelerating growth of desirable vegetation/habitat; implementing risk and decision frameworks in planning; applying biological, chemical, and physical control agents to manage nuisance and invasive aquatic plants; applying risk-based contaminated sediment and soil toxicological assessment protocols; and performing upland disposal testing and assessment for dredged material.

Geotechnical and Structures Laboratory

The Geotechnical and Structures Laboratory (GSL), Vicksburg, MS, conducts research in soil and rock mechanics, earthquake engineering and geophysics, tunneling and trenchless technology, engineering geology and seismology, vehicle mobility and trafficability, unexploded ordnance detection, and pavement technology. The laboratory also determines the response of structures to weapons effects and other loadings, investigates methods for making concrete and other materials more durable and economical, studies the application of explosives technology to military and civilian engineering, and investigates the behavior of earth/structure systems subjected to blast loading and projectile penetration. GSL is a world leader in research on effects of earthquakes on embankment dams and the evaluation, maintenance, and rehabilitation of mass concrete and steel and reinforced structures.

Information Technology Laboratory

The Information Technology Laboratory (ITL), Vicksburg, MS, advances, applies, and delivers information technologies that address a wide range of engineering, scientific, and management challenges. ITL manages one of the six DoD Supercomputing Resource Centers formed under the auspices of the DoD High Performance Computing Modernization Program. ITL also manages the Computer-Aided Design and Building Information Modeling (CAD/BIM) Technology Center, a multi-agency vehicle to coordinate CAD/BIM activities within DoD. ITL is highly recognized for its expertise in the areas of Facilities Management technologies required by Army Civil Works projects; computer-aided interdisciplinary engineering and analysis; software engineering and informatics; scientific visualization; support to R&D and application efforts requiring sensor and instrumentation technologies; and library and information systems science services and collaborative technologies.

Topographic Engineering Center

The Topographic Engineering Center (TEC), Alexandria, VA, provides new topographic capabilities in geospatial science to the Corps of Engineers to ensure superior implementation of the Nation's civil and environmental initiatives through research, development, and application of remote

sensing; geographic information; global positioning; and topographic, hydrographic, and information technologies. TEC scientists and engineers continue to develop faster, more accurate, and cost-effective ways to use new remote sensing technologies to describe, characterize, and analyze the surface of the earth. Remote sensing technologies form an essential part of a new national approach to infrastructure engineering and environmental stewardship.

ARMY CIVIL WORKS R&D PROGRAMS

The Army Civil Works R&D Program is formulated to directly support the established business lines of the Civil Works Program, including flood and coastal storm damage reduction, inland and coastal navigation, environment (including natural resources, compliance, mitigation, and restoration), water supply, hydropower, recreation, emergency management, and regulatory.

Civil Works R&D needs and requirements are identified based on the current Civil Works Program Strategic Plan, Corps Division and District input, and existing authorities under the Water Resources Development Act. The R&D effort is a problem-solving process by which the Corps systematically examines new ideas, approaches, and techniques and develops field-ready products to reduce costs and improve quality of its planning, design, construction, and operations and maintenance (O&M) activities in an environmentally sustainable manner. In order to most effectively use the limited R&D resources and to avoid unnecessary duplication of research effort, the Civil Works R&D Program maintains external technical exchange and technology transfer efforts with other federal and major water resource agencies, International Boundary Water Commission, International Joint Commission, the Navy, and state and local governments.

Most of the activities that comprise R&D are funded out of the Investigations Appropriations. Other R&D activities are funded out of the Operations and Maintenance Appropriations and Construction Appropriations. Under the Investigations R&D program, the primary business lines supported by R&D include Navigation, Flood and Coastal Storm Damage Reduction, and Environmental Restoration. Additional research serves to cut across and support all business lines. In particular, the System-Wide Water Resources

Program serves multiple business needs. The major R&D program areas are described in further detail below.

Other activities performed by ERDC are in the category defined as technical support, technology transfer, data collection and processing, or demonstration activities. These efforts play a vital role in the overall R&D process by ensuring new technologies are validated and fully deployed to the primary users, the Corps Districts. Descriptions of the major efforts in this category follow the R&D program descriptions.

Navigation Systems Research Program

The Corps provides inland and coastal navigation capability essential to the national economy and defense. Corps projects also provide 25% of the Nation's hydropower. The Navigation research area is funded under the Investigations appropriation. Navigation research, which includes hydropower, delivers tools and guidance essential for improved reliability, increased efficiency, and sustainable increased capacity of the complex and aging transportation/power network. The Navigation research framework integrates water dynamics, infrastructure mechanics, advanced materials, power physics, economics, innovative construction, coastal and riverine processes, automated control and monitoring, remote sensing, operations research, stochastic processes, and emerging technologies to produce effective solutions for the multiple demands, requirements, and constraints of real world commodity transport and power production problems. Research efforts target navigation channels, locks, jetties, breakwaters, dams, and power plants to facilitate improved asset management of navigation and hydropower infrastructure. Research includes techniques for optimizing life-cycle and reliability trade-offs (ensuring defensible economic assessment), providing better investment decision tools for predicting performance and deterioration with time, and scheduling and prioritizing maintenance and repairs balanced with the consequences of delays.

Accomplishments in FY 2008 include:

- Developed the Integrated Survey System (ISS), a combination of an abovewater laser and an interferometric multi-beam hydrosurvey system to allow rapid, cost effective, and safe assessment of coastal

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navigation structures and adjacent navigation channels.

- Developed computational modeling capability for wave/structure interaction to aid in design of coastal and hydraulic structures, including wave breaking on flexible and porous structures to provide the most functional and low cost design alternatives.
- Improved accuracy for assessing environmental impacts of navigation on inland waterways modeling vessel-generated currents and sedimentation required to estimate channel erosion and off-channel deposition.
- Developed innovative concept for energy-absorbing bull-nose, which has the potential to greatly reduce loss of life and property damage to Corps navigation dams by preventing breakup of barge trains following bull-nose impact.
- Developed method to assess rapid closure of locks and dams during emergency situations to reduce navigation closures and ensure project safety.
- Developed computational modeling capability for coupled vessel motion and two-phase Reynolds-Averaged Navier-Stokes flows to predict vessel and vessel-generated dynamics to provide decision support for selecting project design alternatives that will serve both project and environmental needs.
- Improved lock approach wall design and construction, with reduced costs, by expanding the newly developed structural design methodology with additional types of flexible reinforced concrete walls to accommodate different foundation soil conditions.
- Completed a series of controlled Barge Impact Experiments on an instrumented flexible approach wall system to obtain experimental information that provided empirical data on the impact force time history; and the relative motion of the structural elements making up the flexible wall system so that reliable designs can be developed at the lowest cost.
- Improved methods for justifying improvements to federal navigation project by providing the ability to address issues of

multimodal (barge, rail, truck) competition with the finalization of the beta version of the Regional Routing Model.

- Completed the beta version of the Navigation System Simulation Model that provides the Corps with the ability to conduct river system scale lock repair and rehabilitation optimization over time while considering reliability.
- Modified the Ohio River Navigation Investment Model (ORNIM) to incorporate shipper response into the ORNIM suite as a beta testing version as suggested by the National Academy of Science to enhance regional planning of lock improvements.
- Improved economic justification procedures for inland navigation projects by providing the Corps with the ability to perform commodity forecasts that account for competition between markets and alternative modes of transportation by generalizing in a beta version the techniques demonstrated in the Global Grain Model.

Flood and Coastal Storm Damage Reduction Research Program

This R&D activity is funded under the Investigations appropriation. As part of its “Flood and Coastal Storm Damage Reduction” mission, the Corps of Engineers is responsible for more than 600 dams, operates over 400 major lakes and reservoirs, maintains 8,500 miles of levees, and has over 100 coastal storm damage reduction and related projects. Flooding that occurs in the United States costs about \$4 billion annually. Despite all efforts, annual damages in the flood plain continue to rise due to continued urban development. In addition, the 2000 census showed that more than 50% of the U.S. population lives within 50 miles of a coast and is vulnerable to dangerous coastal storms and costly flooding. Consequently, over the past several years, federal coastal storm damage reduction expenditures increased to more than \$100 million per year to protect the public and related economic investments.

In managing flood and coastal storm damage reduction projects around the country for the public’s safety and benefit, the Corps is challenged to simultaneously optimize additional requirements for navigation, hydropower, water supply, environmental stewardship, and recreation while maintaining

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sustainable and adaptable watersheds. The Corps must have the most advanced capability to conduct risk-based assessments of alternative project designs and operational scenarios; those capabilities must be robust, reliable, and comprehensive; and they must lead to sustainable solutions.

R&D delivers efficient and effective capabilities to plan, design, construct, operate, maintain, and improve water resources projects in all climates and settings, from warm to ice-affected, and from inland to coastal. Capabilities to prevent loss of life, minimize property damage, and reduce the life-cycle costs of projects are critical. Capabilities include advanced processes and design models, economic models and decision support software, infrastructure condition and risk assessment tools, infrastructure design guidance, innovative operation and maintenance technologies, flood-alert instrumentation, expedient emergency response capabilities, and the capability to take advantage of new real-time data sources (e.g. precipitation radar) to accurately forecast real-time flow and stages.

In FY08, Actions For Change identified several of the Corps' highest priority research needs associated with flood risk management. These priority research activities were included in the program development process, with I-wall stability, effects of levee vegetation on structural stability, and system-scale coastal storm simulation improvement initiating in FY 2008.

Accomplishments in FY 2008 include:

- Expanded capabilities of existing hydraulics and hydrology models applied in watershed studies and water supply operations by fielding an operational snow database available via Corps Water Management System, and a new version of reservoir simulation model that simulates optimization of management alternatives for multiple reservoirs and improved real time forecasting for emergency management operations.
- Provided initial version of a modeling framework to practitioners in the field that integrates standard hydraulic and hydrologic models to improve efficiency and accuracy of multipurpose water resources studies including water supply, flood damage reduction, and environmental restoration.
- Integrated advanced geospatial methods for mapping hydrologic, hydraulic, and

sediment transport processes and improving hydrologic frequency analysis that improve efficiency of watershed, floodplain, and dam break studies.

- Prioritized the rollup of Screening Portfolio Risk Assessments (SPRA) of Corps dams, and trained SPRA national teams in conducting assessments to support corporate ranking of infrastructure investments that best reduce public risk.
- Completed development of initial versions of six Dam Safety Portfolio Risk Assessment engineering toolboxes for individual project structural components and extremal hydrologic event analysis, with plans to transition engineering products for implementation by the Dam Safety Methodology Team in FY 2009.
- Completed the corporate Planning Model Improvement Program certification process for a newly developed and operational integrated coastal engineering-economics model that enables the practitioner to conduct project-level alternative measure life-cycle analyses, adaptive management scenario evaluations, and risk-based asset management in a standardized manner.
- Included the capability in standardized flood impact analysis software to evaluate life-loss associated with a specified flood event, enabling the Corps to more effectively determine flood damage reduction benefits attributed to individual flood-control projects, and to provide information relevant to preserving life safety during real-time emergency response activities by including the capability as part of the Corps Water Management System.
- Demonstrated real-time access to levee infrastructure components during 2008 Mississippi River flood event through newly developed in situ monitoring and remote communications technologies that increase accuracy of measured field parameters (e.g., levee seepage) and reduce reporting time of measured and field-analyzed information to water managers from weeks or days to hours. Technologies are targeted for application via the Corps Water Management System.
- Improved the efficiency of upward reporting of data relevant to emergency management decision making associated with flood

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damage infrastructure from days to hours by integrating national databases and automated information systems. Integration of the Levee Monitoring Utility, Corps Water Management System, National Levee Database, and EngLINK made use of innovative and state-of-the-art geographic information systems, hydrologic and hydraulic modeling capabilities, levee and embankment dam condition assessments, and real-time data collection and visualization that automatically satisfies end user reporting requirements.

- Provided engineering application and planning guidance documents and training to practitioners tasked with implementing channel grade and bank stabilization structures associated with flood damage reduction and environmental restoration projects in ice-affected rivers and urban settings. Guidance for these non-traditional measures result in structures that are more economically and environmentally sustainable over the project lifecycle.
- Conducted a joint UK-US Interagency workshop on national comprehensive flood risk assessment methods.

Ecosystem Management and Restoration Research Program

This R&D activity is funded under the Investigations appropriation. Ecosystem Restoration is a growing focus of the Corps' Civil Works program, ranging from large-scale projects such as the Everglades to smaller, localized ecosystem restoration projects. In addition, the Corps carries out environmental and natural resource management and restoration activities on more than 11 million acres of land and water resources. The goal of this R&D is to provide Corps field personnel with cost-effective/innovative technologies for project planning, design, construction, O&M, and regulatory activities. Product lines include: Environmental Benefits Analysis, Ecosystem Functional Evaluation, Ecosystem Restoration, and Environmental Stewardship and Management. Products are concise, how-to guidance documents that provide rapid/low-cost technologies and methods for high-priority field needs. This technology is critical to the success of the Corps' Continuing Authorities Program (CAP) as well as larger Investigations-funded projects.

Accomplishments in FY 2008 include:

- Provided validation of post-project benefits of restoration projects in large watersheds.
- Provided GIS desktop tools for support, integration, and display of environmental benefits assessment model results.
- Provided a suite of tools for improved natural resource inventories on Corps lands and waters.
- Evaluated potential for applying the habitat equivalency analysis technique to Corps ecosystem restoration projects.
- Provided Technical Note series related to coupling physical process models with environmental analysis.
- Initiated development of a Corps web site for ecosystem restoration and environmental benefits analysis.
- Developed metric sets for assessing benefits from ecosystem restoration projects.
- Evaluated the application of conceptual models to ecosystem restoration and benefits analysis.
- Developed standards of practice for applying professional judgment in ecosystem restoration projects.
- Developed an ecosystem restoration output annualizer tool
- Developed interim guidelines for the use of reference procedures for environmental benefits analysis.
- Developed guidance for incorporation of environmental services in Corps planning.

System-Wide Water Resources Research Program

This R&D activity is funded under the Investigations appropriation. The goal of the System-Wide Water Resources research area is to support all business lines of the Corps of Engineers and its partners by providing the capabilities to balance human development activities with the natural system in a sustainable manner through regional management and restoration of the Nation's water resources over broad temporal and spatial scales.

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The capabilities provided herein include science-based water resource management methodologies, implementation guidance, computational frameworks and technologies, and decision support. These capabilities are being built from sound scientific principles reflecting an improved understanding of inter-relationships among key system attributes such as hydrology, geomorphology, chemistry, ecology, and socioeconomic. Capabilities are being served via a seamless, integrated architecture allowing projects to be considered at multiple scales during project planning, design, construction, and operation and maintenance.

Accomplishments in FY 2008 include:

- Delivered enterprise data visualization tools to 12 Districts, 4 Divisions, and 5 stakeholder groups for complex data exchange and viewing of high resolution imagery, critical landscape features, and time series model output.
- Delivered five watershed assessment tools to the field with applications in all District planning studies, runoff analysis, and system-level assessments.
- Delivered three riverine analysis tools that are used in all of the Districts for water control, water quality, sediment budget, and ecosystem studies (e.g., Columbia, Snake, Cowlitz, and Truckee Rivers).
- Demonstrated connectivity of 1D and 2D hydrodynamic models to allow large-scale assessments with different levels of modeling complexity.
- Demonstrated multi-dimensional hydrodynamic models and selected ecological models for habitat restoration studies (e.g., Upper Mississippi River and Chesapeake Bay) and operational assessments (e.g., Upper Mississippi River).
- Delivered the SubSurface Toolkit that provides 2D and 3D seepage analysis using a variety of subsurface and modeling tools.
- Developed complex surface water and groundwater interaction algorithms and incorporated them into multi-dimensional models. Initiated applications for Aquifer Storage and Recovery studies in South Florida.
- Demonstrated prototype decision support system for efficacy analysis of ecosystem restoration project alternatives in complex river systems (e.g., the Upper Mississippi, Missouri, and Rio Grande Rivers).
- Demonstrated large-scale data acquisition tools for complex watershed studies (e.g., Western States, arid region).
- Developed a suite of parameter estimation tools for multi-dimensional models and reducing uncertainty.
- Demonstrated data fusion technologies (combined sensors) for large-scale ecological assessments for estuarine and coastal areas and impacts related to water resource management activities (e.g., New England coast).
- Continued refinement of coupled multi-dimensional hydrodynamic models and ecological response models for more accurate forecasting of near-term and future conditions as a result of water resource management and ecosystem restoration alternatives (Pool 5 Upper Mississippi River).
- Developed applications of multi-dimensional hydrodynamic models that quantify nutrient and sediment transport at multiple spatial scales in watersheds (e.g., Eau Galle, WI, and Auglaize, OH).
- Demonstrated standardized data acquisition and management techniques for more efficient watershed and aquatic systems assessments (e.g., the Everglades and coastal Louisiana).
- Demonstrated coupled hydraulic and an agent-based fish model for sturgeon habitat assessment in the Mississippi River.
- Demonstrated coupled multi-dimensional surface water, groundwater, and vegetation modeling in complex watershed (Cibola River Basin, Texas). Developed a "lite" version for planning studies.
- Continued development of the coastal storm surge modeling system (MORPHOS).
- Developed improved sediment transport kinetics for one-, two-, and three-dimensional hydraulic models for more accurate estimates of sediment movement in rivers and estuaries.

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- Demonstrated innovative approaches (e.g., combined hyperspectral, thermal, and visual) remote sensing technologies for ecosystem assessments (e.g., coastal Mississippi, Louisiana, and Texas).
- Demonstrated/tested three-dimensional hydrodynamic modeling of salinity using an adaptive hydraulics grid for more accurate predictions of water movement and material transport in estuarine and coastal environments.
- Demonstrated barrier island morphological assessments and piping plover habitat impacts associated with morphology changes (e.g., Fire Island, New York)
- Developed alpha version of connected one- and two-dimensional reservoir models for operational and water quality assessments. Application on the Detroit River tributary to the Willamette River.
- Demonstrated the Habitat Evaluation and Assessment Tools (HEAT) in five studies in complex riverine systems (e.g., Middle Rio Grande, Missouri, River, and the Upper Des Plaines Rivers)
- Released three aquatic plant growth simulation models for freshwater species and demonstrated simulation in studies in the Upper Mississippi and Illinois Rivers.
- Developed the Conceptual Model Builder for construction of two- and three-dimensional numerical models

Urban Flood Damage Reduction and Channel Restoration Development and Demonstration Program for Arid and Semi-Arid Regions, New Mexico and Nevada

This R&D activity is funded under the Investigations appropriation. The program purpose is to develop and demonstrate innovative techniques to address severe urban flooding and channel restoration issues unique to the arid and semi-arid regions of the southwestern United States. The program is a collaborative effort between the Corps of Engineers, the Desert Research Institute of Nevada, and the University of New Mexico. The topics have been selected with input from the Corps' field personnel, along with state and local stakeholders.

Accomplishments in FY 2008 include:

- Held a 1-day Independent Technical Review (ITR) at the Floodplain Managers Conference. The program's technical activities were reviewed including applications of tools for arid-region hydraulics and hydrology, post wildfire hydrology, studies into related arid-region processes, and flood-control channel restoration performance. Approximately 50 floodplain managers attended the review sessions. The South Pacific Division, Los Angeles and Albuquerque Districts, and regional stakeholders had the opportunity to comment on the work and make recommendations for new areas of study. Fact sheets for each project have been posted on the Web.
- Held workshops at the American Society of Floodplain Managers Conference (Reno, NV; May 2008) and at the Floodplain Managers Annual Conference (San Diego, CA; September 2008) on the tools for arid regions flood damage reduction and restoration to transfer knowledge and capabilities. These tools were developed from work units under the program. Approximately 100 people participated in each workshop, with opportunities to provide feedback on the tools. Attendees included representatives from flood control districts, state and federal agencies, and other Corps personnel.
- Studied vegetation-hydrodynamic interactions in flood control channels. Within many flood control channels in the Southwest, vegetation has become established, reducing the channels' conveyance capacity below the original objectives and greatly increasing the risk for loss of lives and property damage in the case of large flood events. This research will provide analytical techniques that predict the impact of vegetation wash-out on flood-channel conveyance. In FY 2008, field data were collected at three sites on the forces required to uproot vegetation. The data will be used in an analytical tool for District use. No analytical method currently exists. The project was identified as a high priority research need by the USACE's Los Angeles District, and the work is being coordinated with District engineers and regional stakeholders. This information will improve

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the Corps' ability to provide adequate flood control channel and levee capacity. It will support engineering design in the areas of levee safety and flood damage risk reduction.

- Documented design criteria for stone toe streambank protection in Las Vegas Wash. Over the last 50 years, Las Vegas Wash has undergone severe channel bed degradation and bank erosion causing the channel planform to change, wetlands to diminish, and water quality to decline. Over 17,000 linear feet of severely eroding streambank have been stabilized. The lessons learned from this site are being used to improve the design criteria for longitudinal stone toe protection. Improved design criteria for stone toe protection have regional and national benefits for this cost-effective, successful, and environmentally acceptable bank stabilization measure.
- Held an interagency technical workshop on "Wildfire Impacts on Watershed Hydrology" (June, 2008) in Las Vegas. The workshop was attended by approximately 25 leaders in the field, representing seven federal agencies and three academic institutions. The workshop was initiated in response to a request from Los Angeles District to address regional issues raised in the completed Virgin River Watershed Study, one of the five HQUSACE comprehensive planning studies. Information was shared at the workshop on analysis methods for post-wildfire hydrologic computations, and potential next steps to improve methods and processes were identified. The proceedings are under review and will be published in FY 2009. In another section of this project, several hydrologic models are being tested on historic data from the San Dimas National Forest.

Southwest Urban Flood Damage Program (SWDP), New Mexico

This R&D activity is funded under the Investigations appropriation. The program purpose is to develop and demonstrate innovative techniques to address severe urban flooding and channel restoration issues, and is a collaborative effort between the Corps of Engineers, University of New Mexico, and Sandia National Laboratories.

Accomplishments in FY 2008 include:

- A 1-day Independent Technical Review (ITR) was held at the Floodplain Managers Conference (San Diego, CA; September 2008). The program's technical activities were reviewed that included applications of tools for arid-region hydraulics and hydrology, post wildfire hydrology, studies into related arid-region processes, and flood-control channel restoration performance. Approximately 50 floodplain managers attended the review sessions. The South Pacific Division, Los Angeles and Albuquerque Districts, and regional stakeholders had the opportunity to comment on the work and make recommendations for new areas of study. Fact sheets for each project have been posted on the Web.
- Monitored climate, evapotranspiration (ET), groundwater, and vegetation in an urban reach of the Rio Grande. The inter-related effects of groundwater, surface water, climate, and vegetation are being monitored for their effects on ET. A database has been developed for the demonstration site including the eddy covariance ET and groundwater depth from the Rio Grande for cottonwood forests and reference species such as saltcedar, Russian olive, and willow. The database includes a full documentation of climate, drought, fire, and restoration effects on ET. Relationships are being found between ET and fire, regrowth and water salvage, first-year drought conditions, and seasonality. Relationships are also being found between riparian ET and groundwater.
- Investigated groundwater / surface water interaction in an urban reach of the Rio Grande. This work is developing an understanding of the hydraulic connection between the river, groundwater, and Bosque soil moisture as affected by the presence and operation of a drinking water diversion dam. A database has been developed along with a Bosque ecosystem monitoring program with local area schools. This work helps calibrate models for groundwater/surface water interaction, near-surface water balance, and sediment transport. Efforts are under way to link terrain models and surface water models

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to determine depth to groundwater. In the future a demonstration restoration area will be selected, adaptive management strategies tested, and evapotranspiration and soil evaporation estimated.

Basic Research

Initiated in FY 2008 at the recommendation of Civil Works business area managers and R&D managers, the Civil Works Basic Research (BR) program was structured to fill needs not being met by the current overall R&D structure. The Corps' R&D structure emphasized applied research and demonstration activities. The objective of the Civil Works Basic Research program is to gain greater knowledge and understanding of the fundamental aspects of phenomena related to water resources. This effort will consist of farsighted and higher risk research with the potential for broad applications.

The BR program is structured to provide physical, engineering, environmental, social, and life sciences support to the major Corps of Engineers missions of reducing flood and coastal storm risk; facilitating navigation; and restoring and sustaining the environment. Successful investigations could lead to subsequent applied research and technology advancement and improved functional capabilities in water resources science and engineering. The laboratories will conduct basic research that challenges accepted theory or empirical assumptions. The BR program began modestly in FY 2008 with \$550,000. Three activities were started in FY 2008 specific to the fundamental nature of how the dynamics of currents and waves interact with vegetation, social cognitive modeling and risk analysis related to flood risk management, and electrokinetic transport in concrete. The BR program intends to commit \$1,170,000 (or 7% of the R&D budget) for basic research in FY 2009. It is expected that a research work package will last no more than 3 years.

Focus areas for the BR program are listed below.

Computational and Information Sciences. Basic research in the computational and information sciences could support the Corps' full range of water resource management disciplines and activities. The supported disciplines include surface water and groundwater hydrology, open channel hydraulics, coastal hydrodynamics, sediment and constituent transport, geotechnical and structural engineering,

and environmental science and engineering. The central themes addressed in this focus area include, but are not limited to, (1) human/computer interface design optimization, (2) intelligent problem solving techniques and environments, (3) temporally and spatially variable model integration, (4) novel approaches to reduce computational burdens in discrete- and continuum-based process models, and (5) defining and bounding uncertainty across water resources.

Human Dimensions of Water Resources Management and Decision Making. The most challenging problems facing the Corps' Civil Works program are the result of a complex web of science, engineering, and human factors. While significant emphasis has historically been given to resolving the science and engineering questions at the heart of these problems, it is increasingly apparent that limitations in our understanding of how people conceptualize, interpret, and respond to problems represent a significant impediment to successfully resolving water resource problems. In addition, social processes including human behavior and economic trends will affect and be affected by our projects and their performance. The human dimensions of water resource management and decision making include basic research in (1) the cognitive science of decision making, (2) interpretation and use of multi-attribute risk information in problem solving, (3) risk perception and communication, (4) cognitive barriers to human acceptance of new technology, (5) governance and public involvement in decision making, (6) human interactions with technology to facilitate public decision processes, (7) conflict avoidance and resolution, and (8) economic/demographic impacts on water resources.

Material and Transport Processes. The Corps' capability to analyze, plan, engineer, and operate its water resource projects depends on the extent of knowledge of the physics of material and transport processes. In this context, materials include fluids (e.g., air, water, and ice), sediment, soil, chemicals, temperature, biomatter, and others. This focus area is concerned with investigations into material processes both locally and in transport. Local material processes are independent of material movement. Examples of local processes are ice formation, sediment consolidation, and changing water chemistry. Transport processes depend on material movement. Examples of transport processes are ice and debris movement, vegetation impacts on hydraulics, water quality of watershed, erosion processes, and deposition of biomatter. Material

interactions are considered as well where one material interacts with another such as in air-sea interaction, surface water-groundwater interaction, terrain response to physical processes, and ice-soil interaction.

Ecological Processes. Ecological processes span the entire spectrum of interactions between the biological, physical, and chemical components of the ecological community. This basic research focus is on formulating and quantifying the underlying theories necessary to explain and predict the long-term sustainability of land and water resources through relatively short-term tests and observations. The principles of data integration and assessment technologies to accommodate a variety of spatial and temporal scales from multiple land use and management activities are additionally of concern. Potential areas of interest include, but are not limited to, physio-chemical impacts on biological systems, species interactions and requirements (particularly threatened and endangered), ecological simulation technologies, environmental recovery, organism behavior and physiology, and nutrient cycling.

Structures and Infrastructure Systems. This focus area is concerned with fundamental processes that cause the deterioration of construction and geological materials (e.g., steel, concrete, and soils) and component elements of major structural features (e.g., locks, dams, breakwaters, and other water control structures). As these structures age, static and dynamic loadings, corrosion, biological, and other forces (e.g., ice, waves, vibrations, and object impacts) reduce the strength of the materials and the resistance of the structure to service and extreme loads. Because the population of existing projects exceeds our ability to conduct major rehabilitation, the primary emphasis is on rapidly detecting, arresting, and remediating deterioration of our infrastructure. Of particular interest at this time are basic research proposals relating to the impact of piping and seepage and vegetation in compromising or deteriorating the condition of levees and/or dams.

Variability and Change in Water Resource Systems. Watersheds and coastal systems are spatially and temporally dynamic and variable. This includes the influences of scale, changing climatic, geographic, environmental, and anthropologic drivers. The interconnectivity and changing balance of natural and modified water systems will impact future water resource science and engineering management. Basic research is needed in the sensitivity and interrelationship of those physical and human systems as they impact the performance and

sustainability of USACE mission functions. Specific areas of potential research relate to changing patterns in precipitation, snow cover, and coastal storms; water quality and quantity stressors; meteorological contributions to landscape evolution; and ecological and human interactions. Basic research proposed under this focus area should not be redundant of the wealth of scientific research being conducted on the causes of climate change, but rather directed toward the effect on water resource management.

Accomplishments in FY 2008 include the initiation of the following projects:

- **The Physics of Wave-Current-Vegetation Interactions Relative to the Impact of Surge and Waves at the Coast.** This basic research project is an investigation of the fundamental nature of how the dynamics of currents and waves interact with vegetation, considering both the response of the vegetation (bending, breaking, uprooting, etc.) and effect that the vegetation has on surge and wave conditions. There are two main elements relating to this research effort: (1) theoretical developments of vegetative response to dynamic forcing and the coupled effect of the vegetation on wind input at the surface and on wave and current dynamics; and (2) a field test in Currituck Sound to examine realistic cases of the wind-wave-current-vegetation interactions. This effort will provide a much needed foundation for interpreting observational evidence and could lead to markedly improved predictions of the effects on wetlands of coastal waves and surges. Such a foundation is critical to understanding the interplay between the role of wetlands (preservation and restoration) and flooding risk in coastal areas which should aid the Corps of Engineers in performing its critical missions involving coastal flood protection and environmental stewardship.
- **Cognitive Barriers in Flood Risk Perception and Management: Mental Modeling and Multi-Criteria Decision Analysis.** The goal of this basic research project is to study thought processes that influence how technical experts and the affected public: (1) perceive coastal and inland flood risk; (2) set priorities and strategic objectives for risk mitigation and response; and (3) make risk management decisions. This project will address gaps in

the field of social cognitive modeling and risk analysis related to flood risk management, including risk perception and communication. It will also develop new scientific methods and algorithms that will allow bringing understanding of individual cognition and values into the Risk Informed Decision Framework (RIDF) in a tractable form. This effort will provide a foundation for other risk management problems which include management of navigation infrastructure, ecosystem restoration, and war fighter risk perception and decision making process. An integrated approach across the disciplines of risk analysis, risk management (including the RDIF) and risk communication using mental modeling will be developed.

- **Electrokinetic Transport in Concrete.** This basic research project will develop a quantitative understanding of the physics of electrokinetic transport in concrete. Of particular interest is the transport of ions, particles, and fluid through hardened concrete that could mitigate or reverse its deterioration by various processes. Some of the processes considered are reduction of seepage by electro-osmotic-pulse, electrokinetic reduction of permeability, and chloride extraction.

Aquatic Plant Control Research Program

This R&D program is funded out of the Construction appropriation. The Aquatic Plant Control Research Program (APCRP) is the nation's only federally authorized research program providing the technology to manage invasive aquatic plant species. Millions of acres nationwide are now infested with invasive aquatic plants that create water resource problems. These plants when imported as exotic, have few natural enemies, and rapidly out-compete native aquatic plants. Eurasian watermilfoil, hydrilla, waterlettuce, and other invasive species continue to propagate from local infestations. Many of these plants are interfering with navigation, flood control, hydropower production, water quality conditions, and waterborne recreational uses. They have a very low value to fish and wildlife and contribute significantly to overall environmental degradation. New colonies of invasive aquatic plants continue to be found, including hydrilla in the Potomac River, Chesapeake Bay, the upper Midwest,

and the Northwest; Eurasian watermilfoil in the upper Midwest and Northwest; giant salvinia in Hawaii, Texas, Florida, and other southeastern states; and water chestnut in New York and New England. In addition, hybridization between native and invasive aquatic plant species and the development of herbicide-resistant plant populations have recently been documented and can impact the efficacy of current management practices.

The objective of the APCRP is to develop cost-effective, environmentally compatible aquatic plant control technology, including biological, chemical, ecological, and integrated control methods. APCRP research is producing information on the growth and ecological requirements of invasive aquatic plants and is producing new biological, chemical, and ecological technologies for their control. Specific information on the biology and ecology of invasive aquatic plants, obtained through research in the APCRP, has greatly improved the efficacy and diversity of management options, while minimizing adverse effects on the environment.

Accomplishments in FY 2008 include:

- Documented and monitored changes in plant response to herbicides.
- Developed assays to evaluate response of hybrid and parental watermilfoil populations to herbicides.
- Documented differences in the response of native plant phenotypes to herbicides.
- Developed operational guidance for large-scale contact herbicide use against fluridone-resistant hydrilla.
- Evaluated large-scale use of newly registered Acetolactase synthesis (ALS) herbicides for control of fluridone-resistant hydrilla.
- Determined the impact of environmental factors (temperature, pH, and turbidity) on herbicide efficacy.
- Developed and demonstrated herbicide application methods to protect native plant populations including Threatened species and species of concern.
- Developed rapid response protocols to control new infestations of Eurasian watermilfoil in the Midwest and Great Lakes regions.

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- Developed species-selective management capabilities to protect fish and wildlife habitats and water quality.
- Provided guidance on the use of herbicide combinations for controlling invasive submersed plants in the Midwest.
- Evaluated new species-selective active ingredients for national registrations.
- Established techniques for integrating herbicides and pathogens to improve control of invasive submersed plants.
- Evaluated the performance of ALS herbicides combined with pathogens as a strategy for controlling hydrilla.
- Documented the impact of pupal parasites on *Hydrellia* spp.
- Documented the mass-rearing insect biocontrol agents for hydrilla.
- Documented the mass-rearing insect agents for the management of salvinia.
- Documented preliminary testing of *Mycrocoleptodiscus terrestris* formulations.
- Documented the use of *Mycrocoleptodiscus terrestris*, an endophyte turned latent pathogen on Eurasian watermilfoil.
- Documented the storage stability of dried microsclerotia of the biological control pathogen *Mycrocoleptodiscus terrestris*.
- Documented senescence as a factor in latent pathogen infection in Eurasian watermilfoil.
- Developed and documented a decision support system for submersed aquatic vegetation revegetation site selection.
- Documented recent advances in biological control of submersed aquatic weeds.
- Evaluated and documented the use of triclopyr and *Mycrocoleptodiscus terrestris* for control of Eurasian watermilfoil.
- Documented the classical biocontrol use of fungi as a viable option for submersed aquatic plant management.
- Documented the nutritional characteristics of *Hydrilla verticillata* and its effect on two biological control agents.
- Documented the impact of insect herbivory on establishment of *Hydrilla verticillata* (L.f.) Royle Fragments.
- Documented the global problem of *Hydrilla verticillata*.
- Developed and documented an ecological approach to aquatic plant management.
- Developed and documented the basics of biocontrol and its role in an integrated management approach.
- Documented the production methods and related efficacy of the biocontrol pathogen *Mycrocoleptodiscus terrestris* for management of the aquatic macrophyte hydrilla.
- Distributed over 5000 copies of Aquatic Plant Information System (APIS) version 3.0.
- Developed APIS Mobile Version 1.5
- Documented a comparison of the Point Intercept and Surface Observation GPS survey methods.
- Documented the comparison of three biomass sampling techniques on submersed aquatic plants.
- Documented the effects of salinity and pH on growth of giant salvinia.

Aquatic Nuisance Species Research Program

The Aquatic Nuisance Species (ANS) Research Program is an expansion of the Zebra Mussel Research Program. Funded under the Operations and Maintenance appropriation, this expanded program addresses all invasive aquatic animal species. Invasive species in general cost the public over \$137 billion annually. Zebra mussels alone cost the public over \$1 billion annually and they have now been discovered in lakes and rivers west of the 100th meridian. It is estimated that over 100 nuisance species are introduced into U.S. waters annually. Many of these species have the potential to impact facility operations - as well as threaten valued native species diversity. The Corps is responsible for the O&M of water resource projects on navigable waters and the associated resources. More effective, inexpensive methods of prevention and control of aquatic nuisance species must be developed to reduce impacts to public facilities and protect valuable natural resources.

Prevention methodology focusing on dispersal barrier technology will be investigated. Control

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strategies are being developed for navigation structures; hydropower and other utilities; vessels and dredges; and water treatment, irrigation, and other water control structures. Methods to reduce invasive species impacts to Threatened and Endangered species and restore natural habitat will be investigated. Numerous dredged material disposal areas in the Atlantic, Gulf coast, and Great Lakes region have mosquito abatement programs. Due to the introduction of the West Nile Virus, local communities want greater assurances that mosquito populations at Corps disposal sites are controlled to the maximum extent practicable. Following the introduction of the northern snakehead fish, a number of Corps reservoir projects have had to take interdiction measures to prevent introduction of the fish.

Accomplishments in FY 2008 include:

- Assessed the impact of harmful algal blooms on USACE operations.
- Determined the potential use of plant-specific, enzyme-inhibiting herbicides for managing algal species responsible for harmful blooms.
- Developed a computer-based information system containing aquatic nuisance species profiles and management options for quick access by Corps project managers.
- Developed a detailed cost template for reporting invasive species expenditures within the USACE.
- Completed evaluations on population growth, habitat uses of early life history stages, and feeding of silver and bighead carps in the upper and lower Mississippi River.
- Provided guidance and technical assistance on the development of an interagency management and control plan for Asian carp in the Mississippi River.
- Initiated an aquatic invasive species risk assessment for the Chicago Sanitary and Ship Canal.

Coastal Inlets Research Program

The Coastal Inlets Research Program (CIRP) is a R&D program funded under the Operations and Maintenance appropriation. Records demonstrate that

the Corps will expend an estimated \$15 to \$20 billion over the next 25 years at the more than 150 coastal inlets with existing major federal navigation projects to maintain, modify, and create navigation channels and structures, and to mitigate damages to adjacent beaches. Political, engineering, and demographic factors may increase these costs. The national “2020” plan for deeper and wider channels to accommodate the next class of vessels as well as the forecasted increase in long-term sea level bring great uncertainty in prediction of maintenance requirements, reliability of jetties, and integrity of adjacent beaches. The public perception, right or wrong, that federal activities at inlets cause adverse response at adjacent beaches may require additional, expensive mitigation. Public sensitivity to the practice of placing sediment that is dredged during O&M in offshore disposal areas is resulting in advocacy for more nearshore placement of beach-quality sediment. Inlets are the primary conduits for the transport of environmental constituents between bays and the open ocean, and the Corps may be constrained from performing present activities unless it can make accurate predictions of inlet response, and thus environmental response, to such activities.

As inlet behavior becomes better understood through the R&D, reliable tools for management of inlets for navigation projects, such as models and empirical relationships, are becoming available for inlet O&M. These new tools will lead to more efficient, cost-effective designs and reduce O&M requirements and, consequently, costs.

Accomplishments in FY 2008 include the following:

- Incorporated R&D advances into the Coastal Modeling System (CMS), an integrated wave, current, and sediment transport numerical modeling system, available to all Corps users through the Surface-Water Modeling System, to calculate channel shoaling, morphology change, and wave overtopping of structures. Transferred technology to 8+ Districts through workshops, individual hands-on training, and site-specific applications at Districts.
- Developed Coastal Structure Management, Analysis, and Ranking Tool (CSMART) to provide decision-support for allocating O&M funding to repair 600+ coastal structures in the Corps’ portfolio. CSMART facilitates prioritization through comparison of economic indicators such as commercial

tonnage, fishing, and maintenance dredging requirements as well as life and safety issues. Developed Google Earth© interface for visualization of results.

- Developed beta Channel Prioritization Tool to prioritize O&M in navigation channels based on metrics such as draft utilization, commodities, and dredging requirements.
- Integrated new barrier island breaching model into CMS technology for analyzing breaches that occur near older jetties. Applied technology for Galveston District at Matagorda Entrance Channel, TX.
- Developed and integrated ShipSed numerical model into the CMS to calculate shoaling of channels due to ship wake, prop wash, and adjacent bank erosion. Applied technology for Galveston District at the Upper Matagorda Ship Channel, TX.
- Developed Rapid Assessment of Morphology and Non-Equilibrium Transport, calculations methods to facilitate long-term simulations at coastal inlets, estuaries, and adjacent beaches.
- Adapted Particle Tracking Model (PTM) for the CMS to visualize movement and transport of sediment and constituents as transported by waves and currents. Applied PTM to assist Baltimore District in design of new dredged material placement habitat at Poplar Island, MD.
- Began development of a channel infilling database for empirical and numerical analysis.

Dredging Operations and Environmental Research Program

This R&D program is funded under the Operations and Maintenance appropriation. The Dredging Operations and Environmental Research (DOER) Program is the single research program supporting the Corps' \$1 billion navigation dredging program. Dredging and disposal must be accomplished within a climate of increased dredging workload, fewer placement sites, environmental constraints, and decreasing fiscal and manpower resources. A major challenge is balancing environmental protection with critical economic needs while accomplishing dredging activities. The program has validated innovative technologies for

high-profile contaminants and developed risk-based assessment methods that will significantly reduce testing costs at virtually all harbors. Methods for reclamation and beneficial use of dredged material will contribute to sustainable management of disposal sites, providing both economic and environmental benefits. Commercially available, innovative technologies are objectively evaluated within the program to meet the needs for greater dredging efficiency and productivity; where technology gaps remain, they are filled through R&D activities within DOER.

Major focus areas of DOER include dredged material management, environmental resource protection, operations technologies, and risk science. Accomplishments in FY 2008 are listed below by research focus area.

Dredged Material Management:

- Completed a major update to the Particle Tracking Model (PTM). PTM is a Lagrangian particle tracking model that monitors the far field fate of dredged material in wave/current environments. Features added increased the accuracy and analytical capabilities of PTM, which was demonstrated at multiple projects.
- Completed development of source term algorithms for dredging operations. Incorporated source term algorithms into PTM model for far field fate of dredged material. Collected field data for overflow source terms for model validation.
- Particle Imaging Camera System (PICS) was demonstrated to increase predictive accuracy of dredged material plume models. PICS was applied to demonstrate importance of bed aggregates and flocculation in hopper dredge plumes.
- Completed development of a sustainable management strategy for management of dredged material in confined disposal facilities (CDF).
- Demonstrated new analytical and statistical tools to evaluate the adequacy of available data in characterizing CDF material.
- Developed methods to quantify how passive desalination of dredged material can be accomplished for beneficial recycling of dredged material.

Environmental Resource Protection:

- Published a risk-informed decision framework for setting environmental windows that allows input of stakeholder values.
- Conducted studies of swimming capabilities of multiple Threatened or Endangered sturgeon species in a large capacity Brett-type swim tunnel as a necessary step in evaluating risk of entrainment by hydraulic dredges.
- Applied a new GIS-based tool, using eCoastal as a platform, to assess potential impacts of navigation projects on foraging habitat of protected gulf sturgeon. The tool will assist planners in avoiding conflicts with protected species. Applications are being conducted in collaboration with the National Marine Fisheries Service.
- Initiated field studies to fill high priority data gaps to address critical Threatened and Endangered bird habitat management issues that arise in conjunction with beach nourishment projects.
- Applied evidence-based analysis of risk factors for sea turtle takes to gain significant modifications to existing environmental windows, resulting in greater operational flexibility and substantial cost savings.
- Completed extensive field studies of Atlantic sturgeon behavior in navigable waters of Virginia. Results will be used to proactively determine risk factors associated with dredging operations. Studies included an active partnership with the U.S. Fish and Wildlife Service, academia, and nongovernmental organizations.
- Developed and field tested methodologies for comparing performance of dredging management practices intended to limit sediment resuspension. Results will have major implications for existing regulatory constraints placed on navigation dredging.

Operations Technologies:

- Completed test and quality assurance plans to guide the planning, execution, data analysis, and reporting of technologies to reduce fuel consumption on dredges. Performance evaluations conducted

according to these plans will provide needed performance data.

- Completed development of key performance measures related to navigation channel reliability. A pilot model was completed to automate consistent calculations of channel performance.
- Completed model studies of different configurations of dredging bed levelers to investigate respective operating characteristics in relation to sediment movement and subsequent impacts on Threatened and Endangered turtles.
- Demonstrated the Silent Inspector automated mechanical dredge monitoring system on a contractor dredge.
- Completed a system requirements analysis to support development of a new technology to measure density profiles of fluid mud and residuals to improve surveying capabilities in navigation and environmental (contaminated sediments) dredging projects.
- Instituted an Innovative Adoption Process for use in evaluating new technologies within USACE.
- Developed design documents for CE-DREDGE (a suite of applications, methods, and procedures for data management, analysis, and visualization of dredging data).
- Completed a comprehensive technical report on “Dredging in Sediments Containing Munitions and Explosives of Concern (MEC)” that provides guidance to personnel supporting dredging projects with sediment containing MEC.

Risk:

- Completed a detailed review and engineering analysis of promising contaminated sediment treatment technologies to evaluate the costs and benefits relevant to the navigation program.
- Enhanced DREDGE model source term and users guidance to provide more reliable estimates of sediment resuspension rates and exposure estimates for risk assessment.
- Upgraded RECOVERY and CAP models to provide more accurate predictions of contaminant flux from sediment to the

overlying water. Such models are essential design tools for evaluating confined aquatic disposal options for contaminated dredged material.

- Completed experiments to increase the cost-effectiveness of existing bioassays used to perform environmental evaluations of dredged material.
- Completed experiments to evaluate use of solid-phase microextraction as a much less costly and time-consuming experimental method for predicting porewater concentration and the bioavailability of polychlorinated biphenyls in sediments.
- Complete a review and analysis of food-web models used to evaluate risks posed by contaminated sediment. The results of the analysis will be used to enhance existing models used by the USACE dredging program.

Other Programs

Within the Investigations, Operations and Maintenance, and Construction appropriations, the ERDC conducts technical support efforts that consist of activities such as demonstrations, mapping, data collection and management, studies, and technology transfer and support. Significant activities in this area of effort are described below.

Coastal Field Data Collection

The Coastal Field Data Collection (CFDC) Program (<http://chl.erd.c.usace.army.mil/cfdc>) has a nationwide scope designed to measure, analyze, and assemble information required to accomplish the Corps' mission in coastal navigation and storm damage reduction. It is designed to collect non-project-specific data, i.e. regional data that is necessary for many projects. Through this program, the Corps also contributes to the Nation's Integrated Ocean Observing System (IOOS).

Significant accomplishments in FY 2008 include:

- In collaboration with NOAA, revised the National Operational Wave Observation Plan for the IOOS. The plan

comprehensively addresses all aspects of a measurement program including spatial and temporal coverage and the accuracy requirements to serve the broadest range of wave information users. This is a significant document that builds on the limited wave observation network that exists today.

- Added five new directional wave measurement stations to the Coastal Data Information Program (CDIP) for a total of 30 stations: (1) Chesapeake Bay Entrance, (2) Masonboro Inlet, NC, (3) Jeffries Ledge, NH, (4) the 26-m buoy at Duck, NC, and (5) St. Croix, Virgin Islands. All sites were established in coordination with multiple federal agencies and local sponsors. Thirteen sites were converted to Iridium satellite communications, eliminating shore stations, reducing cost, and improving reliability. CDIP is a collaborative effort of the Corps of Engineers with the State of California and the Scripps Institution of Oceanography.
- Dr. Robert Jensen was named as chairman of the Joint Technical Commission for Oceanography and Marine Meteorology, Pilot Project on Wave measurement Evaluation and Test from moored buoys. JCOMM is an international committee under the United Nations World Meteorological Organization.
- Mapped 120 miles of coastal Southern California twice in FY 2008 using airborne LIDAR, continuing a unique effort that began in 2002. The mapping provided a new understanding of a previously undocumented alongshore variation that is not predicted with existing coastal sediment/evolution models. Based on the LIDAR mapping data and estimates of sediment transport based on wave observations, these studies advanced regional sediment management concepts through a new nearshore sediment budget formulation.
- Under the Pacific Island Land-Ocean Typhoon (PILOT) experiment, which is studying storm surges on islands caused by typhoons: (1) added St Croix in the Virgin Islands to the cross-reef measurement locations; (2) continued 100% data record (began in 2004) on a reef in Guam; and (3) continued 100% data record at Mokuleia on Oahu, HI. The University of Hawaii is lead

collaborator at the Guam and Hawaii sites. Completed 16 conference and journal publications discussing observations of wave and storm surge events over reefs.

- The Surge and Wave Island Modeling Studies (SWIMS) activity released TWAVE, a tropical storm modeling package appropriate for island and reef environments that includes winds, deepwater waves, and calculation of waves, water levels, and inundation on one-dimensional transects. TWAVE is designed to be useful to emergency managers. To better understand their requirements, Corps researchers participated in a State of Hawaii Civil Defense hurricane exercise, which was very instructive. Completed three technical reports and four conference presentations addressing progress in wave and current modeling over reefs. These efforts made use of the developing data collected under PILOT.
- Completed six reports, conference papers and posters discussing hindcasted wave data for the Pacific basin. Completed the development of a new, sophisticated wave system partitioning product along with new wind sea and swell rose plots that have received great reviews from District users in Hawaii. Working with the Portland District, developed a preliminary climate product that analyzes storm energy. Collaborated with the National Oceanic and Atmospheric Administration to set up a multi-grid version of the Wave Watch III model for the Pacific on the High Performance Computing system.
- Began development of a new beach monitoring system that integrates a land-based scanning LIDAR with GPS and a motion system to allow high resolution mapping of the beach and dune system while under way. A modified marine radar provides concomitant information on the surf zone and sandbar morphology. This system greatly enhances our ability to collect accurate and synoptic beach observations.
- Developed a beach morphology testbed at ERDC's Field Research Facility in Duck, NC, which will be used to validate and verify computational models. Two different sites were monitored with multiple surveys during a period of 10 minor storms and one

major one (waves > 3.5 m). In addition, four new wave and current instruments were deployed across the surf zone for real-time model evaluation. This testbed is a significant step toward evaluating the performance of a number of coastal models.

Remote Sensing/Geographic Information System (GIS) Center

The Remote Sensing/GIS Center is the Corps' Center of Expertise for Civil Works remote sensing and GIS technologies, providing mission-essential support to the Corps. Through centralized management of this function, the Center provides cost-effective support through technology transfer and applications development for Corps mission responsibilities in all business practice areas: navigation, flood and coastal storm damage reduction, hydropower, regulatory, environment, emergency management, recreation, water supply, and work for others. An enterprise GIS approach is an essential component of this support. Continuing interaction with other researchers and practitioners throughout the Corps, government, the private sector, and academia ensures that state-of-the-art and state-of-the-practice knowledge of evolving trends that are important are available for the Corps and that duplication of effort is avoided.

The Remote Sensing/GIS Center develops approaches for the integration of data from the disparate sources necessary for system-wide land and water resources management including: regional sediment management, regional water management, ecosystem processes and assessment, basin studies, water control, support to emergency management, and compliance with the attendant environmental regulations and related policies. The Center maintains cognizance of state-of-the-art sensors, data collection, analysis, and storage systems; commercial software; and bridging software that integrates these and operational technologies into Corps Division, District, and other agencies activities.

Technology is transferred through telephone and short, no-cost assistance to the field. The existence of the Center ensures that the necessary support can be rapidly directed toward solving operational problems that require specialized expertise. The PROSPECT training program in remote sensing and GIS, managed by Center staff, provides another avenue for the transfer of knowledge to those who

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are, or soon will be, using these technologies. Training is also conducted in the field through workshops, conferences, and distance learning. White papers, pilot projects, publications (including Engineer Technical Letters, Circulars, and Manuals), and the Internet are also used to transfer procedures and lessons learned to end users.

Accomplishments in FY 2008 include:

- As the Center of Expertise, served as key resource and technology point of contact for the Corps of Engineers for Civil Works remote sensing and GIS.
- Provided guidance and technical support to the Corps' Geospatial Community of Practice (CoP) and provided leadership to the remote sensing, hydrology and hydraulics, and emergency sub-CoPs.
- Continued technology transfer through training courses, briefings, development of distance learning, technical papers, technical demonstrations, pilot programs, and conferences.
- Supported one-stop service requests from Corps Districts and Divisions.
- Assisted with geospatial emergency management support during disasters and supported Interagency Performance Evaluation Taskforce (Hurricane Katrina) efforts.
- Provided leadership and technical support to strategic and enterprise USACE geospatial initiatives: National Levee Database deployment; Corps Project Notebook; Corps Map; Real Estate Management Information System; National Wetland Plant List; DISDI Portal; Corps Water Management System; Geospatial Operations and Maintenance Business Interlink developer; Emergency Management, Remote Sensing, GIS, and Modeling Group; and Hydrology and Hydraulics modeling software development and support team member.
- Sponsored and participated in program development of national and international remote sensing and GIS conferences.
- Updated the PROSPECT Remote Sensing Introductory and Intermediate GIS courses.
- Participated in the technical execution of the Missouri River Recovery Program.

- Provided technical support to Corps District offices for the development of implementation plans for geospatial data management including development of enterprise geospatial data approaches.
- Provided ad hoc mapping functions for HQUSACE.

Joint Airborne LIDAR Bathymetry Technical Center of Expertise

The Joint Airborne Lidar Bathymetry Technical Center of Expertise is a Joint Center with the Corps of Engineers, the Naval Meteorology and Oceanography Command's Naval Oceanographic Office, and NOAA's National Ocean Service. The Joint Center's mission is to conduct airborne coastal mapping and charting in support of the partners and perform research and development to evolve capabilities and supporting technologies. Through the Joint Center, the Corps implements its National Coastal Mapping Program. The program provides regional coastal data to measure and monitor engineering, environmental, and economic conditions along the U.S. coast, supporting both regional sediment management and individual project operations and maintenance.

Accomplishments in FY 2008 include:

- Celebrated 10th Anniversary of the Joint Center and signed new general collaborative agreement to extend the partnership through 2012.
- Conducted National Coastal Mapping Program operations for the Corps in Michigan, Indiana, Illinois, and Wisconsin.
- Conducted operations to support Navy littoral analysis in the Philippines.
- Acquired a third post-Katrina topographic LIDAR and hyperspectral imagery data set in the New Orleans vicinity for development of change analysis routines fusing LIDAR and spectral imagery.
- Acquired a second post-Katrina bathymetric LIDAR, topographic LIDAR, and hyperspectral imagery data set for the Mississippi and Alabama islands to support Mississippi Coastal Improvement Program and U.S. Geological Survey storm vulnerability studies in the New Orleans vicinity for development of change analysis

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routines fusing LIDAR and spectral imagery.

- Developed new landcover classification tool that produces basic landcover at 1-m resolution from a combination of LIDAR and hyperspectral imagery. This product can help identify infrastructure and habitat vulnerable to extreme storm events and sea-level rise.
- Produced numerous technical papers, such as “Regional landcover classifications using topographic LIDAR and hyperspectral imagery,” which was presented at the International LIDAR Mapping Forum 2008.
- As of Dec 2008, over 4,447 individual downloads of the Corps’ National Coastal Mapping Program LIDAR data have been made, totaling 397 gigabytes. This is accomplished through the NOAA Coastal Services Center’s LIDAR dissemination system.
- Completed Ninth Annual Coastal Mapping & Charting Technical Workshop in San Francisco, CA, to coordinate with federal, state, industry, academia, and international experts in related technologies. The workshop included 24 technical presentations over 2 days.
- Completed the Coastal Zone Mapping and Imaging LIDAR (CZMIL) detailed software design for an integrated airborne, data processing, and product generation system. CZMIL is the third-generation system being developed through the Joint Center partnership.
- Contributed to the Interagency Working Group on Ocean and Coastal Mapping strategic planning workshop and plan document.
- Initiated and leading Gulf of Mexico Mapping Master Plan activity within the Gulf of Mexico Alliance.
- Contributed to federal response plan for LIDAR mapping post-hurricanes Ike and Gustav.
- Upgraded in-house survey system CHARTS to facilitate use of imagery data collected during LIDAR missions for NOAA shoreline mapping.

Inland Waterway Navigation Charts

This effort provides the Corps’ Electronic Navigational Chart data for all inland waterways and other federal navigation channels maintained by the Corps. On inland waterways, the Corps collects accurate survey and mapping data in support of waterway maintenance and construction activities, which is also used to produce Inland Electronic Navigation Charts (IENC) that are available to users of the waterways. When combined with the commercial chart systems, the IENCs greatly improve the safety and efficiency of navigation. Such capability allows safe navigation through bridge openings during fog and other bad weather conditions as well as during heavy traffic situations, and provides an accurate display when other systems such as radar and Automatic Identification Systems are used. The IENCs use the S-57 international data format, which is readily compatible with commercial systems and enables proper use onboard marine vessels. The IENCs are also consistent with electronic chart products produced by NOAA, which enables seamless transit between shallow and deep water channels. The Corps also coordinates with the U.S. Coast Guard for aids to navigation information and collaboration rules for chart carriage by waterway users. Outreach efforts include meetings with various river pilot organizations and the U.S. Power Squadron to ensure our products are reaching and satisfying the customers for whom they are intended. Exhibit booths of IENC products were displayed at major conventions such as the ESRI International Users Conference in San Diego and the International Workboat Show in New Orleans.

In coastal and Great Lakes areas, the Corps will produce standardized channel conditions chart products that will provide consistent and reliable information to NOAA for chart updates, in accordance with the Water Resources Development Act of 2000, Section 558. Similar channel chart products will be provided to navigation users, and these coastal and Great Lakes channel condition chart products will also follow the S-57 format. The IENC development and publication activities are in accordance with National Transportation Safety Board recommendations to the Corps, and subsequent commitments made by the Chief of Engineers.

Significant accomplishments in FY 2008 include:

- Charts for 6,250 miles of inland waterways were published and maintained, including

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coverage of the Mississippi and Ohio Rivers and various tributaries.

- Inland Paper Chart standards were adopted for the Upper Mississippi River to provide uniform appearance of all printed chart products.
- Development of charts for 1,250 miles of additional waterways began or was continued.
- IENCs were used on several hundred towboats navigating inland waterways.
- IENCs were downloaded by several hundred private recreational boaters on the inland rivers.
- Precise data delineating over 300 coastal deep-draft channels was compiled and used in various chart products.
- Coordination with European Union countries, Russia, and several countries in South America continued to develop a common international data standard.

Dredging Operations Technical Support Program

Within the Operations and Maintenance appropriation, the Dredging Operations Technical Support (DOTS) Program fosters a “one-door-to-the-Corps” concept by providing comprehensive and interdisciplinary technology transfer, technology demonstrations, and training essential to all stakeholders involved in navigation projects. The DOTS Program is managed as a centralized resource across navigation missions to maximize cost effectiveness, while facilitating consistent implementation of National policies and laws pertaining to navigation. The program emphasizes rapid applications of state-of-the-art technology and research results to problems identified by field offices. Maintenance of the Nation’s navigation infrastructure requires compliance with numerous environmental statutes and Presidential Executive Orders. These requirements and new emerging environmental concerns necessitate ready access to advances in scientific knowledge to avoid uncertainties in administration of the Corps’ navigational dredging program. The DOTS Program’s Web-based and expert networking capabilities provide access to extensive, up-to-date, technically defensible databases, predictive models, and tools that enable rapid, proactive responses to

emerging technical issues. This access fosters networking and solutions to common problems confronting the navigation and dredging communities.

Short-term, quick-turnaround technical efforts that address problematic issues encountered during maintenance and operation of navigable waterways and infrastructure are the foundation of the DOTS Program. Demonstration of new, innovative techniques with potentially high returns on investment for management of Corps navigation projects is another important DOTS function. By disseminating knowledge of new R&D products to field offices constrained by staff reductions, the DOTS Program will continue to perform a critical technology transfer role in support of all O&M navigation projects.

Accomplishments in FY 2008 include:

- Provided numerous technical responses to requests for assistance from field offices, including the Chicago, Detroit, Buffalo, New England, New York, Wilmington, Savannah, Jacksonville, Mobile, New Orleans, Memphis, San Francisco, and Portland Districts. Responses covered diverse issues, including rapid detection of polycyclic aromatic hydrocarbon (PAH) contaminants in hopper dredges, concerns for microbial pathogens in dredged material, beneficial use of dredged material for bird habitat construction, volatilization of contaminants in CDFs, open-water placement of dredged material, fish spawning habitat protection, Essential Fish Habitat consultation, risk-based model training, water quality and circulation model applications, and equipment selection for turbidity controls.
- Performed mandated reporting and coordination with the Environmental Protection Agency (EPA) and the International Maritime Organization in compliance with the 1972 London Convention.
- Conducted an intensive dredged material management training seminar attended by over 150 regulators and stakeholders. Initiated planning for a new regional training seminar/workshop to be held in the new fiscal year. Topics address changing technology needs and solutions with an emphasis on risk-based evaluation

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methodologies. Renewed training efforts will expand upon the cumulative 5,000 personnel trained by DOTS since 1991.

- Continued expansion of Web-based tools used by field offices to reconcile and manage incidental takes of Threatened and Endangered species across individual District and Division boundaries. Significant progress attributed to DOTS support has been made in revising sea turtle protection protocols with a high probability of significant cost savings.
- Refined the DOTS-sponsored Web-based O&M Project Endangered Species Act cost compliance reporting system. This tool has become the Corps' standard for generating required annual reports and facilitated coordination with the Fish and Wildlife Service.
- Expanded collaborative efforts with the American Bird Conservancy to resolve potential conflicts between O&M projects and bird habitat conservation. Significant progress was made in high-priority areas, including interior least tern and coastal piping plover protection initiatives.
- Fostered improved methodologies for remediation of contaminated sediments via the Center for Contaminated Sediments. Treatment and handling of residuals following cleanup dredging continues to be a priority topic as well as applications of Multi-Criteria Decision Analysis methodologies.
- Continued to update content of Web-based databases and tools that represent critical aids for successful implementation of guidance contained in Corps/EPA dredged material testing manuals.
- Continued support for collaborative interactions with the Marine Board of the National Academy of Sciences.

Monitoring of Completed Navigation Projects

The purpose of the monitoring program is to identify the best navigation project practices and use them to improve the performance of all navigation projects. Optimizing project performance requires that projects be monitored and evaluated against preconstruction projections and present needs, and

that the lessons learned be translated into proactive management guidance for Corps Districts. Information gained from monitoring navigation projects, including changes in sediment transport, water levels, currents, waves, flushing, river flows, and other hydraulic phenomena with associated environmental impacts, will be used to verify design expectations, determine benefits, and identify O&M deficiencies. Information collected from monitored navigations projects can improve project performance and optimize opportunities for environmental enhancement. Information collected and analyzed on a national basis documents successful designs, disseminates lessons learned on projects with problems, and provides upgraded field guidance that will help reduce life-cycle costs on a national scale.

Selective and intensive monitoring of Civil Works navigation projects is executed to acquire information to improve project-purpose attainment, design procedures, construction methods, and O&M techniques. Both shallow- and deep-draft navigation projects located in rivers, reservoirs, lakes, estuaries, and the coastal zone are included in the program. Projects that will potentially provide maximum life-cycle cost savings are identified, and those that best address high-priority cost savings are selected for monitoring and evaluation. Monitoring plans are developed jointly by Corps Districts and ERDC. Plans consist of either a comprehensive detailed survey to verify post-construction conditions on a one-time basis or a repetitive collection of field data. The intensive data are analyzed and the results compared with the pre-construction predictions to verify or upgrade existing design guidance for minimizing O&M cost and ensuring project benefits. The analyses include structural, topographic, bathymetric, hydrodynamic responses and inter-comparisons of projects when applicable.

Coordination between the Corps and other federal, state, and local agencies is essential for proper accomplishment of this program. In addition to satisfying the Corps' requirements, the data are made available through technical publications and will be valuable to federal, state, and local agencies tasked with development and implementation of regional coastal and inland navigation management policies. Results are communicated to member agencies of the Marine Transportation System.

Accomplishments in FY 2008 include:

- Kaunalapau Harbor, HI: The largest Corps-developed CORE-Loc™ concrete armor units were utilized for breakwater stability.

Monitoring construction techniques during rehabilitation placement have been completed. Baseline follow-up monitoring with Ground Based Tripod-LIDAR continued. High-resolution geo-referenced Digital Elevation Model was linked to existing benchmark. Multi-beam surveys of breakwater sub-aerial surface and toe were conducted. Analysis of settlement and movement of armor units continued. Wave data were analyzed, and numerical model of wave transformation from ocean gage to inner harbor was applied. Toe stability and armor unit concrete strength analyses were completed. Remotely operated vehicle with underwater camera used to inspect CORE-Loc armor units. Documented concrete casting and strength measurements. Monitoring data were imported into Enterprise Coastal Inventory Database. Began technical report preparation.

- John T. Myers Locks and Dam, KY: Barge tow damage to lock wall armor is a major maintenance problem, especially at the 1,200-ft locks along Ohio and Upper Mississippi Rivers. Present design does not provide for wall armor protection at vertical joints. Innovative repair techniques were developed, and installation demonstration was completed at vertical joints at both upstream and downstream bullnose. Demonstrated horizontal wall armor strip successful repair with minimal disruption to river traffic. Continued application of non-destructive imaging technique to quantify volumes of wall material lost to spalling and impacts to forecast optimum time for vertical and horizontal wall repairs. Began technical report preparation.
- John Day Lock and Dam, OR: Flow deflectors installed to improve fish passage resulted in hazardous navigation under certain flows. High-velocity surface currents interacted with power house discharge to create hazardous cross-currents at downstream entrance to lock. Acoustic Doppler Current Profiler acquired current documentation of barge tow lock entrance hazardous conditions during spill season (April through August). Data analysis initiated to develop recommendations regarding flow discharge releases from power house and spillway to minimize velocity hazards to tows entering and leaving lock downstream end.
- Great Lakes Armor Stone: Rapid armor stone deterioration results in high O&M costs and is a significant problem around the Great Lakes under freeze/thaw and wet/dry cycles. Conducted quarry investigations, and selected and placed index stones on Burn Harbor, IN, breakwater. Index stones had previously been placed on Keweenaw Waterway, MI, jetty, and Cleveland, OH, breakwater. Keweenaw and Cleveland index stones were monitored three times for temporal weathering under known conditions. Continued laboratory test of scale effects from range of samples and prototype index stones cut to uniform dimensions to estimate stone quality and durability. Laboratory tests conform to three different criteria (Corps, American Society for Testing and Materials, and ERDC Modified Procedure) to develop enhanced acceptance criteria and specifications. Initiated development of numerical model to predict armor stone deterioration.
- Montgomery Point Lock and Dam, AR: Low water levels on Mississippi River resulted in less than navigable White River depths to Norrell Lock, resulting in construction of intermediate location Montgomery Point Lock and Dam. Unique dam designed with flap gates in middle of White River. Lock only used at low water on Mississippi River. Same dam design proposed for Upper Mississippi River. Sedimentation deposits affect flap gate operations. Leakage exists under and between flap gates. Total load on gate operation cylinders will be monitored, and forces on crest gate hinges will be ascertained. Acquired and analyzed Acoustic Doppler Current Profiler velocity and bathymetric data in vicinity of lock and dam. Monitored stone protection grade and cross-section alignment stability for sedimentation estimates.
- Periodic Inspections (PI): Deployed Enterprise Coastal Inventory Database (ECID), and established ECID website. Digitized previous PI data. Continued update of ECID with digitized PI data. Data accessible using Google Earth or a website query. Interface provides structure and inlet locations, NOAA tide gages, and National Data Buoy Center wave gages. Info bubbles contain all available data pertinent to the

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structure, inlet, or gages, and color coded by District. Published Burns Harbor, IN, and Cleveland Harbor, OH, breakwaters PI reports. Prepared first draft of Hilo and Nawiliwili, HI, PI reports. Conducted LIDAR multi-beam surveys at Kaunalapua and Kahului, HI, breakwaters.

Regional Sediment Management Program

Regional Sediment Management (RSM), coastal and watershed management of the sediment, applies to all Civil Works programs through planning, design, construction, operation, maintenance, restoration, rehabilitation, and regulatory activities. This encourages opportunities for enhancing the O&M of existing projects, the long-term effectiveness of existing projects, and the management of ecosystem resources. In addition, RSM facilitates the regional integration of the Civil Works business programs into the identification and development of new Corps initiatives.

The RSM Program's goals are to link the management of authorized Corps projects with one another, particularly across District/Division boundaries, and to leverage data collection and shoreline management activities with other federal agencies and state and local governments within the limits of a regional watershed system (including uplands, rivers, estuaries and bays, and the coast). The purpose of the Program is to demonstrate short- and long-term cost savings and increased economic and environmental benefits of maintaining sediments within their regional system, and of using sediments to sustain a balanced environment.

Accomplishments in FY 2008 include:

- Initiated the Long Island Coastal Planning Project (LICPP) to make more effective uses of sediment from inlets and other sources, enhance environmental habitat, improve the collection and dissemination of data about the movement of sediment, facilitate cooperation among federal and non-federal interests, and ensure the most effective use of taxpayer funds. In 2008 the LICPP initiated development of a shoreline morphology model, developed an inventory of existing sediment borrow areas, compiled existing sediment budgets from Coney

- Island to Montauk Point, and collected monthly beach profile data at Point Lookout.
- The Philadelphia District continued the development of a framework for the restoration of urban watersheds using the Darby-Cobbs Watershed in southeastern Pennsylvania as a pilot. This framework will be applicable nationwide to urban watersheds affected by excessive development, habitat degradation, and recurrent flooding. In 2008 the Philadelphia District developed a detailed database of reports, categorized the reports based on type of data, georeferenced each report, and created an interactive map with georeferenced reports. All reports are available for the public to download. The Philadelphia District also developed an urban stream pamphlet intended to explain sediment and water transport in easily understood terms and for use in public outreach and education.
- The RSM Program continued development of the Chesapeake Bay Regional Sediment Management Plan. The Baltimore District worked with ERDC to integrate sediment transport into the existing Chesapeake Bay water quality model. The model can make simulations for dissolved oxygen, light, and chlorophyll. In the future, this work can be applied to access submersed aquatic vegetation and other natural resources. The District also initiated a contract with the Virginia Institute of Marine Science to develop sediment loads and budgets for all major tributaries in the Chesapeake Bay with the ultimate goal of developing a Chesapeake Bay sediment budget. The Baltimore District and USGS collaborated on the collection of bathymetry data, and the calculation of infilling rates and sediment volume for the Conowingo Dam, a major hydroelectric dam near the mouth of the Susquehanna River and the head of the Chesapeake Bay estuary.
- The Wilmington District initiated a statewide Regional Sediment Management program to develop an understanding of sediment budgets, sediment transport, and sediment management for the entire coast of North Carolina. Initial efforts have focused on collaborating with the North Carolina Department of Environmental and Natural Resources' Division of Water Resources (DWR) and Division of Coastal

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Management (DCM) to mine existing data from Corps databases and stand up a District Enterprise GIS (eCoastal). In addition, detailed sediment budgets are being developed for Brunswick County (Cape Fear to South Carolina state line) and Bogue Banks/Morehead City (Cape Lookout to Bogue Inlet).

- The Mobile Bay Basin Watershed project brings the lessons learned through application of RSM principles and practices in the coastal environment to a broader watershed perspective for sediment and related environmental management planning. By linking the watershed and coastal environments through application of RSM concepts, we will improve our understanding of the watershed processes and improve our ability to make informed, cooperative watershed management decisions. In 2008, the project conducted a watershed literature review and stakeholder's identification, coordinated with Northern Gulf Institute, identified ongoing numerical model studies in the region, and initiated involvement of potential stakeholders.
- The New Orleans District continued the integration of coastal restoration projects into the primary eGIS system for the District and integration of eCoastal RSM/coastal GIS tools for use by nonGIS-proficient users such as project managers and planners. Additionally, the District has georeferenced all federal navigation channels, disposal areas, and beneficial use placement sites and integrated this dredging information into eGIS. The RSM Program has initiated and completed a regional, conceptual coastal sediment budget in Sediment Budget Analysis System – for ArcView SBAS-A and plans to extend the effort into a calibrated budget to provide much needed knowledge on the natural movement of sediment along the coast. This knowledge is critical to plan current and future coastal restoration projects ongoing in Louisiana and will assist in the prioritization of these projects and accurate estimation of the project life. Ultimately, these tools, through a regional approach, will save time and money desperately needed to restore Louisiana's estuarine and coastal environment.
- The Great Lakes Division initiated development of the Great Lakes Sediment Management Plan (GLSMP). The goal of the GLSMP is to forecast regional sediment resource requirements for the Great Lakes Division and share with Navigation, Flood Risk Management, and Ecosystem Management business line lead Districts. In 2008, the Division RSM Project Delivery Team performed a market survey of beneficial use opportunities in Great Lakes Region in cooperation with Great Lakes Commission and investigated enhanced opportunities to remove sediments from CDFs and increase their capacity.
- The Missouri River bed load study utilizes the Integrated Section Surface Difference Over Time method to yield the bed load transport rate. The modified methodology uses a combination of analytic considerations and modern time-sequenced multibeam three-dimensional geometry of a dune field for computing the bed load transported in the dunes. Flume data and field data are being utilized to show the capability of the method to closely measure the bed-material load moving in sand dunes.
- The Omaha District performed phase II of a basin-wide sediment yield analysis for the Niobrara River Basin, NE. This 3-year study is conducted in collaboration with the U.S. Department of Agriculture, the Natural Resource Conservation Service, and the local Natural Resource Districts. Information developed by the study will be used to determine the feasibility of managing sediment from the Niobrara River Basin to reduce impacts to Lewis and Clark Lake and will serve as a model for RSM planning elsewhere in the Missouri River Basin.
- The Howard Hanson Dam (HHD) Sediment Management Project is a component of the general restoration program at HHD and the Green River. In 2008, a series of experimental drawdowns was conducted to investigate sediment erosion and transport in the reservoir and downstream effects. The data will be used by the Seattle District to prepare a sediment management plan that will promote the beneficial transport of sediment through the river system while maintaining water quality and addressing the

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needs of fish species protected by the Endangered Species Act.

- The RSM Program continued the Lower Snake River Programmatic Sediment Management Plan sediment surrogate technology development. This study is developing long-term regional solutions to sedimentation issues in the lower Snake River that impact navigation, flood control, reservoir operations, water quality, and aquatic habitats. The sediment surrogate study, under coordination with the U.S. Geological Survey, can be applied to the lower Snake River and its tributaries. The sediment surrogate monitoring on the Clearwater and Snake Rivers for FY 2008 has improved our understanding of cross-channel variability in sediment at both the Clearwater and Snake River sites.

Water Operations Technical Support

The Water Operations Technical Support (WOTS) Program is funded out of the Operation & Maintenance appropriation. The WOTS Program provides for the effective transfer of environmental and engineering technology to address water resources environmental problems at USACE reservoir and waterway projects, and in river systems affected by project operations nationwide. WOTS is managed as a comprehensive centralized program that will maximize cost effectiveness and ensure broad dissemination and implementation of technology and information. Maintaining the environmental and water management conditions at 562 reservoirs (5,500,000 surface acres), 237 navigation locks, 926 harbors, 75 hydropower projects, and 25,000 miles of inland and coastal waterways impacted by the operation of Corps projects requires compliance with numerous statutes and state standards.

The WOTS Program's direct technical assistance function provides rapid direct technical assistance to USACE project offices in applying technology to solve water quality and other environmental problems. The technology transfer function is designed to ensure the effective use of technologies through the appropriate transfer of information and techniques using a variety of media. Short-term field demonstration efforts for the verification of tools developed through R&D and the application of management strategies, techniques, and approaches

are important WOTS functions. By disseminating knowledge of new capabilities to field offices, the WOTS Program will continue to perform a critical technology transfer role in support of all USACE water resources.

Accomplishments in FY 2008 include:

- Provided technical assistance in response to requests by field offices confronted with water quality and other environmental problems. Responses covered diverse issues, including water quality management, watershed management, fisheries, shoreline erosion control, invasive species, sedimentation, and stream stabilization.
- The program conducts numerous training workshops on water quality and environmental management techniques. In 2008, these workshops were attended by approximately 1,000 personnel from Corps Districts, other federal agencies, state agencies, local agencies, private industry, and universities.
- A continual endeavor of the WOTS Program is coordination with water quality and environmental elements of other federal agencies such as the Environmental Protection Agency, Tennessee Valley Authority, Bureau of Reclamation, Fish and Wildlife Service, U.S. Geological Survey, and the Bonneville Power Administration. These efforts have involved watershed management activities, problems related to the introduction and spread of aquatic invasive species, environmental impacts of hydropower facilities, and impacts of water releases in tailwater areas on fisheries.

Scientific and Technical Information Centers

Five information analysis centers located at the ERDC provide the major interface between the Corps and the public and private sectors to gather and disseminate information as required by Public Law 99-802, Federal Technology Transfer Act of 1986. The function of each center is to acquire, examine, evaluate, summarize, and disseminate newly published scientific and technical information generated within the Corps and other activities in the United States and abroad.

The Coastal Engineering Information Analysis Center focuses on wave data and predictions, shore processes, inlet dynamics, navigation channels and structures, harbors, and coastal construction. The Cold Regions Engineering Information Analysis Center focuses on ice engineering, meteorology, climatology, geophysics, geology, remote sensing, global and climate change, and environmental engineering. The Concrete Technology Information Analysis Center focuses on cements, concrete, aggregates, concrete construction, concrete repair, and rehabilitation technology. The Hydraulic Engineering Information Analysis Center focuses on hydraulic, hydrologic, water resources, and sedimentation of streams, rivers, waterways, reservoirs, and natural impoundments; estuaries, and inland and coastal groundwater; fishery systems; and hydraulic structures of all types. The Soil Mechanics Information Analysis Center focuses on embankment and foundation engineering, earthquake engineering, engineering geology, and rock mechanics.

The information centers critically evaluate and summarize the technical validity and merits of published and unpublished research and technical publications on design, construction, or other technology utilization. User communities have been well established and distribution lists for technology transfer are continuously updated. Electronic media including the Web are used where appropriate. The effectiveness of activities and services is evaluated on a continuing basis, and technology transfer products and methodology are revised when appropriate.

CUSTOMER SUPPORT

Increasingly, ERDC expertise and products developed in R&D programs are being requested to solve challenges in critical areas of concern. Following are a few examples of the many projects the ERDC conducts for its many customers, listed by ERDC laboratory.

Reimbursable highlights from Coastal and Hydraulics Laboratory (CHL)

The Inner Harbor Navigation Channel Hurricane and storm damage risk reduction project. Under the direction of the Hurricane Protection Office (HPO), a surge barrier, similar to a floodwall but much larger, will be constructed near the confluence of the Gulf Intracoastal Waterway

(GIWW) and the Mississippi River Gulf Outlet (MRGO). This barrier will consist of a closure of the MRGO, a sector gate on Bayou Bienvenue, and a dual gate structure on the GIWW with a levee being constructed between these three components to complete the barrier. Because the GIWW is a navigable waterway, it will be spanned with a dual gate structure consisting of a sector gate and a barge gate. The proposed width of each gate is 150 ft. The towing industry requested a larger opening for the sector gate due to safety concerns. However, modifying the gate design would negatively impact the Corps' ability to meet the requirement of completing hurricane protection measures by 2011. At the direction of HPO, ERDC began modeling efforts to test the safety of the 150-ft opening and possibly improve its configuration.

Flow conditions for this project were developed using the Adaptive Hydraulics (ADH) modeling code. ADH is a finite element, adaptive hydrodynamic code capable of modeling turbulent flow and a variety of constituents, including salinity and sediment.

Simulations for towboats transiting through the structure were developed by CHL to test the initial floodgate design. The simulations, conducted on the ERDC Ship/Tow Simulator (STS), allowed mariners to operate in a "virtual world," depicting the GIWW after the gate structure was constructed. The mariners piloted their tows in a variety of conditions with eight different tow configurations, strong and average currents for both ebb and flood tide, and two average and two severe wind conditions.

These initial simulations resulted in changes to the structure and operational parameters that the towing industry felt made the structure much safer. Overall, the results of the numerical modeling and STS simulations illustrated the viability and safety of the 150-ft sector gate opening.

Physical and Numerical Models of the Port of Anchorage. The Port of Anchorage, Alaska, serves 80% of Alaska's populated area, and it handles over 90% of consumer goods sold in the rail belt. USACE Alaska District is responsible for maintaining navigation channels and berthing areas at the Port of Anchorage during and after a \$700M phased expansion. Port authorities and Alaska District engineers need to understand how the Port expansion might modify the tidal flows and consequently affect the Corps' dredging mission. Evaluation of navigation safety and potential berthing problems are

also of paramount concern. The flow regime in the upper Knik Arm of Cook Inlet is dominated by a 30-ft tide range and by large eddies shed by prominent headlands. The Port itself is situated in a large eddy during much of the ebb tide cycle. Physical and numerical model studies being conducted at CHL examined flow modifications and changes to sedimentation likely to occur during and after the Port expansion. Results from the numerical hydrodynamic model are being used to drive navigation simulations of the expanded Port of Anchorage using a state-of-the-art ship simulator.

The large physical model replicates approximately 19 miles of Cook Inlet centered on the Port of Anchorage. The model reproduces accurately the spring tide at the Port, and model validation included reasonable reproduction of field-measured tidal velocities near the Port. Model velocity measurements were acquired and compared at strategic locations near the berthing areas for each phase of the Port expansion. Potential sedimentation problems were identified using flow visualization techniques, such as dye injection, combined with time-lapse video.

In conjunction with the physical modeling, a sophisticated numerical model was developed to simulate the complex large-scale eddies and corresponding flow velocities in the Knik Arm of Cook Inlet. The numerical model successfully reproduced field-measured velocities and agreed favorably with the physical model. A linked hydrodynamic/sediment transport model is being used to estimate changes in sedimentation patterns and rates in and around the Port. An advanced numerical model was used to estimate mooring loads for various Port expansion phases.

In preparation for a ship simulator study, a site visit was undertaken in March 2004. Navigation conditions were observed and photos taken for development of the visual scene. Databases for the existing conditions were developed and validated with the assistance of Alaskan ship pilots. Final testing of the expanded dock is scheduled for the second quarter of FY 2009. This study showcased the utility and advantages of combining physical, numerical, and ship simulator modeling technology to make reliable engineering estimates of impacts likely to arise with the Port of Anchorage expansion.

Reimbursable Highlights from Cold Regions Research and Engineering Laboratory (CRREL)

National Levee Database. The Remote Sensing/GIS Center of Expertise has been managing the National Levee Database for HQUSACE as part of the Levee Safety Program. Beginning in FY 2006 USACE received the mandate to design and assemble a National Levee Database (NLD). In FY 2007 the development of the levee database model was completed. This data model was coordinated with the Federal Emergency Management Agency and pilot collection was conducted on five Districts in FY 2007 (3256 miles of levees). Once the pilot collection was completed, inventory and project data collection was initiated in nine additional Districts. A total of 9800 miles of approximately 14,000 miles of Corps program levees have been inventoried by the end of CY 2008. Geospatial and other collected data that are part of the NLD will be available to project stakeholders through a Web-accessible application. Components include a summary screen with a project history and related links, a map interface for viewing geospatial data, reporting and data mining tools, and a help section. The NLD will be the first national comprehensive geospatial database for critical levee infrastructure in the United States.

USACE Actions for Change: Comprehensive Systems Approach. CRREL led a national team for USACE's Actions for Change (Theme 1: Comprehensive Systems Approach). The Actions for Change are concepts based on internal and external analyses following Hurricane Katrina on which the USACE will focus to transform its priorities, processes, and planning to better serve the nation and its Armed Forces across all our mission areas. The two major goals are to improve public safety and USACE water resources infrastructure. Actions for Change Theme 1 emphasizes an integrated, comprehensive, and systems-based approach incorporating anticipatory management to remain adaptable and sustainable over time that places the highest priority on protection of public health and safety. These changes require USACE to use collaborative, adaptive planning and engineering systems throughout the project life cycle to effectively manage its aging infrastructure in an environmentally sustainable manner through explicit risk management. Products include a comprehensive evaluation and compliance tracking for a nationwide vertical datum; an interagency report on "Climate Change and Water Resources Management: A Federal Perspective" ([USGS Circular 1331](#) released February 2009); development of updated sea level change policy; a preliminary version of a Watershed

Investment Decision Tool; and activities supporting sustainable solutions, adaptive management, post-construction system evaluation, and multi-objective system planning and policy.

National Wetland Plant List. The Remote Sensing/GIS Center of Expertise is leading a national effort by USACE to update the National Wetland Plant List (NWPL). Interest in wetland plants comes from all levels of government, academia, the private sector, and non-profit organizations. The NWPL (and the information implied by its wetland plant species status ratings) is used in wetland delineation, wetland restoration and research, and the development of compensatory mitigation goals, as well as providing general botanical information about wetland plants. The NWPL covers all 50 U.S. states, the District of Columbia, and the Caribbean and Pacific islands that are considered to be U.S. territories. The list is organized into ten regions that coincide with Corps wetland delineation regions. Updating the NWPL is a cooperative effort of the Corps, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Natural Resources Conservation Service, states, Indian Nations, the academic community, and the scientific portion of the public. Each of the regions is represented by a panel consisting of botanists or ecologists from each of the four lead federal agencies; these panels will initiate draft wetland plant ratings. Further scientific input will be incorporated from ecologists from each state and Indian Nation, along with qualified botanists or ecologists from all sectors of government, academia, and the public.

Phenomenological Stages of Sea Ice in Solar Energy. The Terrestrial and Cryospheric Sciences Branch (TCSB) of CRREL has been supporting the National Aeronautics and Space Administration (NASA) in conducting a study to quantify the role of solar energy partitioning in the recently observed decrease in Arctic sea ice mass. In particular, the investigation researches the impact of the lengthening of the melt season on the decrease in Arctic ice by tracking seasonal changes in sea ice stages of development and evaluating the seasonal evolution of albedo associated with the sea ice stages. This analysis will allow evaluation of the relative importance of increased summer length versus increased thermal forcing on the diminished Arctic sea ice cover. This project looks at satellite imagery of seasonal and perennial ice. Through satellite observations it has been determined that older (perennial) ice is being exported from the Arctic leaving thinner ice subject to atmospheric forcing. This study is providing a better understanding of

matching satellite observations to the changes in seasonal and perennial sea ice. The program has demonstrated that dynamics play a major role in the observed decreases in the sea ice cover establishing the role of ice motion as well as thermodynamics.

Cold Weather Performance Investigations. The Force Projection and Sustainment Branch (FPSB) of CRREL has been supporting the Federal Aviation Administration (FAA) in performing cold weather durability studies on their Engineered Material Arresting Material (EMAS). EMAS is a cellular concrete product typically placed at the end of airport runways to form an arrestment bed to replace or supplement Standard Runway End Safety Areas that are not adequate for current safety regulations. Four series of tests were performed on large-scale bed thermal cycling, small-scale temperature and humidity cycling, seam tape adhesion tests, and temperature and humidity cycling under cold weather conditions. These tests provided FAA with positive results for the EMAS cold weather performance for future deployment of this system of national safety importance.

USACE National FEMA Project Delivery Team (PDT). The Remote Sensing/GIS Center of Expertise manages the USACE National FEMA PDT. The FEMA PDT began in October 2004 with two primary goals: to provide nationwide support to FEMA for its Map Modernization (MapMod) and other hydraulics and hydrology studies, and to provide capacity building to the Hydrology, Hydraulics, and Coastal CoP. The PDT also facilitates effective virtual teaming, especially important since FEMA regional boundaries cross USACE Division and District boundaries. The PDT is currently handling approximately \$7M in MapMod studies for FEMA Region III and its partner, Maryland Department of the Environment. These projects involve the participation of 21 Districts in six Divisions, plus the Remote Sensing/GIS Center of Expertise and the ERDC Coastal and Hydraulics Laboratory. The primary benefit of this collaborative effort is that flexible teaming between Districts helps USACE meet FEMA's tight time deadlines for MapMod Projects in a manner that allows USACE to build and maintain core competencies in hydrology, hydraulics, and coastal engineering within a geospatial framework. FEMA benefits through the involvement of local USACE Districts with intimate knowledge of past, present, and future projects impacting flood damage reduction.

Reimbursable highlights from Environmental Laboratory (EL)

Sacramento District Dredging Support. The EL Environmental Chemistry Branch (ECB) has been supporting the Sacramento District O&M dredging activities for the past several years. The Sacramento District is continually maintaining the Deep Water Shipping Channel (DWSC) through dredging activities since this is one of the busiest shipping channels in the United States.

In FY 2008, widening and deepening of the DWSC channel was approved and will be carried out in FY 2009, necessitating a full chemical characterization of the material to be dredged requiring extremely low detection limits. All dredging activities in the channel are approved by the Central Valley Regional Water Quality Control Board (CVRWQCB). Site water and sediment from the channel are analyzed for a range of metals, pesticides, and other chemical and physical parameters. The analyte concentration reporting limits are lower than most commercial laboratories can achieve; furthermore, the saline matrix produces interferences for several analytes, necessitating using specialized methods developed within the ECB.

ECB also performed modified elutriate tests, Dredge Elutriate Tests, and Deionized Water Extraction Tests. The data is reported to the Sacramento District in Staged Electronic Data Deliverable format, including Automated Data Review files. Because the CVRWQCB uses our data to manage and determine the dredging activities, we provide data turnaround in 30 days or less from sample receipt.

Risk and Reliability Study to Evaluate Levee Improvement Alternatives on the West Bank of New Orleans. ERDC scientists and engineers are providing technical support to the New Orleans District to evaluate the risk reduction benefits of alternative hurricane protection system designs on the West Bank of New Orleans. The existing hurricane protection system consists of parallel protection that runs along the Gulf Inter-coastal Waterway, the Harvey Canal, and the Algiers Canal.

The District is presently raising the level of flood protection along the canals to restore an authorized level of flood protection in the area. However, raising existing parallel protection would entail increasing levee footprints and displacing industrial

sites along the canal. The District has proposed alternative designs that avoid increasing levee footprints for more than 30 miles of parallel protection by installing a navigable sector gate and pump station at strategic locations to block storm surge from entering the canals.

ERDC completed a deliberative assessment of the relative reliability of design alternatives and is modeling the risks associated with four revised design alternatives using a model developed by the Interagency Performance Evaluation Task Force following Hurricane Katrina. ERDC is developing fragility curves for the various features and simulating flood frequencies and damages in West Bank subbasins using storm modeling results from the Advanced Circulation Model. The analysis will quantify the flood risks and risk reduction benefits associated with the alternative system configurations. Results of this analysis will assist decision makers in quantifying the benefits and costs of the proposed alternatives and selecting a preferred alternative. The significance of this research is that it has helped to advance the agency's use of risk-based decision methods.

Phase 1 of this project helped improve the Districts communication with stakeholders and the deliberation among the District, sponsors, and other stakeholders regarding design alternatives. Several revisions to the alternatives and incremental project decisions were made considering the deliberative assessment. Phase 2 of this project is modeling the risk reduction benefits and the costs of each alternative. Results of this analysis will assist decision makers in making a final selection of the preferred alternative. Results of this analysis will assist decision makers in quantifying risk reduction benefits and evaluating the net benefits of each alternative to select a preferred design alternative. Modeling results are not yet final, but results to date suggest that there are risk reduction benefits, cost savings, and environmental benefits associated with the navigable sector gate alternatives.

Reimbursable highlights from Geotechnical and Structures Laboratory

Vanadium Steel Reinforcement Bar Cast Study for the Advanced Technology Institute. The effects of using High Strength Low Alloy vanadium microalloyed steel (HSLA-V steel) reinforcing bar coupled with high-strength concrete in walls were investigated to resist a blast threat. One-third scale

reinforced concrete slabs/walls were dynamically tested in ERDC's Blast Load Simulator (BLS) to determine their blast response capacities. An experimental matrix was developed which the reinforced concrete slabs were constructed with high performance materials (HSLA-V steel rebar and high-strength portland cement concrete (HSPCC)) and conventional materials (Grade 60 steel rebar and 4ksi concrete). The reinforced concrete slabs were constructed using combinations of the steel rebar and concrete materials to determine the effectiveness and contributions that each material had to a blast resistant design wall system. All material combinations that the slabs were constructed with were dynamically tested in the BLS with various pressures and impulses to ensure a high level of damage occurred on each slab. The results from each experiment were analyzed and comparisons were made of which slab combinations performed the best under a potential blast environment.

Numerical Simulations of Gravity Dams for HQUSACE. In a recent research study, empirical formulas and computational techniques were used to calculate blast loads and resulting damage to dam components from underwater explosions. State-of-the-art computational techniques were used and compared against experimental data in order to validate and, if necessary, adjust the results of calculations of the blast loads and damage to the dam components. It is proposed that computational models of gravity dams be constructed and numerically subjected to the loads generated by surface and underwater explosions. These models will be at both full scale for parameter studies and small scale for validation against experimental data. Charge sizes will be determined to generate significant damage within the gravity dams, and the range of charge sizes necessary investigated. The entire underwater explosion process will be examined from initial short time shock loads to possible bubble jetting loads generated at much longer times. Simulations will be validated against the acquired test results, and further simulations will be performed over the parameter space varying explosive charge weight and detonation depth and range.

Tunnel Testing for the Department of Homeland Security. This initial effort investigated the vulnerabilities of underwater cast iron transit tunnels to terrorist attack. A total of 12 highly explosive field experiments were conducted to validate a numerical model that was being developed simultaneously. A sub-scale ductile iron pipe was placed in three different types of media and subjected to internal detonations. The breach response of the

pipe was documented and comparisons were made to the response predicted by the numerical model.

Resilient Materials Development for HQUSACE. The use of innovative ultra-high performance concretes to harden and/or repair existing hydraulic structures from the effects of blast will be investigated. This investigation will examine the use of pre-cast panels made from ultra-high performance concrete that can be incorporated into existing Corps repair techniques using the pre-cast, stay-in-place forming method. This proposal seeks to develop and evaluate new composites through both laboratory and field evaluations.

Anti-terrorism Force Protection for HQUSACE. Risk assessments will be performed of 18 USACE administrative facilities selected by the Command Provost Marshall (CPM) and the Critical Infrastructure Protection Manager (CISP). Four assessments (Physical Security, Risk Management, Unified Facilities Criteria, and Higher Headquarters (ARNORTH directed checklist)) were performed for each facility, and reports developed and provided to the facility, CPM, and CISP. All scheduled assessments were completed.

Underwater Jetting for the Department of Homeland Security. Underwater explosions can generate a jet of water that can impart a large amount of impulse onto a structure. Historically, the vertical version of this phenomenon (manifested as a water plume near the surface) has undergone considerable investigation. Also, a considerable amount of effort has been made to determine the effect on the components of dams from the shock loading due to underwater explosions. This project is investigating the effect of the bubble jet on dam structures, including the determination of under what circumstances the bubble jet will form and strike the structure, what the loads on the structure will be from the bubble jet, and what is the response of the structure to those loads.

Reimbursable highlight from Topographic Engineering Center

National Datum: Vertical Control Project Delivery Team. The Vertical Project Delivery Team (VCPDT) is part of the Action for Change Theme 1 initiative to implement the lessons learned from Hurricane Katrina. ERDC leads a team of members from HQUSACE, Districts, academia, and several groups within NOAA to implement a nationwide datum and subsidence standard methodology for the

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Corps, initiate and populate database, provide and update guidance manuals containing references to elevations and datums, develop certification process and provide training to reach certification, and develop standard methodology for updating geodetic and water level information within projects. This effort was initiated in FY 2007 and is planned to continue through FY 2012.

Comprehensive Evaluation of Project Datums.

ERDC expertise in survey engineering was enlisted for the Comprehensive Evaluation of Project Datums (CEPD), a nationwide program to conduct a vertical datum review of all Corps federally authorized and constructed hurricane protection, shore protection, flood control, and navigation projects. ERDC coordinated the effort to implement lessons learned from the recent findings of the Interagency Performance Evaluation Task Force (IPET) on Hurricane Katrina. These findings highlighted the need to ensure that the Corps' flood control and navigation projects across the country are referenced to the proper vertical datums to correctly compensate for subsidence/sea level rise. The IPET findings also highlighted the need to ensure that all projects are adequately referenced to nationwide spatial reference systems used by other federal and local agencies responsible for flood forecasting, hurricane surge and inundation modeling, navigation, flood insurance rate maps, hurricane evacuation route planning, coastal boundary delineation, bathymetric mapping, and topographic mapping. This review is to inventory the vertical datums used on all flood control, hurricane protection, and navigation projects; identify deficiencies in those datums that require corrections; develop a plan to transition to the correct datums; and implement appropriate project changes if needed. Accomplishments included the development of guidance documentation for the evaluation and reporting of project vertical datums (Engineer Circular 1110-2-6065), the development of a training class in coordination with NOAA, conducting a training and certification class for District Datum Coordinators from each Corps District, and development of a database and tool to track the evaluation process.

INSTITUTE FOR WATER RESOURCES

BACKGROUND

The U.S. Army Engineer Institute for Water Resources (IWR) is a field operating activity under the staff supervision of the Director of Civil Works, Headquarters, U.S. Army Corps of Engineers (HQUSACE). The Institute is the USACE knowledge center for integrated water resources management (IWRM), and is specifically recognized as a national expertise center for planning methods, risk analysis, hydrologic engineering, citizen participation and conflict resolution, international water resources, global climate change science, and the collection, management and dissemination of Civil Works and navigation information, including the Nation's waterborne commerce data.

IWR was established by the USACE Chief of Engineers in 1969 with the approval of the House and Senate Appropriations Committees and the Subcommittees on Public Works in order "to enhance the capability of the Corps of Engineers to develop and manage the Nation's water resources, within the scope of the Corps' responsibilities, by developing essential improvements in planning to be responsive to the changing concerns of our society."

The Institute's mission is to facilitate the adaptation of the Civil Works program to future needs by providing the USACE with the capability for developing forward-looking analysis and state-of-the-art methodologies. IWR fulfills this mission by supporting the Civil Works Directorate and USACE Major Subordinate Commands (MSCs) and District offices by providing: (a) analysis of emerging water resources trends and issues; (b) state-of-the-art planning and hydrologic engineering methods, models and training, and (c) national data management of results-oriented program and project information across Civil Works business lines.

IWR CENTERS

IWR has offices at three locations, each of which is a USACE designated center of expertise (DX): the National Capital Region (NCR) and Navigation Data Center (NDC) offices in the Casey Building at the Humphreys Engineer Center, Alexandria, Virginia; the Hydrologic Engineering Center (HEC) in Davis, California and the Waterborne Commerce Statistics Center (WCSC) in New Orleans, Louisiana. WCSC is part of the Navigation Data Center (NDC).

In 2008, IWR was in the process of establishing a fourth office at a location to be determined – the Risk Management Center (RMC), which will provide USACE with a critical mass of specialized engineering expertise in dam and levee safety.

National Capital Region Office: The IWR NCR office is the Corps designated center of expertise for the development of methods, models, and analytical tools used for water resources and water systems planning, investment decision-support, public participation and conflict resolution, and international water resources. IWR fulfills this mission through a synergy of water resources planning and socio-economic expertise that blends practice with research, policy development and information. IWR planners, economists, social scientists, civil engineers and specialists in the physical sciences lead Civil Works strategic planning and technology transfer initiatives; conduct national and focused policy development studies; develop a broad range of partnering and investment decision-support techniques, methods and models for integrated water resources management (IWRM) and navigation system applications; interact with national and international members of the water resources community at-large and partner with the HQUSACE, Corps field offices and laboratories in solving complex technical water resources planning and evaluation problems. In particular, the Institute provides a critical mass of socio-economic expertise within the Corps and serves as the residence for the USACE Chief Economist position, which is responsible for the leadership of the Corps Economics Community of Practice (CoP).

IWR also provides a cadre of international water specialists who lead the USACE's engagement in water resources partnerships around the globe. In 2007 IWR expanded its collaborative partnerships when it established the International Center for Integrated Water Resources Management (ICIWaRM). USACE IWR, through ICIWaRM, was nominated by the U.S. Government to be a UNESCO Category II Water Centre, working in collaboration with key university, federal agency and non-governmental partners sharing an interest in the advancement of the science and practice of integrated water resources management. In 2008, ICIWaRM's nomination as an international water center was endorsed by the governing body of UNESCO's International Hydrological Programme (IHP).

IWR's new Conflict Resolution and Public Participation Center (CPC) focuses both on the processes associated with conflict resolution and the integration of public participation techniques with decision support and technical modeling (Computer Assisted Dispute Resolution - CADRe). The Institute has pioneered the development and advancement of one such CADRe approach known as *Shared Vision Planning* (SVP), and in 2008 IWR was actively involved in supporting USACE districts, the International Joint Commission (IJC), and a range of State and local governments, on the application of SVP as a means to address water resources problems across the nation. Additional information about IWR is available on its web site at www.iwr.usace.army.mil.

Hydrologic Engineering Center (HEC): The primary goal of HEC from its inception in 1965 has been to support the Nation in its water resources management responsibilities by increasing the Corps technical capability in hydrologic engineering and water resources planning and management. An additional goal is to provide leadership for improving the state of the art in hydrologic engineering and analytical methods for water resources planning. Program efforts in research, training, planning analysis and technical assistance raise awareness of the problems and needs of the Corps and the Nation. HEC is committed to keeping abreast of the latest developments throughout the water resources engineering profession and to make use of this information in a manner best suited to the needs of the USACE nationally and internationally. HEC increases the effectiveness of the Corps and the profession by bridging the gap between the academic community, practicing hydrologic engineers and planning professionals. HEC ground-tests and incorporates state-of-the-art procedures and techniques into manuals and comprehensive computer programs. The procedures are made available to the USACE, United States government and international professionals through an effective technology transfer system of technical assistance, publications, DVD's and training. Technical specialty areas addressed by HEC include: precipitation runoff processes, reservoir regulation, reservoir systems analysis, hydrologic statistics and risk analysis, river hydraulics and sediment transport, groundwater hydrology, water quality and analytical aspects of water resources planning. Application areas include: flood risk management, real-time water control, water control management, hydroelectric power, navigation, erosion control, water supply, watershed studies and ecosystem restoration. Additional information about HEC and its software is available on its web site at www.hec.usace.army.mil.

Navigation Data Center (NDC): NDC is the Corps designated center of expertise for the management of infrastructure utilization and performance information for U.S. waterways and port and harbor channels. Because of the integrated nature of water resources, NDC also directly supports a range of related Civil Works business areas, including hydropower, recreation, environmental compliance, environmental stewardship, water supply, regulatory and homeland security, as well as other Federal, state and local agencies and the private sector. The primary operational arm of NDC is the Waterborne Commerce Statistics Center (WCSC), which provides one-stop capability for national navigation information systems. NDC also provides integrated business information in support of Corps decision making including financial output, performance measurements and performance-based budgeting processes. Additional information about NDC is available on its web site at www.ndc.iwr.usace.army.mil.

FY 2008 SUMMARY

Post-WRDA 2007 Context: The Institute's FY 2008 program continued to affirm IWR's status as a key USACE institutional asset, serving as the intellectual foundation to the future direction of the Corps Civil Works program, the overarching USACE missions, and the Nation's water resources. Many of the technical and policy development challenges faced in FY 2008 represented an extension of the ambitious program that emerged in the aftermath of the hurricane devastation wrought along the U.S. Gulf Coast in 2005, and the subsequent program and policies reforms ushered in through the enactment of the Water Resources Development Act (WRDA) of 2007 (P.L. 110-114).

The robust mix of planning, policy, engineering and research initiatives that IWR initiated and continued during FY's 2006-2008 was based on the anticipation of a renewed national emphasis on water resources systems (i.e., regional and watershed level planning), accompanied by a Federalism shift from the "project-partnering" paradigm applied to water resources during the late 20th Century, to a new, more collaborative relationship between Federal and State governments in solving water resources at the regional scale. This contemporary planning focus on IWRM and global change provided the overarching context for what proved to be the most challenging, productive and rewarding year in the Institute's 39-year history.

After years of preparatory planning, organizational enhancement, and strategic refinement of IWR's

capabilities and focus, FY 2008 represented the culmination of the Institute's substantive technical contributions during an especially crucial timeframe for the USACE and the Nation given the need to transform Federal water resources programs to emphasize 21st Century perspectives, policies and approaches. The enactment of WRDA 2007 served to promulgate program and policy changes based on the results from a wide range of post-hurricane inquiries, investigations and analyses that focused on the circumstances around the 2005 hurricane induced disasters along the U.S. Gulf coast, while also addressing several broader issues of policy interest: (1) the application of integrated water resources management (IWRM); (2) producing outcomes that reflect sustainable solutions, i.e., balancing society's goals for economic development with those for healthy aquatic ecosystems and public safety; (3) a renewed commitment to resilient infrastructure and communities; (4) the embrace of risk-informed communications and decision-making; and (5) enhanced collaboration between Federal, State, local and non-governmental stakeholders.

The U.S. and its principal agencies and science academies (in partnership with other government agencies, non-government organizations, professional societies, universities, and international organizations) undertook a number of comprehensive post-flood audits aimed at identifying lessons learned to inform future decisions on how to harden the hurricane protection system and strengthen flood preparedness and response processes. Aspects of the review encompassed the design and safety standards used for infrastructure, governance and institutional considerations, along with examining the analytical principles and policies used for determining project scope, formulation and justification. The Institute actively participated in this unprecedented array of ex-post initiatives, which involved technical experts drawn from across IWR and the entire USACE.

Key Post-WRDA 2007 Activities: In particular, the enactment of a number of WRDA provisions directly impacted IWR FY 2008 activities, illustrated by the following examples:

- The revised cost-sharing provisions for **watershed studies** (WRDA 2007, Sec. 2010) served to further the alignment of the Civil Works program with IWRM and elevate the importance of the Institute's FY 2008 work on the enterprise GIS-based watershed investment decision tool, the Hydrologic Engineering Center's research to advance the Watershed Assessment Tool (HEC-WAT), and policy and programmatic initiatives

for assisting USACE districts in applying regional sediment management approaches (also relevant to WRDA 2007 Sec 2037);

- The technological advancement of electronically accessible, mission relevant performance data (WRDA 2007, Sec. 2017) reinforced the IWR-NDC information program (OMBIL - *Operations & Maintenance Business Information Link*) and OMBIL's Regulatory Module (ORM2.0) which was fully deployed to USACE districts;
- The emphasis on **international water resources** (WRDA 2007, Sec. 2030) affirmed the growing importance of U.S. goals for international water security and sustainability, and aligned with IWR's status as the U.S. nominated global center for IWRM in partnership with UNESCO's International Hydrological Programme (IHP). In 2008 IWR also forward deployed an international water resources expert as the USG liaison to the Secretariat of the 5th World Water Forum in Istanbul, Turkey, in anticipation of the Forum event in March 2009;
- The revision and update of the **Water Resources Principles and Guidelines** (P&G) (WRDA 2007, Sec. 2031) manifested IWR's active support to the HQUSACE and Office of the Assistant Secretary of the Army (Civil Works) [OASA(CW)] in scoping proposed P&G revisions, assisting in the conduct of the June 2008 public meeting to solicit comments on the existing P&G; participating in the development process for the revised P&G put forward by the ASA(CW) in September 2008, and the review and analysis of the public comments received in response to the published draft;
- In anticipation of the upcoming revision to the P&G, IWR initiated several planning methodology initiatives aimed at seamlessly providing USACE field practitioners with new planning reference tools that are aligned with the contemporary water resources principles. These include an *Economic Primer*, the update of *National Economic Development Manuals for Coastal Storm Damage Reduction and Deep Draft Navigation*, an *Overview NED Manual*, handbooks on the consideration and treatment of *Other Social Effects* and *Regional Economic Development*, a *Multi-objective Planning Manual*, and a *Multi-Criteria Decision Analysis* software module within the IWR Planning Suite Model.
- The provisions of WRDA 2007 (Sec. 2034) for **Independent Peer Review** resulted in IWR

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support to HQUSACE in scoping new review procedures and requirements, and the initiation of a new contracting vehicle for procuring services that facilitate a robust capability for accomplishing independent peer reviews on a national level; and,

- The enactment of the **Levee Safety Program** (WRDA 2007, Title IX), formalized and elevated the role of USACE in national levee safety and was a motivating factor in HQUSACE approval for IWR establishing its Risk Management Center (RMC) to provide nationally consistent safety assessment tools, approaches and outcomes for dams, levees, and other engineered structures.

In addition, the Institute concurrently continued the following post-Hurricane activities in 2008:

- IWR's leadership of the **Hurricane Protection Decision Chronology** (HPDC) to assemble and publicly document the 50-year chronological record of planning, economic, policy, legislative, institutional and financial decisions that shaped the hurricane protection system for greater New Orleans culminated in the publication of the final HPDC report on the IWR website in June 2008; and,
- IWR's national experts continued to serve on the Corps major organizational response team for infusing technological and institutional reforms based on the lessons learned from Hurricane Katrina—the **Actions for Change** (AFC) initiative. The USACE IWR Chief Economist led the Risk Informed Decision Making team, while IWR specialists actively participated in the Risk Communication and Comprehensive Systems teams, including the leadership of the Temporal and Spatial System (Global Climate Change) team; development of the Watershed Investment Decision Tool; and the Multi-Objective System Planning and Policy team.

Overall, in FY 2008 IWR executed a record program of approximately \$52 million with 162 authorized in-house employees, primarily in professional scientific-engineering disciplines, with most possessing advanced degrees. The Institute's in-house staff was supplemented by other experts detailed from USACE field offices and laboratories, and Intergovernmental Personnel (IPA) Act visiting scholars from universities, state and local governments, policy think-tanks, and through contracting with the private sector. A major transforming factor during 2008 was the Institute's corporate focus on recruitment, with over 35

new hires (almost 25% of the in-house workforce) made across IWR, including the active use of Federal programs such as hiring the Corps first Presidential Management Fellow (PMF), and an increasing use of the National Academy of Sciences' Research Assistantship Program (RAP) to bring on recent post-Doctoral graduates as water resources specialists.

In FY 2008, Dr. Yacov Haimes of the University of Virginia continued his appointment at the Institute as the Maass - White Scholar. Dr. Gerald Galloway, Maass-White Scholar at IWR during the period of 2006-2007, continued his association with IWR throughout FY 2008 working on several key initiatives associated with the Institute's leadership of the National Flood Risk Management Program, including the interagency coordination on a joint-USACE-FEMA led effort to update Executive Order 11988 on Flood Plain Management.

Nobel Prize Recognition: FY 2008 also represented a milestone for the recognition of the contributions of climate change scientists around the world, with the Norwegian Nobel Committee awarding the Peace Prize to former Vice-President Al Gore and the *Intergovernmental Panel on Climate Change* (IPCC). IWR's Dr. Eugene Z. Stakhiv, who has been an active contributor to the IPCC from its inception, was honored by the IPCC in December 2007 and shared in the recognition for the Nobel Peace Prize. Dr. Stakhiv co-chaired the first IPCC Water Resources Group, served as lead author in the second and third IPCC reports, and actively participated as a reviewer for the fourth IPCC report.

The summary of the Institute's other major 2008 initiatives are presented within the context of the key themes which framed these activities – IWRM, collaborative planning and partnerships, technological advancements, and international activities:

Integrated Water Resources Management: While the Institute's Future Directions Program and Civil Works Strategic Planning activities continued to foster a corporate recognition of the need for systems approaches to solving water resources problems, IWR specialists played central roles in advancing the practice of IWRM through the successful completion of the *Lake Ontario and St. Lawrence River Study* for the International Joint Commission (IJC), and the acceleration of the follow-on IJC study for the *International Upper Great Lakes* (IUGLS) which is investigating the extent to which Lake Superior outflow water management affects the on-going changes in lake levels for Superior and Lakes Michigan, Huron, and Erie and their connecting

channels, particularly the St. Clair River. The demonstrated value of practicing IWRM was also furthered by the involvement of IWR specialists in the Corps *Western States Watershed Study*, and the embrace of the study findings by the Western States Water Council (WSWC) and the Western Governors Association (WGA), as reflected in the publication of the USACE *Western States Watershed Study Final Report*, and the WSWC's own report *Water Needs and Policies for a Sustainable Future: Next Steps* (June 2008). Among the key outcomes of this initiative was the establishment of WESFAST – the *Western States Federal Agency Support Team*, with a Federal liaison position, representing all of the Federal water-related agencies, and deployed at the WSWC offices in Salt Lake City. The IWR Director participated in the interagency search and served on the selection panel for the position, which was filled by a candidate from the U.S. Bureau of Reclamation.

IWR specialists led the adaptation to climate change assessment portion of the Western States Watershed Study, and continued to actively participate in and lead several follow-on climate change initiatives through active participation in the *Climate Change and Western Water Group* (C-CAWWG). An IWR senior scientist also served as the co-lead, in collaboration with the USACE Engineer Research and Development Center (ERDC), for the Gulf of Mexico Regional Sediment Management (RSM) demonstration program, and other Corps RSM activities, and IWR and HEC specialists continued to provide technical assistance on several pilot project partnerships with The Nature Conservancy on their Sustainable Rivers Program.

At the same time, IWR researchers worked to continue advancing IWRM planning, economic and hydrologic and hydraulic engineering tools, resulting in the 2008 issue of the new *IWR-Planning Suite* software, and the release of new editions of the full range of HEC's flagship NexGen software products, along with the rollout and immediate field application of state-of-the-art systems models for maritime transportation economics as part of the Institute's *Navigation Economic Technologies (NETS) Research Program*. Another significant technology milestone was the completion of the deployment and training phases for the *OMBIL Regulatory Program Module* (ORM 2.0), a web-based, enterprise GIS data management system now used by all USACE field offices, which provides the anchor technology for watershed-based analytics and decision-support for the Corps regulatory program, and is expected to play a foundational role for the entire Civil Works program.

A key IWRM-related activity was the nomination (in February 2008) of USACE IWR's *International Center for Integrated Water Resources Management* (ICIWaRM) by the ASA(CW) and the U.S. State Department as a global water center as part of the UNESCO's International Hydrological Programme (IHP). The USG nomination served to affirm USACE IWR's status among the world's premier expertise centers for IWRM, and ICIWaRM will also be the first U.S.-based UNESCO water center, and the first such center in North America.

Collaborative Planning and Partnerships: Through the Institute's role in supporting the USACE-wide implementation of the Civil Works Strategic Plan (2004-2009) and the ongoing development of the next Strategic Plan (2010-2014) in accordance with the *Government Performance and Results Act* (GPRA), IWR continued to promote, support and engage in intergovernmental collaborations and partnering throughout USACE, and with a wide range of national and international institutions and organizations as a means of accomplishing common goals. IWR continues to serve as the USACE lead for multiple national partnerships and is committed to developing new technologies, processes and policies to further collaborative planning and partnering.

IWR's partnering focus on national water resources issues in 2008 included representing both USACE and the Office of the Secretary of Defense (OSD) on the Executive Office of the President's National Science and Technology Council Interagency Subcommittee on Water Availability and Quality (SWAQ). IWR actively participated in the development of the SWAQ Strategic Plan for Federal water resources agencies to ensure adequate water availability and quality, culminating in the publication of the report "*A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States*", September 2007. IWR is likewise supporting USACE participation in the implementation of the President's Ocean Action Plan through integrated networks and partnerships of Federal, state, local, territorial and tribal authorities, the private sector, international partners and ocean communities.

In the advancement of collaborative planning models and guidance, IWR's *National Cooperative Modeling and Collaborative Planning and Management Demonstration* programs worked in synergy to test and demonstrate a variety of collaborative modeling tools and concepts. Given the Institute's long history of applying collaborative modeling tools through its signature *Shared Vision Planning* (SVP) process, IWR was positioned to advance and apply contemporary

conceptual and methodological approaches, as well as documenting, vetting and publicizing the advances and experiences of other institutions.

This led to HQUSACE designating IWR's Conflict Resolution and Public Participation (CPC) as a USACE national expertise center (DX) in 2008. IWR-CPC established an extended partnership via a new MOA with the *U.S. Institute for Environmental Conflict Resolution* (USIECR), located within the *Udall Center* at The University of Arizona. The combined resources of USACE IWR and USIECR provide a robust capability for assisting USACE field offices and other government agencies in the resolution of environmental, natural resources and public land conflicts and controversies through facilitated negotiation, mediation, and collaborative problem-solving, including the use of collaborative computer modeling to help solve disputes over water.

IWR also published a collaborative planning handbook for use by USACE field practitioners. The report entitled, "*Project Planning in Collaboration with Government Entities – Practical Approaches*" (IWR publication *07-R-02*) provides an introduction to the concept of collaboration as it applies to problem solving with Federal, state, and local governmental agencies.

The Institute executed a wide range of technical assistance projects, such as HEC's support of system-wide reservoir operations for the *Lower Colorado River Authority* (LCRA). IWR continued building international water partnerships with the appointment of IWR senior staff to the Governing Board of the United Nations Educational, Scientific and Cultural Organization (UNESCO) *Institute for Water Education* (IHE-Delft), and the Advisory Board of the *International Center for Water Hazard and Risk Management* (UNESCO-ICHARM).

New Memoranda of Understanding (MOU's) were executed in FY 2008 with a number of universities and professional organizations, with these partnerships facilitating cooperation in technology, science and research in aspects of integrated water resource management and capacity building in developing nations and countries in transition. Each of the universities with which IWR has entered into MOUs has unique program features that compliment the strengths and talent of the Institute. These include the aforementioned *U.S. Institute for Environmental Conflict Resolution* (USIECR) within the *Udall Center* of The University of Arizona, and new partnerships with *Colorado State University*, *Civil and Environmental Engineering*

Department/International School for Water Resources, *Sandia National Laboratory* (SNL); the *American Water Resources Association* (AWRA); and the *Global Water Partnership* (GWP).

In FY 2008 the *Silver Jackets Program*, a key partnering mechanism with the Federal Emergency Management Agency (FEMA) and other Federal, State and local agencies to ensure continuous interagency pre-disaster collaboration at the state level, expanded the number of operational regional teams into six states, with the ultimate goal of offering at least one interagency team within every state. Efforts are planned to initiate or supplement existing teams in the states of Idaho, Kansas, Hawaii, Texas, Louisiana, New Mexico, Kentucky, Illinois and Missouri, with at least one team anticipated in both of the Corps North Atlantic and South Atlantic Divisions.

USACE also established the *Regional Interagency Levee Task Force* (ILTF) in 2008 in response to the catastrophic floods in the upper Midwest earlier that year. The ILTF enabled a joint Federal-state partnership to address expedited repair of damage levee systems in the upper Midwest and identify non-structural mitigation measures that could be implemented during recovery to reduce future flood risks. The ILTF included regional representatives from the USACE, FEMA, USEPA, the Economic Development Administration, US Fish and Wildlife Service, NRCS, USGS, the Small Business Administration, Department of Housing and Urban Development, and representatives from the States of Iowa, Illinois, Wisconsin, Missouri and Indiana.

Technological Advancements: IWR continued to provide technical assistance on *Risk Analysis* to the New Orleans District and Mississippi Valley Division on the congressionally authorized Louisiana Coastal Protection and Restoration (LACPR) study. IWR senior staff specified a scenario-based, risk-informed planning approach to be integrated within the Corps traditional six-step planning process, and led workshops with LACPR staff to enhance understanding and advance the implementation of the planning framework for coastal Louisiana. This served a complementary purpose of developing a nationally consistent *risk-informed planning framework* to support implementation of the risk-based concepts in planning, design, construction, operations, and major maintenance action of Actions for Change. IWR involvement was concentrated on implementation, using the LACPR study as a test-bed demonstration.

INSTITUTE FOR WATER RESOURCES

Adaptation to Climate Change: IWR accelerated its work in FY 2008 on the development of a policy and management framework for addressing USACE adaptation to global change across the Civil Works program, including climate change and other changes due to demographics, land use, emerging regional water scarcity, increased competition for water use, and evolving societal values. Key initiatives include:

- An interagency group was formed to develop consistent water management adaptation policies and approaches to address global change across Federal water agencies, and to jointly consider what actions Federal agencies should take to incorporate climate change considerations into their water resources activities. The interagency group is composed of engineers, scientists and water managers from USACE, the U.S. Geological Survey (USGS), the U.S. Bureau of Reclamation (BuRec), and the National Oceanic and the Atmospheric Administration (NOAA) Climate Program Office.
- IWR also supported another interagency group that includes the U.S. Environmental Protection Agency (EPA), USACE, NOAA, USGS, BuRec, and the Department of Agriculture, Natural Resources Conservation Service (NRCS) and U.S. Forest Service, who have come together to cooperate in joint scientific and research efforts aimed at adapting U.S. water programs to address changing climatic conditions.
- IWR worked with other Corps offices and laboratories on the accelerated development and release of a revised *USACE Engineer Circular (EC) on Sea Level Change*, which also reflected scientific collaboration with USGS and NOAA's National Ocean Service. The new EC is scheduled for release in FY 2009.
- IWR is also leading other USACE climate teams in developing more detailed field guidance on the application of the new EC on Sea Level Change for coastal planning, engineering and O&M activities, and to put in place a process for evaluating the vulnerability of USACE coastal projects to climate change.
- In addition, as an outgrowth of the *Western States Watershed Study*, IWR is representing USACE in an intergovernmental partnership addressing the research needs for climate change impacts on the western waters of the U.S. The interagency team, known as the Climate Change and Western Water Group (C-CAWWG) was

started by Reclamation, USGS western regions and NOAA, and IWR attended the C-CAWWG workshop in February 2008. USACE IWR has since become a full partner in C-CAWWG, and we are working together on several initiatives aimed at describing both the current (short-term) and long term climate change research and development challenges, needs, desired capabilities and "gaps" with regards to western waters.

In previous years IWR staff had developed protocols for national *planning model certification* in partnership with Corps laboratories and USACE planning centers of expertise. As of 2008, the IWR Planning Suite Version 1.0.9.0, the NETS Global Grain Forecasting Model, and the NETS Survey Model were the first planning models certified by the Corps. In addition, the Global Grain and Survey models were concurrently used for the *Upper Mississippi River – Illinois Waterway Navigation and Ecosystem Program* (NESP) study. The application of these latter two models, both developed as part of IWR's *Navigation Economic Technologies* (NETS) research and development program, were also subjected to independent technical review and external peer review as part of the NESP study, with both applications approved, affirming that the NETS research and development adequately responded to past criticisms by the National Academy of Sciences with regard to the theoretical assumptions, structure and inputs associated with the previous generation of inland navigation models.

Model certification began in 2008 on the IWR-HarborSym channel widening model, and the HEC-FDA, (Flood Damage Reduction Analysis) Version 1.2.4, a frequency-based model for the estimation of inundation damages, as both were submitted to the respective expertise centers for certification.

International Water Resources: USACE played a highly visible role through its participation on the United Nations *High Level Expert Panel on Water and Disasters*, convened by the U.N. Secretary General's *Advisory Board on Water and Sanitation* in response to the unprecedented water-related events over the last decade. USACE Commander and Chief of Engineers Lieutenant General Robert L. Van Antwerp represented USACE on the *High Level Expert Panel*, along with the participation of Mr. Steven L. Stockton, HQUSACE Director of Civil Works, and Dr. Jerry Delli Priscoli of IWR. The USACE hosted the *High Level Panel's* fourth meeting in New Orleans in October 2008, with the *High-Level Expert Panel* to present its findings at the 5th World Water Forum in Istanbul, Turkey, in 2009.

The USACE Implementing Agreement with the River Bureau of the *Japanese Ministry of Land, Infrastructure, Transport and Tourism* (MLIT) was renewed for another five year term at a signing ceremony in Japan on 26 February 2008. To date, the technical exchanges have been quite productive, consisting of annual technical meetings and tours alternating between sites in the U.S. and Japan and with additional facilitation of personnel exchanges and requests for information between USACE and MLIT.

In FY 2008 IWR-HEC engineers continued to provide training in water resources engineering in Nairobi, Kenya and Addis Ababa, Ethiopia as part of the *Combined Joint Task Force – Horn of Africa* (CJTF/HOA) host nation agreement.

Internationally, IWR continued to conduct work in Iraq and Afghanistan. In Iraq, HEC entered into an MOA with the U.S. Embassy Baghdad/Iraq to provide training to the Iraqi Ministry of Water Resources on the application of the *Tigris-Euphrates Water Management Systems Model* (WMSM). Under previous contracts with the U.S. Agency for International Development, HEC developed and delivered WMSM and documentation to the Ministry and Embassy. Due to the need for additional training of Iraqi Ministry personnel, HEC entered into another MOA for additional training.

IWR and HEC staff participated in a modular portfolio of short courses on Integrated Water Resources Management (IWRM) that was organized with and hosted by UNESCO-IHE, Delft, The Netherlands. The course was a collaborative activity between UNESCO-IHE and IWR/ICIWaRM and was designed for engineers from the Iraq Ministry of Water Resources.

In Afghanistan, HEC developed an operations manual and performing a water budget analysis for the Kajakai Reservoir in the Helmand Valley of Afghanistan and prepared and delivered a final report entitled “Water Balance and Regulation Alternative Analysis for Kajakai Reservoir Using HEC-ResSim” to the Afghanistan Engineer District.

IWR’s specific accomplishments during FY 2008 are described in the following sections, organized in accord with the Institute’s major focus areas.

FUTURE DIRECTIONS

The Institute’s *Future Directions* activities include the identification of emerging water challenges and opportunities and the tactical engagement of USACE senior leaders on these issues to stimulate “strategic thinking.” Such critical thinking is seen as an essential prerequisite to strategy development and planning. IWR employs a variety of approaches to encourage strategic thinking, including the development of water resource outlook papers and the conduct of topic specific provocation sessions with senior leaders. Outlook papers on ecosystem restoration and hydropower were initiated in FY 2008. During FY 2008, IWR continued to use two innovative instruments to engage senior leaders strategically: the *Castle Forum* and the *Lunch Roundtable*. The *Castle Forum*, an off-site event for senior leaders and external thought leaders where they can engage in out-of-the-box thinking regarding subjects not usually addressed by them specifically, is intended to provide a venue for leaders to recognize (previously undetectable) weak signals for emerging issues and to anticipate potential implications. The *Lunch Roundtables* bring in water experts from outside the Corps to provide perspectives on issues familiar to senior leaders.

Castle Forum subjects explored during FY 2008 included alternative delivery of Federal services under severe budget constraints. The speaker proposed devolving delivery of flood risk management services to local and private (profit making and not-for-profit) organizations.

Lunch Roundtable topics included exploring prospects for Corps partnering with states and regional organizations to support integrated water resources planning and management, and developing opportunities with states to meet environmental challenges. The partnering discussion, along with previous IWR research, suggested a path to solving this complex problem. Pursuant to these efforts, the Corps is summarizing State Water Plans and conducting workshops with States and regional organizations to determine gaps and opportunities. During the discussion of environmental challenges, it was suggested Corps explore using its existing regulatory authorities and its project capability to encourage wise and safe use of flood plains.

Strategic Planning: The release of the inaugural Civil Works Strategic Plan in FY 2004 represented the culmination of a multi-year effort aimed at establishing a new direction for the Civil Works Program based on the contemporary IWRM watershed planning approach. The plan’s five strategic goals were firmly grounded in the systems perspective of IWRM and are fully aligned with the principle of environmental

sustainability. IWR FY 2008 strategic activities continued to address implementing the current Civil Works Strategic Plan (for FY 2004-2009) and building the conceptual foundation for the FY 2010-2014 Strategic Plan – *Sustainable Solutions to America’s Water Resources Needs*. These activities included policy research, the preparation of multiple “white papers”, the assembly of background material, the identification of emerging issues and new challenges, and the conduct of strategic engagements with senior leaders via Castle Forums and Lunch Roundtables.

In 2008 another strategic initiative was represented by the IWR preparation of the USACE Civil Works *Five Year Budget Development Plan* (FY 2009-2013), required by Congress. This plan demonstrated how the Corps budgets developed for FY 2009-2013 would meet the objectives of the FY 2004 Strategic Plan and included metrics to measure progress.

IWR contributed significantly to the drafting of the new *Civil Works Strategic Plan for 2010-2014*. The scenarios developed in FY 2006 and the results of a stakeholder outreach session held in FY 2007 were used to develop six robust cross-cutting strategies which formed the centerpiece of this draft plan. They are: 1) Systems approach; 2) Collaboration and partnering; 3) Risk informed decision making and communication; 4) Innovative financing; 5) Adaptive management; and 6) State-of-the-art technology.

At the same time, these cross-cutting strategies shaped the Civil Works strategic goals for the FY 2010-2014 draft plan, which represented a refinement of the goals within the previous plan. The draft goals were updated as follows: 1) Develop safe and resilient communities and infrastructure; 2) Promote sustainable water resources and healthy aquatic ecosystems; 3) Implement effective, reliable, and adaptive life-cycle project performance; and 4) Build and sustain a competent team. This draft strategic plan was completed in 2008 and is currently under review by HQUSACE and the OASA(CW).

The Institute’s staff and OMBIL national data management systems continued to support the formulation of the yearly budget guidance, the five-year development plan and the evaluation of USACE Civil Works program business areas in conjunction with the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) through the application of meaningful, outcome-oriented program performance metrics. Significant progress in the refinement of the performance metrics was made in 2008, along with a commensurate improvement in

performance evidenced across the CW program, particularly in the inland navigation business line.

Interagency Performance Evaluation Task Force (IPET): The results of the analysis and technical documentation for the IPET Interior Drainage and Consequences tasks are included in IPET report “Volume VI: The Performance — Interior Drainage and Pumping” and “Volume VII: The Consequences.”

The IWR-led Consequences Team also developed stage-damage and stage-fatality functions that provide estimates of direct property loss and life loss as a function of inundation elevations for different parts of the greater New Orleans area. These functions were used by the IPET Risk and Reliability team to develop estimates of the probability distributions of life loss and direct physical damage relating to the expected performance of the Hurricane Protection System in Greater New Orleans as of June 2007 associated with a wide range of possible hurricane events with different severities, directions, and points of landfall. In FY 2008, the New Orleans District published risk maps for the New Orleans area using the methodology developed by the IWR-led Consequences team.

Hurricane Protection Decision Chronology: The Hurricane Protection Decision Chronology (HPDC) investigation of the Greater New Orleans hurricane protection system was initiated at the direction of HQUSACE as a complementary activity to IPET. The HPDC provides a chronological record of planning, economic, policy, legislative, institutional and financial decisions that influenced the design, scale, configuration and condition of the Greater New Orleans hurricane protection system. The final report and database of source documents were posted on the IWR website in FY 2008.

Actions for Change: The Actions for Change Initiative (AFC) was developed to address the lessons learned from the Hurricane Katrina and Rita events. The goals of the Actions for Change were to improve public safety and the Nation’s water resources infrastructure by providing expert and professional services to the Nation. The Actions for Change were divided into four themes: (1) Comprehensive Systems Approach, (2) Risk Informed Decision Making, (3) Communication of Risk to the Public, and (4) Professional and Technical Expertise.

IWR is actively participating on the core teams for the first three themes. The objective of Theme 1, Comprehensive Systems Approach, is to review the

dynamic processes that potentially impact USACE projects and to develop guidelines and recommend policy and program changes to address the changes and their impacts. IWR personnel are leading the Temporal and Spatial System Changes project delivery team (PDT), the Watershed Investment Decision Tool PDT, and the Multi-Objective System Planning and Policy PDT. IWR personnel are also members of the Sustainable Solutions PDT.

Theme 2 (Risk Informed Decision Making) includes tasks that collectively aim to infuse risk and reliability concepts into decision making through the lifecycle of Corps projects and related systems. The objective is to develop improved risk assessment and management processes to inform USACE, the public, and other stakeholders of infrastructure condition and critical needs for public safety. The Corps Chief Economist is leading the Theme 2 team and other IWR personnel are members of various Theme 2 PDTs. During FY 2008, USACE co-sponsored a workshop entitled “Workshop on Tolerable Risk Evaluation: A Step Towards Developing Tolerable Risk Guidelines for Dams and Levees”. Other workshop sponsors were the U.S. Bureau of Reclamation and the Federal Energy Regulatory Commission.

Theme 3 (Communication of Risk to the Public) emphasizes the communication of flood risks to the public and public involvement in flood risk management decision making. Initiatives will focus on concepts of residual risk and the involvement of disadvantaged populations that are most likely to be impacted by floods. IWR is leading the Public Involvement sub-team, and is presently partnering with the National Flood Risk Management team to develop a framework for public involvement in flood risk management decision making.

Intergovernmental Panel on Climate Change: The Institute has been involved in climate change impacts analysis and research since 1978. In 1988, the World Meteorological Organization and the United Nations Environment Programme, recognizing the need for an objective, balanced, and internationally coordinated scientific assessment of the understanding of the effects of increasing concentrations of greenhouse gases on the earth’s climate and on ways in which these changes may impact socio-economic patterns, established the Intergovernmental Panel on Climate Change (IPCC).

In FY 2008, the Norwegian Nobel Committee awarded the Peace Prize to the Intergovernmental Panel on Climate Change. For his many

contributions to the IPCC, Dr. Eugene Stakhiv, IWR, was honored by the Nobel Committee and shared in the Nobel Peace Prize in December, 2007.

Adaptations to Climate Change: During FY 2008 IWR accelerated its work on the development of a framework for addressing USACE adaptations to climate change. The objectives of the initiative are to develop consistent water management adaptation policies and approaches to address global change, including global warming along with other changes due to demographics, land use, evolving societal values, etc., throughout USACE Civil Works and in partnership with the other Federal water resources agencies.

The project will provide recommendations for policy and guidance to prepare for, and respond to, climate change and variability. An interagency group was formed to consider what actions Federal water agencies should take to incorporate climate change considerations into water resources activities. The group is composed of representatives from USACE, the U.S. Geological Survey (USGS), the U.S. Bureau of Reclamation (BuRec), and the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. A joint report, *Climate Change and Water Resources Management: A Federal Perspective* is scheduled to be released in FY 2009.

IWR also supported another interagency group that includes the U.S. Environmental Protection Agency (EPA), USACE, NOAA, the USGS, the Bureau of Reclamation, and the Department of Agriculture, Natural Resources Conservation Service (NRCS) and U.S. Forest Service. The objective of this group is to cooperate in scientific and research work to adapt water program management to reflect changing climatic conditions. IWR scientists provided technical support to the Assistant Secretary of the Army (Civil Works) for this interagency group, with the ASA(CW) entering into a multi-lateral MOU on behalf of USACE as the instrument for providing a formal charter for the effort.

The IWR “Adaptation to Climate Change” effort is working closely with the “Actions for Change” initiative. A draft Engineer Circular on sea level change was written with NOAA and USGS. Other teams have been formed to develop more detailed guidance for coastal planning and engineering and to evaluate the vulnerability of USACE coastal projects to climate change. In addition, a team of water managers and hydraulic engineers was formed to develop a strategic plan for how USACE water managers should deal with climate change.

Louisiana Coastal Protection and Restoration (LACPR): During FY 2008 IWR continued to provide technical assistance to the Corps' New Orleans District and Mississippi River Division on the Congressionally authorized LACPR study. In partnership with ERDC, a small team of risk analysis experts developed a decision framework that weaves together quantitative risk assessment, scenario planning and risk-informed decision making with active and transparent stakeholder involvement. IWR senior staff outlined a process to integrate risk-informed planning within the traditional six-step planning process, then led workshops for LACPR staff to enhance understanding and advance the implementation of the planning framework for coastal Louisiana. IWR also advised the LACPR study team on best planning practices, and an IWR senior social scientist lead the formulation and evaluation of non-structural components to the comprehensive risk reduction strategies. This combined effort served a complementary purpose of developing a nationally consistent risk-informed planning framework to support implementation of the risk-based concepts in planning, design, construction, operations, and major maintenance action of Actions for Change. IWR involvement was concentrated on implementation, using the LACPR study as a test-bed demonstration.

USACE Chief Economist: Dr. David Moser of IWR is the USACE Chief Economist and leader of the Economics Community of Practice (CoP). During FY 2008, the Chief Economist continued to provide support to the IPET Risk and Reliability team.

The Chief Economist's leadership engaged to build and advance the economic analysis capability across the USACE, holding two national meetings and regular teleconferences with senior economists.

A subject matter expert (SME) database of all Corps economists was reviewed and updated by senior economists to maintain a directory identifying economists by experience and expertise for each economic activity conducted by the USACE. This SME database is used by MSC economists, planning centers of expertise and others to identify resources for feasibility studies, independent technical reviews, and special purpose teams. The Chief Economist also participated in over a dozen selection boards for senior economists throughout USACE.

As a complementary activity to building capacity, IWR focused on enhancing technical guidelines and economic manuals available to field practitioners. In

FY 2008 work proceeded on the update of water resources planning National Economic Development (NED) Manuals.

In FY 2008, the Chief Economist also continued as the National Team Lead for *Theme 2 - Risk Informed Decision Making* one of the four themes of the *Actions for Change* initiative. As part of that effort, the Chief Economist led development of approaches and frameworks to articulate the value of risk analysis, with emphasis on risk management, to Civil Works decision making. He was also involved in issues relating to National Economic Development evaluation of transportation externalities, agricultural water supply and value of time saved.

National Shoreline Management Program: The National Shoreline Management Program, authorized by the Water Resources Development Act of 1999 (Public Law 106-53, Section 215(c)), remains a collaborative, inter-agency effort that is adapting to the recent surge in coastal and ocean initiatives. The program is intended to describe the extent and causes of erosion and accretion along the shores of the U.S., the economic and environmental effects caused by erosion and accretion, and the systematic movement of sand along the shores. The program focuses on the resources committed by Federal, state and local governments to restore and nourish shores, recommend appropriate levels of Federal and non-Federal participation in shore protection and serves to advance the use of systems approaches to sand management.

Initiatives and events have influenced the future course of national shoreline management program. These include the formation of a Committee on Ocean Policy and an associated new ocean governance structure; U.S. Geological Survey publication of the results of shoreline change studies; the initiation of a National Coastal Data Bank; joint coastal mapping initiatives; emerging joint Federal coastal science and technology collaborations; and the formation of regional coastal collaborations to address ocean and coastal management in an ecosystems context.

The study management team has engaged partner agencies in discussions of how the study could best serve and synchronize these ongoing initiatives to improve agency program integration and effectiveness with emphasis on systems approaches to Federal and non-Federal roles in shoreline management. In FY 2008, the study team prepared an interim report that summarizes study products and results of other relevant initiatives and made

recommendations for next steps towards producing a final report.

Policy Development: The Water Resources Development Act of 2007 (Public Law 110-114, Section 2031) restated national policy objectives for water resources projects and directed the Secretary of the Army to revise the 1983 Principles and Guidelines that state how these objectives should be accomplished. The Assistant Secretary of the Army (ASA (CW)) responded in behalf of the Secretary. IWR staff composed the bulk of the subject matter experts serving on the Corps internal P&G review team, and IWR assisted in organizing the OASA(CW) hosted public meeting in June 2008 to solicit agency and stakeholder views and comments on the 1983 version of the P&G, and then participated with HQUSACE in preparing a draft version of a new Principles and Guidelines. A draft set of Principles were subsequently published in September 2008. IWR also participated in the analysis of the comments received in response to the public meeting.

COLLABORATION AND PARTNERING

The USACE recognizes that the Civil Works mission must be carried out in collaboration with multiple partners and stakeholders with differing authorities, capabilities and perspectives. Thus a major IWR focus has long been as the intellectual nexus for USACE expertise on collaboration, partnering and public participation. In FY 2008 the Corps took several important steps towards official recognition of that role with funding for a Center for Conflict Resolution and Public Participation, along with formal designation of the center in 2008. As an important part of this role, IWR serves as the USACE lead for multiple national collaborative partnerships and is committed to developing new training instruments, technologies, processes and policies to further USACE's overall capability in collaborative planning and partnering.

In FY 2008 IWR shepherded a review of current practices in environmental conflict resolution and continued the National Cooperative Modeling and Collaborative Planning Demonstration programs with multiple Federal, state, university and non-governmental partners. Of particular note, IWR led the development of an interagency federal initiative on the intersection of computer tools and multi-stakeholder collaborative water resources management processes. In FY 2008 the proceedings of an IWR led interagency workshop on Computer Aided Dispute Resolution (CADRe) were published.

IWR represented USACE and the Office of the Secretary of Defense (OSD) through participation in the National Science and Technology Council's interagency Subcommittee on Water Availability and Quality (SWAQ) and its Subcommittee on Disaster Reduction. IWR actively participated in the development of the SWAQ Strategic Plan for Federal interagency R&D to ensure adequate water availability and quality: *A Strategy for Federal Science and Technology to Support Water Availability & Quality in the United States, September 2007*, and is leading development of the resultant interagency Federal Initiative on Collaborative Tools and Processes for U.S. Water Solutions.

IWR also developed a handbook on collaborative planning in support of HQUSACE, led execution of Corps-wide Memoranda of Agreement (MOA's) and Memorandum of Understanding (MOU's) and engaged the academic community through the Maass-White Visiting Scholars program, the Universities Council on Water Resources (UCOWR) Fellowship Visiting Scholars program, the National Research Council (NRC) Research Associates program, the American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellows program, and the Leo R. Beard Visiting Scholars program (resident at HEC).

National Partnerships: Forming strategic alliances, both through formal agreements and informal working relationships, is becoming a way of doing business in the USACE, government agencies and non-governmental organizations (NGO's). Driving this movement are the complexity and far-reaching impacts of today's water resource problems, juxtaposed with the limited financial and intellectual resources of any single organization. The USACE is increasingly committed to partnerships as a means of accomplishing common goals. In FY 2008 IWR initiated new MOU's and renewed existing agreements with various federal partners.

Natural Resources Conservation Service Partnership: In FY 2008 an existing partnership agreement with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) was renewed. The partnership agreement was initially signed between the Corps and the NRCS on July 7, 2005. The purpose of the agreement is to promote a long-term working relationship and collaborative effort to improve the management of water and related natural resources under the missions and authorities of the NRCS and USACE. Collaboration continues to focus on three areas: (1) watershed planning and implementation; (2) wetland creation, restoration and enhancement and (3)

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natural disaster recovery. The agencies agreed to coordinate other programs and activities, including the Wetland Conservation Compliance (the *Swampbuster* provision of the Farm Bill) and the Regulatory Program (Section 404 of the Clean Water Act). FY 2008 accomplishments included implementation and updating of the action plan that was developed in 2007. In June 2008 Senior Leaders from both agencies reviewed progress and concurred on the Action Plan.

An interagency agreement was put in place for IWR's Hydrologic Engineering Center to work with NRCS agronomists to include agricultural damages in the Flood Damage Assessment model (HEC-FDA), and to reestablish technical support for NRCS employees using HEC's RAS model. NRCS is also participating in the Interagency Levee Task Force and Missouri River basin activities led by USACE.

U.S. Institute for Environmental Conflict Resolution (USIECR): In FY 2008 the Institute entered into a MOU with the USIECR. The USIECR was established through the Environmental Policy and Conflict Resolution Act of 1998 (Public Law 105-156), as an independent federal entity with the mission to impartially assist in the resolution of federal environmental, natural resources and public land conflicts and controversies through facilitated negotiation, mediation, and collaborative problem-solving. IWR and USIECR have a common interest in the areas of IWRM, water security, and environmentally sustainable development. The MOU focuses on areas encompassing the advancement of techniques for and the facilitation of interagency and intergovernmental negotiations and collaborative planning efforts; process design and related technical and/or advisory assistance on collaborative USACE projects; technical assistance on a broad range of environmental conflict resolution and computer assisted dispute resolution techniques, such as shared vision planning (SVP); and advancing of Federal agency capacity in alternative dispute resolution (ADR) through training and technology transfer.

U.S. Geological Survey Partnership: Significant activities for the U.S. Geological Survey MOA included senior level meetings addressing national stream-gage issues; climate change and related water management issues; the sharing of water data; coastal, geotechnical and biological research; and on the status of regional and international water studies, such as on the Great Lakes. The major joint USACE-USGS initiative in 2008 expanded into a multilateral effort involving technical and scientific staff from four federal agencies, including the two primary Federal water development agencies – USACE and the Bureau

of Reclamation, and the two principal water science agencies - the USGS, and NOAA, on the development of nationally consistent approaches for incorporating the adaption to global climate change into water resources management. The resulting report is expected to be jointly published by all four agencies in FY 2009. USACE also partners with USGS on international water resources, as both agencies are core members of the U.S. National Committee for UNESCO's *International Hydrological Programme* (IHP). The IWR Director is the designated USACE representative on the U.S. National IHP Committee.

U.S. Bureau of Reclamation Partnership: Significant FY08 activities with the U.S. Bureau of Reclamation included senior level meetings addressing climate change and water resource issues and the development of consistent approaches to climate change science throughout USACE and in partnership with other Federal agencies. USACE is working closely with Reclamation on the Climate Change and Western Water Group (C-CAWWG), which also includes representation from USGS and NOAA scientists as core members. The group's objectives are (1) to define the most critical gaps in our capability to forecast and adapt to climate change; (2) to conduct collaborative research to address those gaps; and (3) to develop mechanisms to provide training for infusing climate change science into water planning and technical studies.

Oak Ridge National Laboratories Partnership: During FY 2008 IWR continued to implement the MOU executed with the U.S. Department of Energy's Oak Ridge National Laboratories and ERDC in 2005 that centers on energy, security and environmental sustainability. Thrusts of the agreement include joint work on regional energy and water management, transportation modeling, emergency response, homeland security and environmental sustainability.

Other Partnerships: IWR is working closely with Sandia National Laboratories through the National Cooperative Modeling Demonstration Program.

Academic and Professional Practice Partnerships

Universities

In FY 2008, IWR continued to expand its partnership with academic institutions, professional organizations and non-governmental organizations. IWR entered into Memorandum for Understanding (MOU) with the Colorado State University, Civil and Environmental Engineering Department/International School for Water Resources.

This partnership with Colorado State University will facilitate cooperation in research in a number of areas including integrated water resources management, scientific research in the adaptation to global climate changes and their impacts on water resources, and methods for understanding and managing extreme hydrological events and related natural hazards and disaster preparedness.

Each of the universities with which IWR has entered into MOUs has unique program features that compliment the strengths and talent of the Institute.

The University of Arizona is home to the National Science Foundation's Science and Technology Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHARA), thus allowing the Institute and the University to focus on sustainable development and sound water management policies, particularly in arid and semi-arid climates.

The **University of New Hampshire's Institute for the Study of Earth, Oceans, and Space, Water Systems Analysis Group**, which focuses on the understanding of water resources issues on a global scale and the application of technological improvements in water resource management, allows cooperation in the field of global water science, integrated water resources management, and interdisciplinary scientific research and capacity building, particularly in developing and emerging countries and post-disaster nations and regions.

The **Oregon State University's Institute for Water and Watersheds**, which focuses on integrated water resource management, sustainable development, ecological design, ecosystem restoration and environmental conflict resolution, allows for cooperation in numerous areas including, infrastructure development, adaptive management and adaptation to global climate change, flood risk management, hydrologic analysis, risk analysis and systems modeling, environmental restoration, ecological design, consensus building, conflict resolution, alternative dispute resolution, and shared vision planning.

Professional Practice Organizations

In FY 2008 the Institute entered into an MOU with the *American Water Resources Association (AWRA)*. Both the Institute and the AWRA have a common interest in integrated water resources management, environmentally sustainable development, and water resources education, technology transfer and capacity

building. The MOU will further both organizations' goals of enhancing the use of effective water resources development and management policies, and will establish a long term cooperative effort in a number of areas including the field of integrated water resources development and management; hydrologic, hydraulic and water resources systems analysis modeling; ecosystem analysis and design; and capacity building, including training and technology transfer.

In FY 2008 the Institute entered into an MOU with the *Global Water Partnership*, an international network of organizations involved in water resources management. The *Global Water Partnership* was established in 1996 by the World Bank, the United Nations Development Program, and the Swedish International Development Agency, and is headquartered in Stockholm, Sweden. The MOU will further both organizations' goals of developing procedures and methods for integrated water resources management in support of sustainable development, adaptation to global climate change and its impacts on water resources, and will establish a long term cooperative effort in a number of areas including flood risk management; hydrologic analysis, risk analysis and systems modeling; environmental restoration, ecological design, eco-hydrologic analysis and water quality; and capacity building, including training and technology transfer.

FEMA Silver Jackets Program: The *Silver Jackets Program* is a key mechanism for achieving the interagency coordination necessary to fulfill the goals of the National Flood Risk Management Program.

Through the *Silver Jackets Program*, managed by IWR, the USACE cooperates with FEMA and other Federal, State and sometimes local agencies to ensure continuous interagency collaboration at the state level, leveraging available resources and information between agencies.

The program has created a mechanism to collaboratively solve issues and implement or recommend those solutions, while increasing and improving flood risk communication and outreach through the united effort. Silver Jackets teams facilitate strategic, life-cycle planning to reduce flood risk and provide assistance in implementing state-identified high-priority actions

FY 2008 accomplishments include the following:

Indiana Inundation Pilot Study: By bringing together the participating agencies, the Indiana Silver Jackets

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team (established in 2006) was able to pair up technologies normally not used together to identify flood areas and when those areas would be impacted through the use of real time river gage data. In FY08 the pilot study successfully calibrated the model against actual river flow data for the White River in Indianapolis. Model outputs can now be integrated with the HAZUS damage model, and GIS and local Property Valuation Administration (PVA) databases. This allows local agencies to quickly determine where to focus flood fighting efforts and to quickly provide reliable post flood damage estimates. Outputs can be read in real time on a web based system. This should also allow citizens to be more responsible for their own safety as they will be able to monitor flood progression and plan accordingly. The cost for setting up this system on a typical gauged stream is relatively low, on the order of less than \$25,000 per stream mile. In FY09 and FY10 this system will be expanded to cover as many as 20 other gauged stream locations within Indiana, subject to availability of funding.

Indiana Risk Communication: The Silver Jackets team participated in the update to the Indiana State Hazard Mitigation Plan mandated by FEMA. This participation by the member Silver Jackets agencies allowed the Indiana Department of Homeland Security (IDHS) to prepare a more comprehensive and accurate Mitigation plan for their state. The group also continued with prior year education efforts to reach out to children to educate them about flooding and severe weather and the measures they and their families can take to assure personal safety. This project involved a number of the member agencies in the distribution of the activity book materials and outreach to various groups specifically working with children throughout the State.

Response to May/June Flood 2008 Disasters: The Indiana Silver Jackets group assumed the role of the Interagency Levee Task Force in Indiana. Sharing time critical information was one of the biggest efforts. One example was where the U.S. Department of Agriculture contacted the local Corps District office regarding Emergency Watershed work (streambank and debris removal) for central Indiana. Within a matter of days, the Corps office had prepared and supplied to USDA estimates for the performance of various requested activities. In another case, the Indiana Department of Homeland Security requested a listing and map identifying which dams and levees in Indiana the Corps could support with repairs. Within one day, the local Corps District office provided a list of the projects that would qualify for Corps aid, as well as those projects

that would not qualify. The Corps also supplied IDHS with the list of those communities that had already contacted the Corps for help. Coordination of post flood responses by the agencies in Silver Jackets has been significantly speeded up and streamlined by their cooperative efforts.

Marietta, Ohio: Coordination through the Ohio Silver Jackets team (established in 2005) has enabled the small community of Marietta to acquire detailed mapping of its community at nominal cost by tapping into an ongoing regional watershed study. These maps are used daily by the City. Through the same Silver Jackets team, an opportunity was discovered to utilize the USACE Planning Assistance to States (PAS) program to provide the initial resources to develop the City's first Flood Hazard Mitigation Plan which will enable them to gain eligibility for FEMA flood mitigation funds. Also as a result of this effort, the City obtained a \$200,000 CDBG grant in FY 2008 from the Department of Housing and Urban Development for "duckbill" backflow prevention for several storm sewer outfalls at the Ohio River. The Silver Jackets team is also working on an ongoing Section 205 Flood Warning System for Washington and Noble Counties that includes areas in Marietta. Life saving rain and stream gages will be installed for early flash flood detection and warning.

Ohio Web-Based Portal: The Ohio Silver Jackets team is currently focused on research and development for a portal that will allow all collaborating agencies to contribute data on their "piece of the puzzle". The focus is on water resource studies and construction work in the state of Ohio. This has the potential to expand to other areas as a Regional Collaborative Architecture for communication. The vision is a web based portal with both public and private permissions. Marshall University (Huntington, West Virginia) is assisting in this effort.

The *Silver Jackets Program* continues team development on a state by state basis, with the ultimate goal of offering a team to every state. In FY 2009, efforts are planned to initiate or supplement existing teams in the states of Idaho, Kansas, Hawaii, Texas, Louisiana, New Mexico, Kentucky, Illinois and Missouri. At least one team is anticipated in both North Atlantic and South Atlantic Divisions.

Ocean Action Plan: The USACE is participating in implementation of the *President's Ocean Action Plan* through integrated networks and partnerships of Federal, state, local, territorial and tribal authorities, the private sector, international partners and ocean

communities. In 2008, IWR coordinated USACE participation in regional ocean governance initiatives, co-leading USACE support to the Gulf of Mexico Alliance with ERDC. The Corps is one of thirteen Federal agencies supporting the Governors' Action Plan for Healthy and Resilient Coasts. IWR staff participated in the development and review of material for the *West Coast Governors' Ocean Health Agreement*, and led USACE participation in the Subcommittee on Management of Ocean Resources (SIMOR), engaging other USACE staff depending upon the issues raised to the Subcommittee. Through participation on the Council on Environmental Quality, National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology, IWR staff contributed to development of the Ocean Research Priorities Plan and its implementation strategy, and to projecting the need for new ocean research facilities.

National Ocean Service Partnership: The USACE and the National Oceanic and Atmospheric Administration's National Ocean Service (NOS) formed a collaborative partnership as an outgrowth of Ocean Action Plan initiatives, calendar year 2005 post-storm experiences, and recognition of mutually beneficial advances and synergies that could be affected through collaboration. The partnership is leveraging each agency's programs and talents through joint centers for coastal mapping, instrument testing, evaluation and training; improving data sharing capabilities; coordinating vertical datum systems and improving tidal measurement and information; and improving natural hazard risk communication that incorporates consideration of community resilience. In 2007, the partnership initiated leveraging the NOS coastal resiliency initiatives with the Corps Flood Risk Management Program. In 2008, the partnership focused heavily on implementing the waves plan for the Integrated Ocean Observing System (IOOS).

Interagency Committee on the Marine Transportation System: The Corps continues coordinating with the Maritime Administration (MARAD), National Oceanic and Atmospheric Administration (NOAA), the Coast Guard and other Federal departments and agencies to support the *Committee on the Marine Transportation System* (CMTS), which was initiated in July 2005. The Corps' Director of Civil Works was selected as the initial chair of the Coordinating Board for the CMTS and the Assistant Secretary of the Army (Civil Works) was designated as the Department of Defense principal to the CMTS. The Coordinating Board chair rotated to the Administrator of NOAA in 2007, to the Maritime Administrator in 2008, and will rotate to the

Commandant of the Coast Guard in 2009. IWR provides logistics support and participates on Integrated Action Teams, including leading the team to develop an assessment of the Marine Transportation System. A contract was awarded to the Department of Transportation's Volpe Center in 2007 to assist with the assessment and work continued throughout 2008. This effort is scheduled to complete in 2009.

Regional Sediment Management: The USACE has adopted the Regional Sediment Management (RSM) approach in carrying out many of its programs. Sediment management spans the USACE Navigation, Flood and Coastal Storm Damage Reduction, and Ecosystem Restoration missions and responsibilities. The RSM approach implements the watershed perspective and the principles of integrated water resources management. The USACE applies this perspective and approach as a major stakeholder in many of the Nation's inland and coastal watersheds. In 2008, IWR staff continued work on guidance for implementing the RSM approach, and initiated coordination with the Continuing Authorities Program staff implementing the new RSM provisions provided to the Section 204 program by WRDA 2007 (Public Law 110-114, Section 2037). IWR staff also continued to support development of Gulf Region Sediment Management Master plan to support the Gulf of Mexico Alliance.

Coastal Engineering Research Board: The CERB provides broad policy guidance and review of plans and requirements for the conduct of research and development in support of coastal engineering and the objectives of the Chief of Engineers. In 2008 IWR supported the Director of Civil Works in organizing the CERB visit to the Mississippi and Louisiana coastlines regarding flood risk management and coastal protection, and reporting to the Chief of Engineers on their findings. The Board also visited Portland, Oregon to look at other aspects of system applications.

Environmental Advisory Board: IWR has led the USACE technical team supporting the Chief of Engineers Environmental Advisory Board (EAB) since FY 2004. In FY 2008, the EAB embarked on a theme of exploring field level outreach and internal implementation of the Corps *Environmental Operating Principles* (EOP). This theme emerged from a series of ecosystem restoration topics the Board was engaged in during FYs 2006 and 2007. The Board held one public meeting in FY 2008 — 30 April 2008 in Seattle, Washington — which provided the Board the opportunity to meet with Corps Seattle District staff to discuss how the district has implemented the EOP's.

The Board also met with local area environmental non-governmental organizations to discuss their views as to how the District has implemented the EOP's.

Inland Waterways Users Board: IWR continued its technical and administrative support of the *Inland Waterways Users Board* (IWUB) in FY 2008, including the analysis of and reporting on the financial status and capability of the Inland Waterway Trust Fund, assistance with drafting of the IWUB Annual Report to Congress, evaluation of candidates nominated for Board membership and the administration of three IWUB meetings including No. 56 on November 2, 2007 in Quincy, IL, No. 57 on March 27, 2008 in Baton Rouge, LA, and No. 58 on July 31, 2008 in Walla Walla, WA.

Collaborative Planning: IWR has a long history both of applying collaborative modeling tools through its signature Shared Vision Planning (SVP) process, and in developing tools and providing technical assistance in conflict resolution and public participation. During FY 2008, IWR continued to focus on developing new conceptual and methodological foundations, building awareness of collaborative planning tools, and assisting Corps offices and states in improving public participation in water resources planning and decision making.

FY 2008 activities included laying groundwork for the creation of the Institute's *Center of Expertise in Conflict Resolution and Public Participation* with a strong emphasis on computer aided dispute resolution using the *Shared Vision Planning* methodology. IWR initiated a Corps-wide assessment of collaborative capacity and surveyed Districts on their use of third-party neutrals in environmental conflict resolution cases as part of a White House mandate. In conjunction with Theme 3 of *Actions for Change* (Communication of Risk to the Public) and the National Flood Risk Management program, IWR led the development of a framework for Public Involvement in Flood Risk Management.

Other activities included the development of the Collaborative Planning Toolkit, research papers on the future of collaboration in modeling, a book chapter on Shared Vision Planning, and publication of the proceedings of the workshop entitled "*Computer Aided Dispute Resolution: Proceedings from the CADRe Workshop, Albuquerque, New Mexico, September 13-14, 2007*" as [IWR Report 07-R-6](#).

In the area of technology transfer and outreach, IWR staff members delivered presentations and training at the Corps Planning Conference, the national

Environmental Conflict Resolution Conference, the American Water Resources Association annual meeting, Western States Water Council meetings, Corps PROSPECT training classes, the Chesapeake Modeling Forum, and other venues. FY 2008 saw the development of a website and Sharepoint collaborative workspace for *Shared Vision Planning*, as well as the development of a primer and video on the use of Shared Vision Planning in the 404 permitting process for water supply. IWR worked with partners at the Department of Interior, Center for Alternative Dispute Resolution, the USEPA, Conflict Prevention and Resolution Center, and the U.S. Institute for Environmental Conflict Resolution on Performance Measures for Collaborative Modeling. IWR also initiated and is chairing the American Society of Civil Engineers committee on Best Practices for Collaborative Modeling.

During FY 2008 IWR provided technical assistance to the State of California's Department of Water Resources in development of the State Water Plan. Assistance included leading a workshop on *Shared Vision Planning*, as well as presentations to the Water Plan Advisory Board and to the State Water Analysis Network and process design assistance. In conjunction with the Western States Watershed study and the Western States Water Council, IWR supported the Omaha District in a test case for the potential use of *Shared Vision Planning* in the 404 regulatory process for water supply permitting on the Cache la Poudre river in Colorado. Corps support transitioned to a full pilot project that is financially supported by funds from cities, the state and non-governmental organizations. IWR continued to provide support to Portland District in conjunction with Sandia National Lab and local partners on integrated modeling to understand linkages between reservoir operations, water quality, ecology and economics on the Willamette River in the State of Oregon.

The Nature Conservancy Sustainable Rivers Project: Begun in July 2002, the Sustainable Rivers Project is a nationwide partnership between the USACE and The Nature Conservancy (TNC) to restore the health and life of rivers across the United States. This nationwide effort to modify operations of Corps dams to improve ecosystems, while maintaining or enhancing project benefits, currently involves work on eight rivers systems - the Willamette in Oregon, the Bill Williams in Arizona, the Green in Kentucky, the Savannah in Georgia and South Carolina, the Roanoke in North Carolina and Virginia, the White, Black, and Little Red in Arkansas and Missouri, the Connecticut in New Hampshire, Vermont, Massachusetts and

Connecticut, and Big Cypress Creek in Texas and Louisiana. Sustainable Rivers is working towards its goals through a combination of partnered activities, including demonstration projects, training, software development, and staff exchanges via the Intergovernmental Personnel Act. Successes already achieved are attracting interest from other river management interests both within the United States and internationally, where methods used in Sustainable Rivers are now being applied in Asia, Africa, and South America. In 2008, the USACE received The Nature Conservancy's Outstanding Partner Award in recognition of the broad and successful partnership between the two organizations.

National Flood Risk Management Program: In May of 2006 in an IWR-led effort, the USACE established the *National Flood Risk Management Program* for the purpose of integrating and synchronizing USACE flood risk management programs and activities both internally and with counterpart activities of FEMA and other Federal, state, regional and local agencies. Its vision is to lead collaborative, comprehensive and sustainable national flood risk management to protect the public and reduce flood risk. The objectives of the NFRMP are to:

- Provide current and accurate floodplain information to the public and decision makers at the national, regional and local levels.
- Identify and assess flood hazards posed by aging flood damage reduction infrastructure.
- Improve public awareness and understanding of flood related hazards and risks.
- Coordinate flood damage and flood risk reduction programs across local, state, and federal agencies, and
- Improve capabilities to collaboratively deliver and sustain flood damage reduction and flood risk mitigation services to the nation.

Since its inception, the National Flood Risk Management Program continues to build on coordination work that has already taken place between USACE and FEMA to ensure consistent communication to the public on FEMA's *Flood Mapping Modernization (MapMod)* Program and related flood risk issues and to leverage resources when working on similar activities or within the same geographic area. Some of the specific accomplishments that have taken place under the

umbrella of the National Flood Risk Management Program include:

- Improved coordination between FEMA and USACE programs through quarterly meetings of an Intergovernmental Flood Risk Management Committee (IFRMC), which provides a venue for FEMA and USACE leadership to coordinate programs and policies, and thus improve program implementation for the flood risk management community.
- Improved coordination and pursuing collaborative opportunities with other Federal agency partners through a *Flood Risk Management Task Force*. The Task Force is responsible for updating and maintaining a unified national program for floodplain management; coordinating agency policies for flood risk management; identifying and recommending actions of the federal government necessary to reduce losses due to flooding and protect the safety of flood plain residents.
- Expanded coordination between USACE headquarters and FEMA headquarters to ensure that current and future policies for flood risk mapping, certification and other flood risk related policies are fully coordinated and compatible with each agency's programs.
- Established the *Regional Interagency Levee Task Force (ILTF)* in response to the catastrophic floods in the upper Midwest in 2008. The ILTF enabled a joint Federal-state partnership to address expedited repair of damage levee systems in the upper Midwest and identify non-structural mitigation measures that could be implemented during recovery to reduce future flood risks. The ILTF included regional representatives from the U.S. Army Corps of Engineers, Federal Emergency Management Agency, Environmental Protection Agency, Economic Development Administration, U.S. Fish and Wildlife Service, Natural Resource Conservation Service, United States Geological Service, U.S. Small Business Administration, Department of Housing and Urban Development, and representatives from the States of Iowa, Illinois, Wisconsin, Missouri and Indiana.

INSTITUTE FOR WATER RESOURCES

- Policy work, through the “Wise Use of Flood Plains” study, to identify any procedural or legislative changes that may be warranted to allow the Corps of Engineers to be more effective in working with other Federal agencies, states and local governments and stakeholders in the management of flood risk. The study is addressing both the question of how to evaluate the performance of programs and policies in addressing flood risk and how to approach the task of evaluating flood risk at a national scale.

IWR Visiting Scholar Programs: The Institute benefits from supporting a number of visiting scholar programs. These programs seek to bring the foremost water resources experts from academia, private industry and other agencies and laboratories to residence at IWR or HEC for periods of six months to one year. Visiting scholars are expected to infuse new energy, perspectives and ideas to the IWR program, while the practical work environment at IWR and HEC provides a stimulating context for mutual exploration of potential advances in water resources planning and hydrologic engineering and analysis.

FY 2008 marked the seventh year of the Institute’s Maass - White Visiting Scholar program, established in 2001 in recognition of the contributions of, and the Institute’s intellectual alignment with, two of the founders of modern water resources planning’s theoretical underpinnings — Professors Arthur Maass of Harvard University, and Gilbert White of the University of Colorado. FY 2008 was the fifth year for two other designated visiting scholar positions, both established in 2004: the first a partnership with the Universities Council on Water Resources (UCOWR) and the second, HEC’s Leo R. Beard Visiting Scholar program, named after the founding director of HEC. FY 2008 marked the third year since the establishment of two new post-doctoral Fellows programs: the National Research Council (NRC) Research Associateship and the American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellows program. IWR and HEC underwent a rigorous certification process by independent reviewers in order to qualify for these two prestigious programs.

In FY 2008, Dr. Yacov Haimés, the Lawrence R. Quarles Professor of Engineering at the School of Engineering and Applied Science, University of Virginia continued as the Maass-White Fellow for the period of 2007-2008. Dr. Haimés is engaged in risk

analysis and risk informed decision making as part of the Actions for Change initiative.

Dr. Paul Kirshen of the Department of Civil and Environmental Engineering, Tufts University was named as the 2007–2009 Universities Council on Water Resources (UCOWR) Visiting Scholar. Dr. Kirshen’s work is advancing Shared Vision Planning.

Dr. David W. Watkins, Jr. of the Department of Civil and Environmental Engineering, Michigan Technological University was named as the Leo R. Beard Visiting Scholar for 2008 at HEC. Dr. Watkins’ research focused on the next generation of the Corps risk analysis procedures for flood damage reduction and decision making under uncertainty.

Dr. Stacy Langsdale, Ph.D. in Resource Management Environmental Studies, University of British Columbia continued at the Institute as a National Research Council Research Associate for 2007-2009. Dr. Langsdale’s research focus is in the field of modeling and stakeholder based decision support processes as they apply to water resources planning and management.

Dr. Michael Deegan, Ph.D. in Public Policy and Administration, University of Albany joined the Institute as a National Research Council Research Associate for 2008-2009. Dr. Deegan’s research focus will be in the field of flood risk management and the factors influencing policy formulation, adoption, and implementation.

Dr. Kenneth Strzepek, Professor of Civil, Environmental, and Architectural Engineering at the University of Colorado at Boulder, will join the Institute in 2009 as the next Maass- White Visiting Scholar for 2009-2010. Dr. Strzepek’s research will focus in the area of climate change and adaptation of water resources.

Previous IWR visiting scholars have included:

- Maass-White Visiting Scholars: Dr. Daniel (Pete) Loucks, Cornell University (2002-2003), Dr. Peter Rogers, Harvard University (2003-2004), Dr. Leonard Shabman, Resources for the Future, (2004-2006), Dr. Gerald Galloway, University of Maryland (2006-2007), and Dr. Yacov Haimés, University of Virginia (2007-2008).
- UCOWR Fellow: Dr. Bruce Hooper, Southern Illinois University (2004-2005).
- Leo R. Beard Visiting Scholar: Mr. Tony Thomas, founder and president of Mobile

Boundary Hydraulics (2004); Professor Jerry Stedinger, Cornell University (2005).

- IWR NRC Research Associate: Dr. Peter Rogers, Colorado State University (2006), Dr. Jason Giovanettone, Duke University (2006, at HEC).
- AAAS Fellow: Dr. Alexey Voinov, University of Vermont, (2006-2007).

As part of Dr. Voinov's work at IWR as an AAAS Fellow, Dr. Voinov authored a paper: "*Energy-Water Nexus: Why Should the Corps Care?*" published in August 2008 as IWR Report 2008-VSP-01.

WATER RESOURCES METHODS AND MODELS

Two major IWR focus areas are (1) the evaluation of engineering, economic, social, institutional and environmental needs and, to address those needs, (2) the development, transfer and application of improved water resources analytical techniques, models and information systems. The goal is to produce state-of-the-art multi-purpose planning and hydrologic engineering methods and models to support investment decisions. This is accomplished by means of programs in research, training, planning analysis and technical assistance.

Planning Models Improvement Program: HQUSACE guidance EC 1105-2-407, *Planning Models Improvement Program: Model Certification*, published in 2005 prescribed a corporate business process and policy for the development, certification, training and on-going support for planning models, with the certification process based on internal and external peer support and review and with the responsibility for establishing priorities and managing the certification process residing with the planning centers of expertise in coordination with the findings of the *Strategic Engineering and Technology Initiative*. In FY 2006 IWR, with input from Corps laboratories and the planning centers of expertise, developed protocols for model certification that include the processes and criteria to be used for certifying planning models. In FY 2008, IWR Planning Suite Version 1.0.9.0 was certified to be in compliance with the requirements of the *Planning Models Improvement Program*. Also in FY 2008, HEC-FDA, (Flood Damage Reduction Analysis) Version 1.2.4, a frequency-based model for the estimation of inundation damages, was submitted for certification by the Hydrologic Engineering Center.

IWR continues to actively participate in the model certification efforts, providing input on policy and processes and as a member of the HQUSACE Model Certification Panel.

Navigation Economic Technologies Research: For more than a century the USACE has played a key role in maintaining a robust national economy by ensuring that farmers, manufacturers and businesses can easily transport goods up and down our Nation's rivers and out to sea via coastal ports. The Navigation Economic Technologies (NETS) Research Program supports the navigation mission by developing state-of-the-art, credible, independently verified economic models, tools and techniques to be used by USACE field planners in informing investment decision making at all levels of the agency. The knowledge and tools developed by the NETS research program are based on reviews of economic transportation and market theory, current best practices both within and outside of the USACE; data needs and availability; and peer recommendations.

In FY 2008, the NETS developed tools and techniques began their transition to field use:

- The Global Grain forecasting model was certified by the Corps and used for the *Upper Mississippi River – Illinois Waterway Navigation and Ecosystem Program* (NESP) study.
- The Survey Model was also certified by the Corps and used for the NESP study. The Survey model incorporates the findings of NETS shipper response research, directly responding to criticisms made by the National Academy of Sciences to the structure and inputs of previous models.
- The channel widening version of the HarborSym model continues to be used by Corps districts. Model certification has begun on the HarborSym channel widening model. The NETS team is extending HarborSym functionality to include channel deepening analysis for bulk carriers.
- Prototypes for suite modules have been developed for the *Navigation System Simulation* (NaSS).
- NETS' shipper response research (also known as the "Wilson-Train" Technique) is being incorporated into Corps legacy models. Working with the Planning Center of Expertise for Inland Navigation, NETS has

completed a survey to estimate the shape of the shipper response curves on the Ohio River. The NETS team is working in conjunction with the Oak Ridge National Laboratory and the Planning Center of Expertise for Inland Navigation to incorporate these results into the *Ohio River Navigation Investment Model* (ORNIM).

- NETS researchers continue to develop techniques to evaluate and forecast container freight traffic.

The NETS program is scheduled to conclude in 2009. The focus is to complete and transfer the tools and techniques developed by the NETS Research Program to the Planning Centers of Expertise for Inland and Deep Draft Navigation. The NETS web site www.nets.iwr.usace.army.mil is being updated and finalized as a publicly available archive of the research program.

Environmental Sustainability: The Environmental Sustainability Project, managed by Dr. Richard Cole, includes activities that pertain to the implementation of the *Environmental Operating Principles* (EOP) and sustainable solutions in the USACE. Development of a framework for achieving environmental sustainability has been completed in draft and awaits final internal review. An assessment of the condition of freshwater biodiversity at Federal water resources projects continues to be reviewed before final approval for publication. A new metric for measuring the benefits from ecosystem restoration projects has been developed and two technical reports are being readied for publication by ERDC. A third technical report, in review, compares the new metric with other metrics now used for ecosystem restoration benefits estimation. A technical note and a journal article draft are now in review. A report on the concepts of sustainability, developed under the leadership of Dr. Cole by the Sustainable Solutions project development team of the “Actions For Change” initiative is undergoing internal review. Another Sustainable Solutions project development team report on the status of sustainability in the USACE is under development.

IWR Planning Suite: Version 1.0.9.0 was certified in compliance with the requirements of the Planning Model Improvement Program (PMIP) guidance. This model is a water resources investment decision-support tool that performs cost effectiveness and incremental cost analyses associated with the formulation and evaluation of planning alternatives that produce non-monetary or a combination of

monetary and non-monetary outputs. Originally designed to assist with the development and comparison of alternative plans for ecosystem restoration and watershed planning studies, the program can also be applied to a wide variety of integrated water resources planning and management problems by identifying which plans are the best financial investments, then displaying and comparing the effects of each plan on a range of decision variables. Training in the software was delivered to the New Orleans District. Two new modules were developed further based on beta-testing in 2007 and 2008 that can be “plugged in” to IWR Planning Suite: the “Multi-Criteria Decision Analysis” module, and the “Annualization” module. The annualization module computes the annualized cost and outputs based on user provided implementation costs, discount rate, periodic operation and maintenance costs, period of analysis, benefits streams, ecological response rates, etc. A draft guide for the annualization tool as applied to a case-study and a draft guide for the *Multi-Criteria Decision Analysis* tool was also developed.

Regulatory Support: IWR supports the Regulatory Sub-CoP through policy analysis and training. IWR assisted HQUSACE prepare the final DoD – U.S. Environmental Protection Agency rule on “Compensatory Mitigation for Losses of Aquatic Resources” (*Federal Register*, 10 April 2008 <http://edocket.access.gpo.gov/2008/pdf/E8-6918.pdf>). After the rule was issued, IWR gave many briefings on the Mitigation Rule at many national conferences and played a major role with Corps HQ and EPA developing 1½-day mitigation regulation familiarization sessions for Corps and EPA staff and many of the presentations at the three Corps-EPA sessions in Atlanta, Seattle, and Denver.

IWR has a major role in teaching the interagency course entitled *Mitigation Banking Interagency Review Team Training*, at the National Conservation Training Center in Shepherdstown, WV, offered in June 2008. IWR helped organize the course along with the staffs of the U.S. EPA, the U.S. Fish and Wildlife Service, the Conservation Fund, and the Environmental Law Institute (ELI).

IWR continued its long-standing support managing the Regulatory Prospect courses and the Regulatory Executive Seminar, to which it added a Senior Manager’s Training Seminar in August 2008.

IWR has had a major role the last several years overseeing the development of the new Corps regulatory database — ORM 2.0 — the second

version of the OMBIL (Operations & Maintenance Business Information Link) Regulatory Module. By the end of FY2008, the database was deployed and historical data loaded for all districts with continual improvements being implemented.

In FY 2008, IWR became actively involved in managing the development of the Regional Internet Bank Information Transfer System (RIBITS), a compensatory mitigation bank data program. A second phase of the RIBITS contracts was awarded in late FY 2008 and legacy mitigation bank data collection begun.

Transportation Systems: The Transportation Systems Program supports HQUSACE and USACE district offices in accomplishing waterborne navigation project planning and evaluation responsibilities through the provision of (1) uniform and consistent maritime transportation data concerning costs of operation and replacement of foreign-flag and domestic commercial vessels and (2) comprehensive statistics on the composition and physical parameters of the world deep draft fleet and the domestic shallow-draft inland fleet. Macro-level world trade and cargo flow forecasts are also provided. Work completed in 2008 included updating of vessel operating costs for both the deep and shallow-draft fleets with an increase in statistical samples and the number of ship types covered compared to previous years; world trade and commodity flow forecasts; distribution of updated materials and statistics from various maritime industry data subscriptions; and award of new multi-year contracts for transportation, trade and economic forecasts from Informa Economics, Inc. and IHS Global Insight. The Global Insight service includes updated barge and rail transportation modal cost models. Future work includes the development of operating costs for Great Lakes vessels, oceangoing barges, dredge plant and intermodal container transport.

Flood Damage Data: The Flood Damage Data Collection program is intended to produce generic relationships for computing expected annual flood losses and tools for the collection and management of floodplain inventory data. In FY 2008, IWR developed flood damage functions and content-to-structure value ratios for 20 nonresidential use categories. The program provided training and technical support for IWR-GeoFIT, a geospatial floodplain inventory tool for residential, business, and public property. IWR-GeoFIT was updated to accommodate Arc-GIS 9.2. The program oversaw development of a design document and prototype for estimating flood damage to roads.

System-Wide Water Resources Research (SWWRP): System-Wide Water Resources Research (SWWRP), a joint effort between IWR, led by HEC, and ERDC laboratories, is focused on expanding research activities to the “System Wide” perspective, reflecting a concerted effort by USACE to follow concepts of sustainable development in a watershed context. Funding from SWWRP supports the development of multiple software packages that are widely used throughout the USACE and the professional engineering community, including: HEC-HMS (Hydrologic Modeling System), HEC-RAS (River Analysis System), HEC-WAT (Watershed Analysis Tool), HEC-PRM (Prescriptive Reservoir Model) and HEC-EFM (Ecosystem Functions Model). Details on all of these products are available on the HEC website <http://www.hec.usace.army.mil/>.

Flood and Coastal Storm Damage Reduction Research (FCSDR): The Flood and Coastal Storm Damage Reduction Research (FCSDR) program is a collaborative effort between ERDC and IWR, with HEC as the lead office within IWR for the program. FCSDR looks at methods to improve the analysis and development of tools relating to modeling of flood damage and flood damage reduction techniques. Funds from FCSDR support the development of HEC-WAT (Watershed Analysis Tool), HEC-ResSIM (Reservoir Simulation Model), HEC-DSSVue (Data Storage System), HEC-SSP (Statistical Software Package), HEC-FDA (Flood Damage Analysis), HEC-FIA (Flood Impact Analysis), HEC-GeoRAS (Geospatial River Analysis System) and HEC-GeoHMS (Geospatial Hydrologic Modeling System).

Research work units pursued in 2008 included: extreme flood events, groundwater/surface water interaction and real-time forecasting. Details on all of these activities and R&D products are available on the HEC website <http://www.hec.usace.army.mil/>.

IWR-HEC H&H and Risk and Uncertainty: Funds from FCSDR support the development of the HEC-FRM (Flood Risk Management) software. This new tool is the next generation of HEC’s Flood Damage Analysis (HEC-FDA) model. It includes a systems approach, event-based sampling, the ability to do scenario analysis, and structure-by-structure, cost, non-structural, loss-of-life, and agricultural damage analyses. The tool accommodates most, if not all, of the recommendations that the Corps concurred with from the National Research Council report on the Corps’ implementation of risk analysis for flood damage reduction published in 2000, and it will also

aid in implementing the Chief of Engineers' Actions for Change initiative.

HEC continued the modification of two Engineer Manuals, EM 1110-2-1413, "Engineering and Design – Hydrologic Analysis of Interior Areas" and EM 1110-2-1619, "Engineering and Design – Risk Based Analysis for Flood Damage Reduction Studies" via the Guidance Update Management Program (GUMP) to include materials generated from research actions. It is expected that these will be 85% complete in Q3 of FY 2009.

HEC continued to lead the project development team for the new Engineer Circular (EC) addressing levee system evaluations for the National Flood Insurance Program (NFIP). This EC will supplement and clarify existing policy, procedural and technical guidance; provide an overview of documentation requirements; outline an Independent Technical Review (ITR) process; and summarize authority and funding mechanisms.

During FY 2008, the Corps' South Pacific Division requested assistance from HEC on a study of the Sacramento River Flood Control Project (SRFCP) levees. The SRFCP is a large system of regulated and unregulated inflows, watercourses, bypasses, hydraulic structures, and tidal influences. The request relates to the determination of possible system impacts due to a non-Federal proposal for modification of a Federal project and the documentation required for compliance with the 33 USC 408 permitting process. The impact analysis requires a comprehensive approach that considers system-wide assessment of potential transfer of risk in terms of system performance. This effort provides the methods and steps to use current probabilistic analysis tools in a system-wide context to assess performance and changes to performance from modifications to project levees. This study has led to formal guidance in the use of probabilistic methods to support 33 USC 408 permit requests. This study also served as a proof-of-concept and gap analysis in the development of HEC-FRM software.

IWR-NCR Alternatives Analysis and Decision Making (AA&DM): The AA&DM in the old structure of ERDC, was a stand-alone program aimed at addressing decision making criteria, such as social impacts and economics. It evolved into a methods approach to address a growing number of concerns, including how to formulate and evaluate projects that do not have an economic basis or justification for being. Ecosystem restoration projects, the newest mission of the Corps of Engineers, falls into this

category. In the AA&DM program there are several work units aimed at this objective.

The "Catalog of Management Measures" is an illustrated set of management measures which was created to better enable planners to consider a wider range of alternatives, including non-structural for ecosystem restoration projects. The catalog has been digitized and posted on the IWR website to promote greater access. The catalog is available at <http://www.iwr.usace.army.mil/inside/products/pub/MMDL/FLD/>.

The IWR Planning Suite was initially a tool for conducting cost effectiveness and incremental cost analysis on restoration projects. It guided planners and decision makers to the alternative plans that provided the greatest amount of output for the least cost. It has grown to include plan formulation assistance as well as accommodating a tradeoff analysis tool known as Multi-Criteria Decision Making or "MCDM." The next effort will attempt to link environmental values to the output discussions.

A continuing work unit in the program in FY 2008 is the research subject entitled "Estimating Flood Damage to Roads" caused by severe and prolonged flooding events. A model is being developed to link the expected damages to roads based on the severity of a given flood. Future efforts will link the cost of those damages in terms of time lost in travel due to damages.

A new research project initiated in FY 2008 entitled "Non-Structural Flood Damage Reduction Measures" is aimed at producing cost estimating techniques for implementing a number of defined non-structural measures. This effort is being jointly produced by IWR and the Huntington District.

Planning Methodologies:

National Economic Development Manuals: IWR is in the process of updating the National Economic Development (NED) Manuals series, originally published between 1987 and 1991. The manuals are important basic references for economists and others involved in planning and analysis of Federal water resource projects. The manuals discuss the principles and concepts associated with NED benefits and provide detailed procedures to measure and calculate benefits. The updated manuals will be exclusively web-based to increase accessibility for field personnel; facilitate the maintenance and update of the manuals; improve the efficiency and effectiveness of providing up-to-date information to the field; and be responsive

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to a diverse audience. The Flood Risk Management manual is complete and available for use. The Economic Primer, the Overview NED Manual, the Coastal Storm Damage and the Deep Draft Navigation manuals are under development and are scheduled to be completed in 2009.

Update of “Digest of Water Resources Policies and Authorities” and “U.S. Army Corps of Engineers Civil Works Policy Pocket Reference”: The policies and guidance established for the Corps of Engineers are contained in a voluminous body of public law, executive orders, Engineer Regulations, Engineer Manuals, and policy memoranda. In order to make this guidance more accessible to users, the Corps of Engineers publishes Engineer Pamphlet 1165-2-1, “Digest of Water Resources Policies and Authorities” (also referred to as the “Policy Digest”). The last revision of the Policy Digest occurred in 1999.

This pamphlet is a ready reference, providing a brief summary, in digest form, of the existing administrative and legislative water resources policies and authorities pertinent to the Civil Works activities of the Corps of Engineers. In order to maintain the value of the Policy Digest as a reference tool, IWR is currently revising the Policy Digest to bring the reference up to date. The updated Policy Digest will be released as a web-based publication with hyperlinks to original policy sources.

A companion of the Policy Digest is the “U.S. Army Corps of Engineers Civil Works Policy Pocket Reference” (also referred to as the “Pocket Digest”). This ready reference was last updated in December 2005 and is also currently under revision at IWR to include policy changes. It will be released as an abbreviated hardcopy pocket edition of the larger Policy Digest.

Other Social Effects (OSE) Handbook: EC 1105-2-409, “Planning in a Collaborative Environment” reemphasizes the importance of fully considering the Other Social Effects (OSE) and Regional Economic Development (RED) accounts in project development, evaluation and decision making. The OSE handbook provides field analysts with the framework and tools they need to perform an OSE analysis. The handbook includes a framework and principles for OSE analysis; tools for performing analyses and examples by business line. The OSE handbook is the third item produced addressing the OSE account. Previous reports on this subject include an IWR white paper entitled “*Review of Guidance and Procedures for Regional Economic Development and Other Social Effects*”, dated August, 2006 and a research report entitled “*Theoretical Underpinnings of the OSE Account*”

March 2007. The OSE Handbook underwent final review in FY 2008 and is expected to be published in FY 2009.

Regional Economic Development Handbook: IWR is in the process of finalizing a handbook on Regional Economic Development (RED). The need to perform RED has grown in recent years given the renewed emphasis in EC 1105-2-409, “Planning in a Collaborative Environment” on the consideration of all four accounts (National Economic Development (NED), Environmental Quality (EQ), RED, and Other Social Effects (OSE)). This handbook will provide valuable tools and insights into the use of RED analysis. It includes discussion of RED for each of the Corps' business lines. Consideration of RED impacts in the planning process will result in more comprehensive accounting of project contributions and effects. The draft RED Handbook was reviewed internally and externally in FY 2008. It is scheduled to be published in FY 2009.

Multi-Objective Planning Manual: In response to ER 1105-2-100 (“Planning Guidance Notebook”), EC 1105-2-404 (“Planning Civil Works Projects Under the Environmental Operating Principles”) and EC 1105-2-409 (“Planning in a Collaborative Environment”), the Corps has been increasingly encouraged to formulate projects having multiple objectives. Since few Districts have performed true multi-objective planning, IWR is developing this manual to educate planners how to perform this more complex type of decision making. A draft version of this manual is currently under review.

NexGen Software: HEC continued to enhance many software products and introduce new products. Released in FY 2008 were:

- HEC-HMS, Hydrologic Modeling System, Version 3.3. Two new simulation features were added to the HEC- HMS Version 3.2 software. They include: a new option in the SCS Unit Hydrograph transform method and simple reservoir evaporation option. In addition, as with any new release, the identification and repair of a number of bugs also took place.
- HEC-FDA, Flood Damage Reduction Analysis, Version 1.2.4. This long awaited product has many new and improved features which are discussed in the “What’s New” section of the HEC-FDA web page. <http://www.hec.usace.army.mil/software/hec-fda/whatsnew.html>. HEC-FDA provides the

capability to perform an integrated hydrologic engineering and economic analysis during the formulation and evaluation of flood risk management plans. HEC-FDA is designed to assist study team members in using risk analysis procedures for formulating and evaluating flood risk management measures and analyzing the economics of flood risk management projects. It computes expected annual damage (EAD) and equivalent annual damage and provides the annual exceedance probability (AEP) and conditional non-exceedance probability as required for levee certification.

- HEC-SSP, Statistical Software Package, Version 1.0. This initial release of the SSP software begins to replace the multiple DOS based statistical applications that HEC has supported for years. Version 1.0 can perform flood flow frequency analysis based on Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” (1982). HECC-SSP Version 1.1 will be released in FY 2009.
- HEC-EFM, Ecosystem Functions Model, Version 1.0. The inaugural release of this long anticipated software is designed to help determine ecosystem responses to changes in flow regime of a river or connected wetlands. It allows the study team to visualize and define existing ecologic conditions, highlight promising restoration sites, and assess and rank alternatives according to predicted changes in different aspects of the ecosystem.
- HEC-RAS, River Analysis Systems, Version 4.0. Additional features include water quality temperature modeling, sediment transport, gate rules and modeling of the Katrina event. The companion GIS utility package (HEC-GeoRAS) also continues to be updated and is compatible with ArcGIS 9.x versions.

More information about these software packages and other HEC software can be found on HEC’s website, <http://www.hec.usace.army.mil>.

FY 2008 also saw improvements to HEC-FIA, Flood Impact Analysis, with its loss-of-life capabilities and the new Watershed Analysis Tool, HEC-WAT (which includes HMS, RAS, SSP, ResSim, EFM, GeoHMS, GeoRAS and FIA software). A beta version of the

WAT was released in FY 2008 and is available for use and testing. Official releases of this software should be available in FY 2009.

HEC and ERDC continue to integrate HEC-ResSim and CE-QUAL-W2 for modeling of water-quality constraints on the operations of one or more reservoirs. HEC and the USGS, in association with IHE-Delft, are also working together to integrate HEC-RAS and the USGS MODFLOW software. These collaborative efforts will continue in FY 2009.

INTEGRATED CIVIL WORKS SYSTEMS

Performance based budgeting, performance measurement and program assessment are increasingly important. In response, IWR created a corporate data warehouse of financial and navigation infrastructure inventory data, lock characteristics, navigation project profiles, OMBIL outputs, waterborne commerce, lock performance, hydropower, recreation, water supply, National Recreation Reservation System and environmental stewardship data. Data from these sources is linked, integrated and combined to generate performance measures, which are then used in the budget process.

OMBIL: The Operations and Maintenance Business Information Link (OMBIL) Plus, a centralized performance management information system, encompasses the Civil Works business lines of navigation, hydropower, recreation, environmental compliance, environmental stewardship, water supply and regulatory. The OMBIL decision support system distributes data to support a variety of Corps management initiatives, performance-based budgeting and Federal and public data requirements.

In support of the Civil Works business performance measurements, the Navigation Data Center (NDC) extracts expenditure data from the USACE Financial Management System (CEFMS) and combines it with business output data to generate efficiency and effectiveness measurements, including submissions to the Office of Management and Budget. NDC data supports and is a source of information and data used in the Corps “*Value to the Nation*” publications and the Federal government’s recreation access site: <http://www.recreation.gov>. Navigation data is also integrated with CorpsMap, providing an intranet web-based GIS interface. All of NDC’s publicly available navigation and water transportation data is available at www.ndc.iwr.usace.army.mil or on its annual CD-ROM.

ORM 2.0: IWR has completed development and deployment of OMBIL Regulatory Module Version 2 (ORM 2.0). ORM 2.0 is a web-based geospatial database application for tracking and managing all aspects of the Corps regulatory process. ORM 2.0 was developed using a unique combination of Corps in-house expertise and contract support. ORM 2.0 supports a consistent national business process for the regulatory program resulting in consistent tracking and reporting of program performance. ORM 2.0 integrates with USACE district enterprise geographic information systems and other federal and state agencies. ORM 2.0 provides the foundation for watershed based decision making in the Corps regulatory program. By the end of FY 2008, the database was deployed and historical data loaded for all districts with continual improvements being implemented.

CWMS: The Corps Water Management System (CWMS) is a comprehensive data acquisition and hydrologic modeling system for short-term decision support of water control operations in real time. CWMS supports field-level decision making within the Corps water management mission. It embodies data acquisition, validation, transformation and management; forecasting, simulation and decision support analysis; and information dissemination.

The first version of CWMS was released in 2002. CWMS has been updated at roughly annual intervals at the thirty plus Corps offices with water control management responsibilities. Improvements to the system continue via a field-prioritized betterments program. Version 1.5 was released in FY 2007, and is the current production system.

At the end of FY 2008, version 2.0 was approaching completion, with testing scheduled for the spring of 2009 and release to the field in the summer of 2009. This version includes major revisions to the basic database structures, allowing water control users more direct access to their data and enabling them to make more effective use of the features inherent in the commercial Oracle database at the center of CWMS. A public release of the modeling component of CWMS, HEC-RTS (Real Time Simulation) will closely follow the release of CWMS 2.0.

In addition to software development, HEC has been actively engaged with ACE-IT and the CWMS management team to configure a standard hardware platform for CWMS and other water control programs. This effort will produce a more uniform and easily supported implementation of water control data and modeling systems throughout the Corps and

support the uniform access to water control data nationwide through access to roll-up databases at the Corps enterprise processing centers. Information about CWMS and other HEC software is available on the HEC web site www.hec.usace.army.mil/cwms/.

WATER RESOURCES TRAINING AND EDUCATION

The Institute for Water Resources, including HEC, has always been a leader in innovation within the Corps of Engineers family. IWR has been responsible for developing techniques and approaches for economic analysis, risk analysis, planning methodologies, public involvement, conflict dispute resolution, water conservation and other topic areas. HEC, through the development of hydraulic, hydrologic and planning analysis methods and models, has built a reputation recognized throughout the world in the fields of hydraulics and hydrology. Over the course of their existence, both IWR and HEC have made considerable effort to build appropriate training vehicles for the instruction in the use of the various tools they have developed. As a result, each office routinely offers eight to twelve courses per year through the Proponent-Sponsored Engineer Corps Training (PROSPECT) program and/or through other training venues, such as workshops and seminars.

PROSPECT Program and Specialty Workshops: IWR continued the USACE Proponent Sponsored Engineer Corps Training (PROSPECT) program in 2008 by presenting 24 week-long courses (fifteen led by the IWR-NCR and nine by HEC). The PROSPECT courses covered a wide range of Civil Works water resources topics: Public Involvement and Teaming in Planning; Public Involvement–Communications; Regulatory for New Regulators; Regulatory – Procedural Issues; Regulatory – Decision-Making; Regulatory Executive Seminar; Hydrologic and Hydraulic Engineering; Water Resources Planning; Ecosystem Restoration; Flood Risk Management; Collaborative Planning; and Plan Formulation. The specialty workshops often used pieces of the PROSPECT training courses but generally, the specialty workshops were built specifically for the requesting office and often included topics outside of the normal PROSPECT training. IWR is committed to technology transfer and the dissemination of its tools, processes and procedures. The organization and staff are committed to provide assistance in using our tools, through workshops, telephone consultation or whatever may be necessary.

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IWR-NCR assumed responsibility for several of the Planners Core Curriculum (PCC) courses in FY 2007 and 2008. IWR staff worked with field instructors to present three of the courses as they were originally created. These included Collaborative Planning, Environmental Considerations in Planning, and Plan Formulation. Other IWR courses included Risk Analysis - Water Resources Planning; Conflict Management and Dispute Resolution taught primarily by contractors; Public Involvement - Communications, again taught by contractors; Regulatory I - New Regulators; Regulatory IIA - Procedural Issues; and Regulatory IIB - Decision Making, all of which were taught by Corps regulators from across the country. In addition to the IWR sponsored courses, IWR staff members are active members in a number of other PROSPECT courses, teaching special topics such as Cost Effectiveness and Incremental Cost Analysis (IWR-PLAN), Economics, Forecasting, Risk Analysis, and Environmental Benefits Evaluation.

In addition to the aforementioned training, IWR is also responsible for managing the Corps Planning Associates (PA) program, which is designed to be comprehensive training to build future leaders in the planning community of practice. The program is a series of interrupted one, two and three week sessions interspersed with trips back to the home district to keep up with the workload. Students are committed to keeping their work at home moving while participating in the program.

IWR manages the Corps' Regulatory Executive Seminar for senior managers and works closely with Corps HQ Regulatory personnel in support of new course development.

IWR is now embarking on a new capacity development venture on an international scale through its International Center for Integrated Water Resources Management (ICIWaRM). IWR has been nominated by the U. S. Government, through the Department of the Army and the U.S. Department of State, to become a UNESCO Category II Water Center. When the UNESCO designation is approved (expected in October 2009), it is anticipated that IWR and IWR-HEC will be called on to place even greater emphasis on water resources training and education for developing an emerging nations around the world. IWR has constructed a new classroom in the Casey Building to accommodate future classes of national and international students.

Under the auspices of the PROSPECT program, HEC conducted ecosystem oriented training courses such

as "Water and the Watershed" and "Hydrologic Analysis for Ecosystem Restoration" as well as a full menu of hydrologic engineering and planning analysis topics, including courses on Flood Frequency Analysis, H&H for Dam Safety Studies, CWMS Modeling for Real-time Water Management, Steady Flow Water Surface Profile Computation Using HEC-RAS, Risk Analysis for Flood Damage Reduction Projects, Unsteady Flow Analysis with HEC-RAS, and Hydrologic Modeling with HEC-HMS.

In addition to the PROSPECT program, HEC conducts many specialized training classes for a wide variety of clients.

In FY 2008, HEC staff presented two hydrologic modeling courses in Kenya and Ethiopia as part of the Combined Joint Task Force-Horn of Africa host nation agreement. As a follow-on effort, HEC in collaboration with the U.S. Geological Survey presented a two-week groundwater modeling course at the University of Addis Ababa, Ethiopia in July, 2008. The training focused on the use of groundwater models and was presented to a combined audience of graduate students, professors, and professional engineers.

Also in FY 2008 HEC staff travelled to IHE-Delft in The Netherlands where training was provided regarding water management and environmental modeling to officials from the Iraqi Ministry of Water. The course spanned a period of three weeks and targeted key water issues that were especially pertinent to Iraq. In addition, HEC worked with the USGS Idaho Water Science Center in Boise to train six engineers from the Iraqi Ministry of Water Resources in the use of HEC-DSS for data management and provided consulting regarding their telemetry system and database designs.

HEC performed additional training for the Iraq Ministry of Water Resources by providing specialized workshops in Jordan as part of a capacity development program. The capacity development program focused on the use of HEC-DSSVue and HEC-ResSim computer programs in a water resources planning study that the Ministry is undertaking.

HEC also provided training on how to evaluate environmental flows to the Mexico Institute of Water Technology.

HEC staff presented a series of seminars and workshops over a period of three weeks to the

Korean Water Resources Association and Inha University. Seminar content included debris yield after wildfires and the use of HEC-HMS for sediment transport modeling. One workshop included four lectures and two hands-on example studies and was presented to nearly 200 engineers and students in the Korean water resources field.

HEC conducted or contributed to courses about sediment modeling using HEC-RAS in Omaha; advanced HEC-ResSim modeling of the Columbia River system of reservoirs in Seattle for Northwestern Division; HEC-HMS training for the California Department of Water Resources; Nonstructural Measures for Flood Risk Management course in Omaha; Unsteady Flow Analysis Using HEC-RAS for Maricopa County in Phoenix, AZ; and a Planning Associates course regarding Flood Risk Management in Folsom, CA.

Planning Excellence Program: Throughout FY 2008, IWR provided managerial and technical support to the Civil Works Planning Community of Practice (CoP) in the execution of the Planning Excellence Program.

This included the management of the Planning Associates (PA) program and conduct of the three-week "Washington DC Experience" module for the FY 2008 class. The goal of the PA program is to develop planning leaders who can manage complex planning studies that lead to quality decision documents and who will provide water resources technical and professional leadership in the future.

IWR, in coordination with HQUSACE, is responsible for the implementation of the program, including setting up the criteria for selection of candidates, development and delivery of training sessions and financial management and logistical support.

IWR also provided support to the local delivery of selected Planning Core Curriculum courses by the Corps MSCs. These seven courses provide the basic, full-performance training needed by entry level planners across the USACE as the means to accelerate their progress to the journeyman stage of their career development. These courses include: Civil Works Orientation; Planning Principles and Procedures; Environmental Considerations; Economic Analysis; H&H Considerations; Plan Formulation; and Public Involvement and Team Planning.

Advanced Degree Program in Integrated Water Resources Planning and Management: The USACE strives to provide optimum training and

development opportunities in order to assure maximum efficiency of members of its workforce in the performance of their official duties. The Advanced Degree Program in Integrated Water Resources Planning and Management has been developed to ensure that the USACE maintains its standing as a leader in water resources planning and management. The program was designed to promote interdisciplinary degrees at the graduate level that were specifically geared towards water resources practitioners.

IWR has worked closely with the Universities Council on Water Resources (UCOWR) to develop a program which addresses the many challenges that the water resources planning and management community faces. Courses are offered at five universities: The University of Arizona; The University of Florida; Harvard University; Johns Hopkins University; and Southern Illinois University.

More than half of the students, either currently enrolled in the program or who have completed the program, have taken their entire program via distance learning. In particular, the University of Florida has been at the forefront of developing distance learning opportunities for participants in the program.

REIMBURSABLE TECHNICAL ASSISTANCE

Reimbursable project work was undertaken by the Institute for USACE field offices as well as: HQUSACE Civil Works Planning, Engineering, Operations, Regulatory, Office of Homeland Security; and Office of Interagency and International Activities; the Engineering Research and Development Center (ERDC), Coastal and Hydraulics and Environmental Laboratories; the Federal Emergency Management Agency; the International Joint Commission (IJC); the U.S. Agency for International Development (USAID); the National Weather Service; the U.S. Geological Survey; the Natural Resources Conservation Service; other Federal agencies; and approved Thomas Amendment Agreement technical support to the Lower Colorado River Authority, Texas and the Tampa Bay Water Authority, Florida. Other projects for USACE clients included navigation systems economic evaluation, technical advice and guidance on plan formulation, incremental cost and cost effectiveness analysis, risk analysis, watershed and reservoir system modeling, water quality, river hydraulics, wetlands hydrology, water control management, regional statistical analysis, flood damage analysis, flood warning response systems, GIS applications in hydrology and hydraulics, groundwater

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modeling and water supply in support of interagency investigations.

IWR worked on a variety of projects including: post-Katrina IPET support, hydraulic modeling, and risk analysis; Ft. Worth Flood Warning modeling; development of an integrated forecasting model for the National Weather Service for joint operations on Feather and Yuba Rivers, CA; Tooele and Ft. Huachuca groundwater modeling; development of HEC-RPT software for use on the Savannah River as part of the Sustainable Rivers Project; providing additional features in HEC-RAS software for the Tampa Bay Water Authority; helping the Lower Colorado River Authority implement CWMS for their water management needs; contributing to the revision of Bulletin 17B; writing levee certification guidance; working with the Corps Screening Portfolio Risk Assessment teams evaluating the safety of the Nation's dams; assisting the Corps' Engineering Risk and Reliability Directory of Expertise with a number of Dam and Levee Safety studies and efforts; assisting the Sacramento District and the South Pacific Division perform a risk analysis of the Sacramento River from a systems context; working with the Mobile District to modernize its Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) reservoir modeling applications using HEC-ResSim; working with the Detroit District to experiment with an unsteady flow HEC-RAS model for routing flows from Lake Superior to Lake St. Clair; and numerous miscellaneous consultations.

HEC entered into an agreement with the Sonoma County Water Agency and initiated another agreement with the South Florida Water Management District. Both of these agreements will allow HEC to add specific enhancements to the HEC software that provides capabilities for these agencies.

IWR staff provided reimbursable technical assistance to the Louisiana Coastal Protection and Restoration (LACPR) study team that is investigating long-term risk reduction strategies for southern Louisiana. An IWR senior economist and senior social scientist are integrated into the team and have assisted the development and execution of the risk-informed planning strategy. IWR has the lead for planning non-structural measures, including the formulation and evaluation of alternatives as well as development of the implementation strategy for these measures within the comprehensive plans.

Internationally, IWR continued to conduct work in Iraq and Afghanistan. In Iraq, HEC entered into an MOA with the U.S. Embassy Baghdad/Iraq to provide

training to the Iraqi Ministry of Water Resources on the application of the Tigris-Euphrates Water Management Systems Model (WMSM). Under previous contracts with the U.S. Agency for International Development, HEC developed and delivered WMSM and documentation to the Ministry and Embassy. Due to the need for additional training of Iraqi Ministry personnel, HEC entered into another MOA for additional training.

In Afghanistan, HEC developed an operations manual and performing a water budget analysis for the Kajakai Reservoir in the Helmand Valley of Afghanistan and prepared and delivered a final report entitled "Water Balance and Regulation Alternative Analysis for Kajakai Reservoir Using HEC-ResSim" to the Afghanistan Engineer District.

HEC provided technical assistance regarding modeling tools to the IWR-lead International Joint Commission Upper Great Lakes Study (UGLS). HEC provided substantial technical support to the modelers at the Detroit District and Environment Canada charged with developing the UGLS "fencepost" alternatives for Lake Superior regulation.

HEC performed a levee evaluation and performance analysis for a levee along the Anseung River protecting Camp Humphreys in South Korea. In addition to the river flooding, interior drainage issues were addressed. Nonstructural measures such as flood warning and flood preparedness were recommended as well.

CIVIL WORKS PROGRAM AND PROJECT INFORMATION

IWR maintains, develops and provides a full range of international, national and USACE project and program data and information for decision support for the Corps, other federal government agencies, the private sector, and the public on key Civil Works activities. National water resources database concept development, design, implementation, operation and maintenance activities are provided through a combination of in-house and private sector systems analysts, statisticians, engineers and scientists who work in close coordination with USACE users. Also IWR acquires external data from other federal agencies and private sector sources, to be used by the Corps for integrated analysis and benchmarking. These data are used within the Corps for program management, budget development and justification, OMB Program Assessment Rating Tool, numerical models and real time management at the project. Major initiatives

within the past year have been the development and creation of performance measures for the Corps business lines to reflect the efficiency and effectiveness of the programs and analysis.

Navigation Data Center: The Navigation Data Center (NDC), located at the National Capital Region headquarters of IWR at Ft. Belvoir, VA., is the central manager of navigation, hydropower, recreation, environmental stewardship, water supply and regulatory program data for the Nation. Information provided by NDC directly supports the USACE annual Civil Works performance-based budgeting program. NDC is responsible for national level executive oversight and management responsibilities, including the development of Federal and USACE Engineer Regulations (ER's), the Code of Federal Regulations, and their enforcement. OMB, acting on legislative mandates, recognizes USACE, acting through NDC, as the Federal collection agent for waterborne commerce, vessel activities and waterway infrastructure data and statistics.

NDC accomplishes its objectives of supplying timely and accurate data through the following activities: assessing user requirements; developing, designing, operating and maintaining systems to collect, process and store data and information; developing and disseminating data, information and statistical products; training providers and users of project and program information and data; and maintaining knowledge of the latest developments in the area of technical and content interoperability.

As a national statistical center, NDC coordinates extensively with other Federal statistical agencies and data users, representing the U.S. government before other nations in the development of data and information standards and protocols and in the negotiation of data exchanges. NDC actively participates in corporate information integration and coordination within the USACE and plays a lead role in developing, coordinating and disseminating water resources information for performance measurement and management purposes. It leads the development of strategic communication with both internal communities of practice and external water resources interests, stakeholders and communities.

Waterborne Commerce and Vessel Statistics: Under the authority of the River and Harbors Act of 1922, as amended and codified in 33 U.S.C. 555, the USACE is to collect, process, distribute and archive U.S. waterborne commercial vessel trip and cargo data. These data and statistics are used to analyze the feasibility of new water transportation projects and

activities; to set priorities for new investment and rehabilitation; and for management of the operation and maintenance of existing projects.

Under Federal law, vessel operating companies must report domestic waterborne commercial vessel movements directly to the USACE. The types of vessels include, but are not exclusively limited to: dry cargo ships and tankers, barges (loaded and empty), towboats (with or without barges in tow), tugboats, crew boats and supply boats to and from offshore locations, newly constructed vessels from shipyards to the point of delivery, ferries and other passenger vessels, and vessels remaining idle during the monthly reporting period. Harbor Maintenance Tax information, providing the name of the shipper of the commodity and the shipper's Internal Revenue Service number or Social Security number, is also reported for the cargo movements into or out of ports that are subject to the provisions of section 1402 of the Water Resources Development Act of 1986 (Pub. L. 99-662). U.S. foreign waterborne import, export and in-transit cargo and vessel movement data is provided to the Corps by the U.S. Customs and Border Protection, the U.S. Bureau of the Census, and the Port Import Export Reporting Service.

Movement data acquired by the NDC Waterborne Commerce Statistics Center is primarily for the use of the USACE and other governmental agencies. Since 2004, data have been incorporated into the USACE budget preparation process, providing the navigation project outputs and performance measures used to rank and justify operation and maintenance funding requests. Summary statistics, which do not disclose movements of individual companies, are also released to private companies and to the general public.

International Trade Data System (ITDS): During FY 2008, the Institute's Navigation Data Center continued its involvement in the development of the *International Trade Data System* (ITDS). ITDS is a multi-agency technology initiative administrated by the e-Customs Partnership, a public-private partnership led by Customs and Border Protection (CBP). Both the public and private sectors have steering committees and numerous sub-committees.

The objective of this initiative is to provide a secure, single source interface for the collection, input, analysis, and proper dissemination of international trade and transportation statistics. The Corps is one of over 20 government agencies working with the trade and transportation community to implement this initiative.

In FY 2008, the USACE expanded the scope of a Memorandum of Agreement (MOA), initially signed in FY 2007, with the Customs and Border Protection and the Census Bureau to receive trade data from CBP and Census, and began work on a Corps-wide Memorandum of Understanding (MOU) to receive trade data from the CBP and the Census Bureau for an indefinite time period. USACE also completed its interface control document (ICD). This formal document is an agreement that specifies the technical transfer of electronic information between USACE and CBP systems.

Coastal and River Information Services (CRIS): CRIS is a public-private initiative lead by the USACE, the U.S. Coast Guard, NOAA, the IRS, and private sector representatives to establish a single method for electronic reporting and disseminating information on U.S. coastal and inland waterways. CRIS members serve on several Integrated Action Teams on the *Committee for the Marine Transportation System (CMTS)*.

The goal of this effort is to provide a framework by which domestic transportation and related information on U.S. coastal and inland waterways can be transmitted and received using one message, one set of codes, and at one time for Federal reporting purposes. The program will serve a wide range of safety, operational, security, environmental, and statistical needs.

In FY 2008, a *Federal – Industry Logistics Standardization (FILS)* sub group was formed under CRIS to address the need for standard cosign schemes for use in future processes and systems that are developed to capture, analyze, and discriminate navigation information. FILS is a joint collaboration between governmental agencies and industry to adopt a uniform nomenclature for U.S. navigational points of interest in order to improve accuracy and efficiency when sharing common information. The group jointly created and adopted a universal location code to integrate into Federal and Industry systems. Requirements for use of the code are being written into the collection regulations for USACE, IRS, the Coast Guard, and CBP. The University of Toledo completed its prototype web interface and portal for NDC. The portal was tested in FY 2008 and approved for development in FY 2009.

NDC continued its research and planning to harness AIS data from the Coast Guard. NDC worked through the FILS subgroup to research and test ways of using the AIS data for quality control checks against other sources of navigation data.

Navigation Infrastructure Inventory: Navigation Infrastructure Inventory information supports the USACE Federal Central Collection Agency responsibility for documenting the Nation's commercial port infrastructure served by Federal channels. Data for over 9,500 individual docks is published on the Internet in summary form and as data files. Data are updated as each port facility is contacted and characteristics are verified. New update and survey procedures are being developed to increase the frequency of update and to allow individual facility operators and port authorities to update their own facility information in the database.

Navigation Infrastructure Inventory information is used to identify industries served by the Federal channels and is part of the budgetary process of prioritizing projects. The U.S. Coast Guard (USCG) is another primary user of the information in the execution of its homeland security mission. A new initiative begun in FY 2008 was the formation of the Federal - Industry Logistics Standardization group which is a working group comprised of the Corps, IRS, USCG, CBP and the barge and towing industry. The highest priority task is to produce a definitive list of dock facilities with unique identification codes and accurate geo-location that both the public and private sector can use when communicating with each other.

Lock Performance and Characteristics: The lock performance database provides the USACE access to individual lock near-real-time information as well as summary and performance statistics. The data are entered into the database by the lock operator as the vessel is locking through the chamber. A national data warehouse provides all USACE users direct access to current and historical data and summaries. The data is used by the USACE and other agencies, such as the U.S. Coast Guard and the Tennessee Valley Authority (TVA), in the execution of their missions, and in the formulation of the USACE budget. A successful pilot project at several New Orleans lock sites demonstrated the ease of using the Coast Guard required vessel *Automated Information System (AIS)* signal to increase lock operator situational awareness by visualizing on a map the location and identification information of all vessels in the vicinity of the lock. This enables the lock operator to better plan the locking procedure. The capture of the AIS signal also will allow selected timing events to be automatically entered into the database. Investigations are underway to implement this capability nationwide.

Lock characteristics data and the physical descriptions of all the USACE owned and operated locks are

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updated as information changes. Lock characteristics and performance information are available on the public web site, <http://www.ndc.iwr.usace.army.mil>. The lock databases are feeder systems to the OMBIL decision support system. The lock data are used to supply the OMB required performance data of lock unavailability due to mechanical problems.

Dredging Statistics: This web-based ORACLE database is successful in supplying information on all USACE performed and contracted dredging to the USACE, industry and private users. Data entry and report generation is accomplished via the USACE intranet and enables all USACE members to access the central system information. Data is used to generate the Small Business Report for dredging contracts. Biweekly reports are posted on the public web site to inform the industry and public of Corps and contracted dredging activities. Standard reports and summaries plus customized queries and reports are quickly generated to meet Corps and user needs. Use of the information has resulted in improved bidding competition and more efficient utilization of dredging equipment. The dredging database is a feeder system to the OMBIL decision support system. The data are used in determining the charge rate of the Silent Inspector system.

Recreation: Recreation data for the Corps' 4300 recreation areas are collected and maintained within the OMBIL database. Recreation inventory (recreation areas, visitor centers, facilities, and amenities), outputs (e.g. visitors, visitor hours) and activities (e.g. citations and interpretive contacts) are combined with revenues and expenditures to produce performance measures that assist the Corps in making management decisions for the Recreation program. This data is furnished to public websites such as Value to the Nation, www.vtn.iwr.usace.army.mil, CorpsLakes, <http://corpslakes.usace.army.mil/visitors> and the federal interagency recreation website at www.recreation.gov. In FY 2008, OMBIL has focused on improving the accuracy of the visitation data and the inventory of recreation projects. OMBIL also supported the budget process by continuing to supply data to the *RECreation Budget Evaluation SysTem* (Rec-BEST), Recreation Self Assessment Tool, and RecStatus, project information and benchmarking report, developed by ERDC.

IWR, in collaboration with ERDC, has provided additional technical support to Corps Recreation Business line activities. The activities that were accomplished in FY 2008 include: continuing to support the Performance Based Budget Development for Recreation Business line; Regional Economic

Impact Analysis of Recreation; GIS Application and the implementation of Google Earth application for all Corps Recreation projects; and other miscellaneous technical support to Corps Natural Resources management activities.

IWR provided technical support for individual public survey submissions on recreation planning and recreation management.

Hydropower: Hydropower data from the 75 Corps power plants is collected and maintained within the OMBIL database. For those power plants in the Northwestern Division that have automated control systems (Generic Data Acquisition and Control System or "GDACS"), electronic upload of generation data is in place. Data such as power generation statistics, unit availability and revenue generated, enable the Corps hydropower program to determine its performance, make budgeting decisions and furnish OMB with program performance information. In FY 2008, all five hydropower performance measures for the FY 2010 budget process were supplied by OMBIL hydropower data. Also added to OMBIL Plus was a module related to capturing the ongoing water supply reallocation studies.

Water Supply: IWR serves as the HQUSACE national program manager for the Water Supply business program. In this capacity, the annual budget and the five-year development plan for that portion of the USACE Water Supply budget is developed in coordination with the MSCs and the strategic plan as presented in the Program Assessment Rating Tool. It is necessary to develop annual budget guidance to the MSCs, collect their data, prioritize it in conjunction with the seven other business lines and eight program areas, present the data to the senior leaders of Civil Works, the Assistant Secretary of the Army (Civil Works) and a panel of water supply examiners from OMB. The annual program must then be modified and adjusted as necessary based on OMB comments and directives.

IWR is responsible for the development and maintenance of the USACE database of Water Supply projects. This database was originally developed in 1996, updated in 2004 and again in 2005. In 2006 an effort was undertaken to develop a Water Supply module in OMBIL and this effort is still underway. This process, once loaded into the Water Supply module of OMBIL, will enable a continual update of the OMBIL data, similar to other business lines. There was no 2006 database due to the effort required to load OMBIL. For both the 2007 and 2008 databases staff is

using a combination of the new OMBIL data, where loaded and the old 2005 data from those districts which have not completed the loading process. The 2008 database shows there are 134 Corps multipurpose projects which contain storage space for municipal and industrial water supply. These projects are located in 26 states, Puerto Rico and in 24 of the 38 Corps districts. In these projects the Corps has 338 repayment agreements representing some 9.28 million acre-feet of storage space and an investment cost of \$1.3 billion. The storage space is capable of providing some 5 billion gallons of water per day for use by municipalities and industries which have signed repayment agreements. All monies collected by the repayment agreements are deposited into the Treasury of the United States.

Optimization Tools for Navigation (OTN): The optimization tools for navigation program supports multiple initiatives concerning methods and analyses to minimize costs or enhance efficiencies for asset management of the Corps' waterborne navigation operation and maintenance (O&M) program. Related initiatives include support for development of the *Channel Analysis Design Evaluation Tool (CADET)* in partnership with ERDC as technical scoping and review lead and NAVSEA-Carderock as prime technical developer; development of a centralized system for benefit evaluation of the O&M program for deep-draft harbors (the *National Navigation Operation and Maintenance Performance Evaluation and Assessment System*, also referred to as "NNOMPEAS"); research and investigation to better quantify critical inputs for navigation analysis conducted with assistance of the U.S. Naval Academy; and support to the USACE Marine Design Center (USACE-MDC).

INTERNATIONAL WATER RESOURCES

The Institute formed the International Water Resources program in 2006 as a means to better coordinate the various international initiatives that are under its purview. These initiatives fall into three categories: global water resources strategies, international partnerships, and technical and advisory support. These initiatives and the major projects that fall under them are:

Lake Ontario and St. Lawrence River Study: The *International Lake Ontario-St. Lawrence River Study* was conducted and completed by IWR for the International Joint Commission (IJC) in May 2006. A [final report](#) was submitted to the Commission, recommending three alternative plans for their consideration. The purpose of the study was to assess

and evaluate the Commission's *Order of Approval*, developed in the late 1950's and used to regulate outflows from Lake Ontario through the St. Lawrence River. During the course of the 50 years of regulation, there were many discretionary changes by the outflow managers to deal with extreme hydrologic conditions and emerging interests such as environmental concerns and recreational boating. The five-year, \$20 million study developed numerous options and recommended three candidate plans after evaluating the impacts of changing water levels on shoreline communities, domestic and industrial water users, commercial navigation, hydropower production, the environment and recreational boating, along with forecasted effects of climate change. The study was conducted in full partnership with Canada, utilizing a transparent planning process pioneered by IWR and known as Shared Vision Planning (SVP). The open citizen and public participation process was guided by a volunteer *Public Interest Advisory Group* appointed by the IJC, while the study team of approximately 150 scientists and engineers was composed of a broad assembly of multi-disciplinary technical experts on nine technical working groups and led by co-directors from Canada and the U.S. The U.S. co-director was Dr. Eugene Stakhiv and U.S. co-Manager was Dr. Anthony Eberhardt both of IWR.

IWR staff provided input throughout 2008 on refining the candidate plans based on agency review and consultation. The IJC continues to explore options for refining procedures for Lake Ontario outflow regulation and is presently considering using the framework of the existing plan, Plan 1958-D, but adapting improvements identified during the Study operationally to achieve increased benefits to all interests.

International Upper Great Lakes Study: As the *Lake Ontario - St. Lawrence River Study* ended, USACE IWR entered into a new MOA with the International Joint Commission for initiation of a new 5-year, \$15 million US-Canadian study focusing on the *Lake Superior Regulation Plan* and the potential erosion problems associated with the St. Clair River channel (thought to cause the long-term lowering of Lake Michigan/Lake Huron levels). Drs. Eugene Stakhiv and Anthony Eberhardt were appointed as U.S. co-Director and co-Manager and IWR was again selected to lead the U.S. contributions to the study, emphasizing the success of the *Shared Vision Planning* approach in the just concluded *Lake Ontario - St. Lawrence River study*.

IWR initiated activities related to investigating whether the current Lake Superior outflow

management procedures could be improved, considering evolving Upper Great Lakes interests and climate change, and investigating St. Clair River flow characteristics, determining how the natural regime of the river has been changed by human activities. Investigations are being conducted by two task teams: the Lake Huron Outflow/St. Clair River Conveyance Task Team to investigate through hydrologic, hydraulic and sediment transport modeling the factors that may be responsible for declining levels (Phase 1) and the *Lake Superior Regulation Task Team* to investigate improved outflow management plans (Phase 2). Dr. Eberhardt is U.S. co-lead of the Lake Superior Task Team.

During 2008, extensive investigations took place and information was gathered in an effort to determine the causes of declining upper Great Lakes levels. Activities were centered around hydraulic modeling and analyses of data, St. Clair River sediment studies and studies of Great Lakes hydro-climatology. These studies were conducted by various elements of the Corps including the Great Lakes and Ohio River Division, the Detroit District, IWR-HEC and ERDC's the Cold Regions Research and Engineering Laboratory, by offices of the USGS and NOAA, along with a number of universities, and with comparable federal and academic participation in Canada. All of these investigations were subject to independent peer review by experts selected through ASCE-EWRI and the Canadian Water Resources Association. Initial findings suggest that the declining upper Great Lakes levels are due to both man-made and natural activities which have resulted in increased conveyance of the St. Clair River, hydrologic factors occurring in recent decades and longer term glacial isostatic adjustments. Uncertainty surrounding each of these factors prevents a definitive determination of individual contributions. The findings of these investigations will be included in the Phase 1 Report, the first draft of which will be completed in May 2009. An extensive communication strategy including fourteen public meetings around the Great Lakes will take place following its release.

During 2008, all of the technical work groups which will perform investigations of coastal processes, hydropower, commercial navigation, recreational boating, municipal and industrial water uses and the ecosystem for Phase 2 of the Study were established. They will concentrate during 2009 on defining performance indicators to be used within the Study's shared vision model to evaluate alternatives to the Lake Superior regulation plan, 1977-A, which has been in use since the early 1990s.

World Water Council: The *World Water Council* (WWC) is an international association of over 400 public and private organizations involved in water-related activities. Established in 1996, the WWC includes the principal United Nations water agencies and international financial institutions as its founding organizations. The main activity of the WWC is hosting the World Water Forum, which is held once every three years. As the main international event on water, it seeks to enable multi-stakeholder participation and dialogue to influence water policy making on a global scale, thus assuring better living standards for people all over the world and a more responsible social behavior towards water issues in line with the pursuit of sustainable development. The *5th World Water Forum* (WWF) will be held 16-22 March 2009 in Istanbul, Turkey, with the theme "Bridging Divides for Water."

Mr. Steven L. Stockton, HQUSACE Director of Civil Works, was elected to the WWC Board of Governors in 2006 and continued to serve on the board through 2008 and into 2009. Dr. Jerry Delli Priscoli (IWR) serves as the alternate and is a representative on the WWC Executive Bureau. Ongoing WWC activities involve close liaison with the U.S. Department of State, in particular, the Bureau of Near Eastern Affairs and the Bureau of Oceans and International Environmental and Scientific Affairs, on the dialogues and content of the WWF, so as to assist U.S. interests.

USACE and IWR will continue to take an active role in international water related research and policy issues through the International Center for Integrated Water Resources Management (ICIWaRM), along with the World Association for Waterborne Transport Infrastructure (PIANC), formerly known as the International Navigation Association.

Perhaps the most visible 2008 international activity in this regard was USACE participation in the *United Nations High Level Expert Panel on Water and Disasters*, chaired by the Prime Minister of South Korea, Han Seung-soo Han. The panel was originally convened in 2007 by the U.N. Secretary General's *Advisory Board on Water and Sanitation* in response to the unprecedented climate-related disturbances such as droughts, hurricanes, floods and tsunamis over the last decade, ranging from Hurricane Katrina in the U.S., to Australia's 1,000 year drought. In 2008 alone, 321 disasters killed 235,816 people, affected 211 million others and cost the world economies over US\$ 181 billion. USACE Commander and Chief of Engineers Lieutenant General Robert L. Van Antwerp represented USACE on the *High Level Expert Panel*, along with the

participation of Mr. Steven L. Stockton, HQUSACE Director of Civil Works, and Dr. Jerry Delli Priscoli of IWR. The USACE hosted the *High Level Expert Panel's* fourth meeting, held in New Orleans, LA, in October, 2008. The *High Level Expert Panel* will present its findings and action agenda at the *5th World Water Forum* in Istanbul, Turkey, in March 2009.

During FY 2008, Dr. Delli Priscoli continued to serve as Editor-in-Chief for *Water Policy*, an internationally acclaimed peer-reviewed international journal that is published six times per year.

Fifth World Water Forum: IWR's ongoing engagement with the World Water Council (WWC) reached a new threshold in FY 2008 through numerous contributions to the 5th World Water Forum (WWF5), scheduled for 16-22 March 2009 in Istanbul Turkey. IWR was actively involved in the extensive WWF5 Thematic, Regional and Political preparatory processes, which began in 2007 and resulted in the definition of six themes and twenty-four topics under the overarching Forum theme "Bridging Divides for Water". Mr. Lindy Wolner, detailed in March 2008 from HQUSACE, Office of Interagency and International Services, served as resident IWR liaison for a one-year assignment at the Secretariat for WWF5, located within the General Directorate State Hydraulic Works (DSI) in Istanbul. A key part of the liaison assignment was to identify and promote U.S. Government agency and stakeholders engagement in the WWF5 preparatory process, providing a linkage between the WWF5 Secretariat, WWC, USACE and a broad range of international and interagency water institutions and organizations, including the U.S. Department of State, other U.S. agencies, NGO's, the private sector, and various international partners.

IWR's commitment and support of successive WWF's is another means of applying the USACE's extensive institutional expertise to the issues raised in government reports including the *Senator Paul Simon Water for the Poor Act, 2008 Report to Congress*, prepared by the U.S. Department of State, and the USAID report entitled *Addressing Water Challenges in the Developing World - A Framework for Action*. The USAID report identifies three key challenges that must be addressed to achieve a water secure world. These include, improving water resources management among competing needs; improving access to water supply and sanitation, and promoting better hygiene; and improving water productivity in agriculture and industry.

These activities and subsequent efforts by IWR will contribute to the successful implementation of WWF5 outcomes, strengthen and expand interagency and international partnerships, and help to achieve U.S. government goals for international water resources.

UNESCO Partnerships: A large number of UNESCO-related activities are sanctioned by the U.S. Government (USG), in particular those related to the U.S. National UNESCO Commission and the U.S. International Hydrological Programme (IHP) Committee.

In 2006, Mr. Robert A. Pietrowsky, Director of IWR, was selected to be one of six permanent Federal agency members of the newly established U.S. National IHP Committee, and he has been part of the USG delegations to UNESCO at the IHP Intergovernmental Council (IGC) Meetings in 2004, 2006 and 2008.

In support of these activities, USACE has five MOUs with IHP and its UNESCO water centers: an umbrella agreement with IHP; a second MOU with UNESCO-IHE (Institute for Water Education, Delft, the Netherlands); and newer MOU agreements with ICHARM (International Center for Water Hazard and Risk Management) in Tsukuba, Japan (signed July 3, 2006); CAZALAC (Centre for Arid and Semi-arid Zones of Latin America and the Caribbean) in Chile (signed July 3, 2006); and CATHALAC (Water Center for Humid Tropics of Latin America and the Caribbean) in Panama (signed August 22, 2007).

IWR manages these agreements and is also engaged through an MOU with the Global Water Partnership (GWP) and its efforts to implement integrated water resources management in developing countries. GWP is an international NGO with the financial support of the European Union and the World Bank. IWR has been working with select members of GWP Technical Working groups to develop IWRM protocols.

During 2008, a key set of activities involved moving forward USACE IWR's International Center for Integrated Water Resources Management (ICIWaRM) toward an eventual designation by UNESCO as a Category II Centre (<http://www.iwr.usace.army.mil/iciwarm/>). The center had been selected as the U.S. Government nominee for consideration as a UNESCO center in February 2008 after a national-level competition. With the support of the U.S. National UNESCO Commission and the U.S. National Committee for UNESCO's International Hydrological Programme (IHP), the U.S. Permanent Representative to UNESCO and the Assistant

Secretary of the Army for Civil Works, ICIWaRM's nomination was submitted to UNESCO Headquarters, and subsequently approved by the IHP Bureau in March 2008. Ultimately, the center was endorsed by the IHP 36-member nation Intergovernmental Council (IGC) in June 2008 at its bi-annual meeting at the UNESCO Headquarters in Paris, France. IWR Director Robert A. Pietrowsky and Dr. Eugene Z. Stakhiv were part of the official USG delegation attending the IGC meeting. During the IGC meeting, Dr. Stakhiv was also re-elected to a four-year term to the Advisory Board for UNESCO's International Centre for Water Hazard and Risk Management (ICHARM) in Tsukuba, Japan.

ICIWaRM has made substantial progress while its formal designation as a Category II Centre by UNESCO was pending, including the continued involvement of Dr. Jason Giovannetone, an IWR-NRC Fellow, on the development of a *Drought Atlas for South America* in partnership with the Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean (CAZALAC)—another UNESCO Category II Water Centre. This project was inspired by the IWR's *National Drought Atlas of the U.S.*—a unique source of information about the frequency, severity and duration of drought as reflected by precipitation depths and streamflows.

Multiple IWR senior scientists, including IWR Director Mr. Robert Pietrowsky, Dr. Paul Bourget, Dr. Gerry Galloway, and National Flood Risk Management Program Director Mr. Pete Rabbon, participated in the 4th International Symposium on Flood Defence held in Toronto, Canada, which was jointly sponsored in North America by Canada's Institute for Catastrophic Risk Reduction, and USACE IWR/ICIWaRM.

Support for UNESCO's Hydrology, Environment, Life and Policy (HELP) program was continued in partnership with one of ICIWaRM's core partners - the National Science Foundation's Science and Technology Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHARA) at The University of Arizona. ICIWaRM co-sponsored a HELP workshop for the Western Hemisphere, hosted at SAHARA in November 2008.

Another high visibility international water resources activity in support of the Mekong River Commission (MRC) was carried out in collaboration between IWR/ICIWaRM, HQUSACE, USACE Northwestern Division, Portland District, and other key U.S. agencies such as the Bonneville Power Authority (BPA). This involved a technical exchange and a

study tour to the Columbia River Basin by fifteen senior officials of the Mekong River Commission (MRC) led by Dr. Jerry Delli Priscoli of IWR. The MRC chose the basin because it and the Mekong share some similar natural characteristics and because several decades ago the Columbia faced similar development and management decisions as many of the Mekong Basin countries face now. In addition, the Columbia River Basin demonstrates innovative approaches in basin management and public participation.

IWR provided extensive support to the World Water Assessment Programme (WWAP) in 2008, and in particular on its preparation of the third World Water Development Report which is scheduled to be released during the 5th World Water Forum in Istanbul, Turkey, in March 2009. IWR staff and fellows contributed in the areas of indicators, water policy, waterway transport and climate change adaptation.

Upon his re-appointment to the ICHARM Advisory Board in June 2008, Dr. Eugene Stakhiv was subsequently elected as board chairman, while also serving as co-chair of the joint UNESCO-IHP and Network of Asian River Basin Organizations (NARBO) sponsored initiative to develop IWRM Guidelines at the river basin level. IWR Director, Mr. Robert Pietrowsky, continued his service as a member of the Governing Board of UNESCO-IHE in Delft, the Netherlands. He also co-presented a paper entitled *Putting UNESCO Centers to Work: Implementing the IHP-VII Program in Developing Nations* at UNESCO's International Conference on *Water Scarcity, Global Changes, and Groundwater Management Response*, December 2008 at Irvine, CA.

At the close of 2008, Dr. Will Logan of USACE IWR/ICIWaRM was selected to serve at the U.S. Mission to UNESCO in Paris as the U.S. Science Attaché in 2009.

Dutch Rijkswaterstaat: The Corps signed an MOA with the Dutch Rijkswaterstaat (RWS) in May 2004 as a means to more effectively exchange information and resources. The RWS has a mission quite similar to that of the USACE and much collaboration has transpired regarding flood and coastal zone management, urban protection, flood risk and safety measures and general water resources policies that highlight the similarities and differences between our respective countries.

There were several exchanges that transpired during 2008. A senior-level Dutch delegation visited West

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Palm Beach, FL and New Orleans, LA to discuss and visit projects related to environmental restoration, emergency management and urban/coastal recovery efforts. In conjunction with that delegation, Florida Earth, a non-governmental organization, led a delegation to the Netherlands to discuss the possibility of establishing an MOA between Florida and the Dutch Government. Representatives from IWR and the Jacksonville District accompanied this delegation, which did not produce a new separate agreement. The Deputy Director of RWS visited Washington, DC to discuss interest in the formation of an MOA steering committee with Corps Headquarters representatives and ASA-CW. The Netherlands Water Partnership hosted a workshop in the Netherlands on levee safety and standards that was attended by Corps representatives. In conjunction with that workshop, a flood risk management team was formed under the MOA to share information through joint papers and meetings. Further discussions were held in conjunction with the Fourth International Symposium on Flood Defence (ISFD) which took place in Toronto, Canada. The first draft of a planned book comparing the development of water management practices between the Dutch and U.S. was produced, and is undergoing review for publication in early 2010.

Workshops between the two organizations on matters related to floodplain and coastal zone management continued in FY 2008. Plans are underway to devise a more strategic approach to the agreement to allow for broader USACE engagement beyond the more localized efforts to date. The Dutch have developed unique approaches to a broad range of water management areas, such as levee and sea wall integrity, operations and maintenance, soft soil technology, dredging techniques and risk assessment methodologies. The joint activities flowing from the MOA continued to gain momentum during this reporting period.

Japanese Ministry of Land, Infrastructure, Transport: USACE participates in an ongoing technical exchange program with the River Bureau of the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The program is governed by an *Implementing Arrangement (IA) under the "Agreement between the Government of the United States of America and the Government of Japan on Cooperation in Research and Development in Science and Technology,"* signed in Toronto, Canada on June 20, 1988, as amended and extended. The IA was signed by the USACE Chief of Engineers at the Third World Water Forum in Kyoto, Japan, in March 2003 and renewed for an additional 5-year term on 26 February 2008. The IA names the Chief of Hydrology

and Hydraulics at the St. Louis District as the Technical Program Officer, responsible for the technical exchange on the USACE side and names the Director of Civil Works as the oversight authority for the exchange. The national project management oversight authority has been delegated to IWR and within the Institute to HEC. To date, the exchange has consisted of annual technical exchange meetings alternating between sites in the U.S. and Japan and facilitation of requests for information between USACE and the River Bureau.

Under the auspices of the agreement with the MLIT, Mr. Christopher Dunn, Director of HEC, and Mr. Tom Evans Chief of the HEC Water Management Systems Division, travelled to Japan during February 2008 to participate in the USACE and MLIT 4th Conference on Flood Control and Water Resources Management. Topics discussed at the conference included climate change, risk management, natural environment and preservation, and river information systems. Corps representatives gave presentations on the Corps Levee Program and on the Corps Risk Analysis Program.

In addition to the water resources technical exchange program, a key objective of the visit was the signing of a 5-year extension of the USACE-MLIT partnering agreement.

The Office of the Secretary of Defense approved the extension to the agreement on 20 February 2008 and Mr. Lloyd Pike, Chief of the HQUSACE Pacific Ocean Division Regional Integration Team led the U.S. delegation on behalf of Mr. John P. Woodley, ASA (CW). IWR was represented in the delegation by Mr. Christopher Dunn, Director of HEC, and Mr. Tom Evans, Chief of the HEC Water Management Systems Division, who also serves as the Corps team leader for the execution of the USACE-MLIT partnership.

In January 2008, HEC hosted Mr. Makoto Kutsukake, Deputy Director of the Water Administration Division in MLIT's River Bureau. Mr. Kutsukake visited the United States under the auspices of a five month residency technical exchange with HQUSACE and IWR. Mr. Kutsukake was awarded a grant by the government of Japan to study abroad and elected to visit USACE, FEMA, and other agencies to focus on "New measures to prevent flood disasters, based on the appropriate mutual relation among construction of levees and dams, flood insurance and land use restriction in flood-prone areas taking Hurricane Katrina into consideration." During his visit to HEC, Mr.

Kutsukake gave a presentation on Japanese River Administration and Flood Management to the Intergovernmental Flood Risk Management Committee, comprised of the leadership from FEMA, USACE, the Association of State Floodplain Managers, and the National Association of Flood and Stormwater Management Agencies.

International Technical Reimbursable Projects: FY 2008 continued to yield major growth in technical assistance projects undertaken in cooperation with USACE, Federal and non-Federal organizations.

In FY 2008, HEC provided training and technology transfer support to engineers in Iraq's Ministry of Water Resources (MoWR) at the request of the U.S. State Department's Iraq Transition Assistance Office (ITAO). HEC provided face-to-face training in three two-week sessions in Jordan and Turkey, spaced roughly two months apart and concluding in May 2008. Topics covered in the training included Reservoir Systems Modeling with HEC-ResSim, the application of HEC-ResSim in a model of the Tigris-Euphrates Water Management System, the use of HEC's DSS database for storage and access to hydrologic data, the use of the HEC-DssVue program as an interface to data stored in DSS, and the use of the Jython programming language for developing customized applications of ResSim and DssVue. In addition, HEC staff provided remote support to MoWR via telephone and email to keep the tech-transfer process moving forward between the training sessions. A report on the project was submitted to ITAO at its conclusion in June 2008.

In conjunction with the Combined Joint Task Force – Horn of Africa (CJTF-HOA) and Naval Facilities (NAVFAC), four professionals from Ethiopia came to HEC to receive surface water modeling training. Data from a basin in Ethiopia was used in the workshop portion of the training. This training was a “train-the-trainer” type exercise. The goal is for the workshop attendees to take home what they learned and show others in Ethiopia how to do surface water modeling. As a result of this training, HEC tools are now being used in classes at the University of Addis Ababa.

Also in FY 2008, HEC teamed with the USGS to provide groundwater modeling training in Ethiopia in conjunction with the Geologic Survey of Ethiopia. The training was held at the University of Addis Ababa and included both students and government personnel.

HEC staff contributed to a course on Integrated Water Resources Management (IWRM) that was organized and hosted by UNESCO-IHE, Delft, the Netherlands. The course was a collaborative activity between UNESCO-IHE and IWR and was designed for engineers from the Iraq Ministry of Water Resources.

HEC provided surface water modeling training in Kenya. This training was held at the University of Nairobi and included both students and Kenya Ministry of Water and Irrigation employees.

HEC was contracted by CJTF-HOA, through NAVFAC, to build a rainfall-runoff model for the Ogaden Basin in Ethiopia. This model will be given to the Ethiopians and used as a sample for model building. Additionally, it will be used in a two week training class scheduled for Ethiopia in May 2009.

HEC is working in conjunction with the USGS on combining the HEC-RAS software with the USGS's ModFlow software. It has been decided to use a method developed in Europe, OpenMI, to facilitate this combination. In order to move forward, work has commenced in association with the Deltares Institute in the Netherlands. Deltares has experts that HEC has contracted with to help with the software combination. The agencies have had two productive week long meetings at HEC and additional collaboration is scheduled in the future.

WORLD ASSOCIATION FOR WATERBORNE TRANSPORT INFRASTRUCTURE (PIANC)

The World Association for Waterborne Transport Infrastructure (PIANC), formerly known as the International Navigation Association, is an organization with twenty-two national sections and membership in 65 countries, including 31 qualifying members, two international river commissions, about 450 corporate members (private companies, harbor agencies, firms, laboratories, universities, etc.) and about 2,000 individual members. From its headquarters in Brussels, Belgium, it acts as a clearinghouse of technology and experiences relating to ocean and inland navigation improvements which are exchanged among engineers, scientists, port operators, and marina and vessel owners, to name a few. Its objective is to advance, on a worldwide basis, the sustainable development of all kinds of navigation through the exchange of technical information on port and waterway development. The objective of the Association is met by holding International Congresses and by publishing technical

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bulletins and special reports. Special reports are published describing the results of the work of international research teams, or working groups, composed of those national members interested in the particular subject under study. The organization also serves as an excellent source of identifying individual and corporate expertise throughout the world on PIANC-related subjects.

The United States, a member of PIANC since 1902, provides an annual appropriation for the support and maintenance of the organization. This includes an annual subvention to PIANC and payment of a portion of the travel expenses of officially appointed U.S. delegates (Commissioners) to meetings of the Annual General Assembly and Congresses. The annual appropriation for the U.S. Section PIANC is currently \$45,000, including the annual subvention of approximately \$15,000. The U.S. Section is administered by law under the auspices of the USACE. It is located at the IWR NCR Humphreys Engineer Center facility. The U.S. Section is composed of dues-paying individual and corporate members. U.S. Section membership on September 30, 2008 totaled 215, consisting of 187 individual members and 28 corporate members.

United States National Commission: The United States National Commission constitutes the governing body of the U.S. Section. In 2008 the ex-officio officers of the U.S. National Commission were: Chairman, John P. Woodley, Jr., Assistant Secretary of the Army (Civil Works); President, MG Don T. Riley, Deputy Commanding General; Secretary, Ms. Anne Cann, an employee of IWR.

In 2008, U. S. National Commissioners were: Mr. Shiv Batra, Vice President representing the Western Region and President, INCA Engineers, Inc.; James McCarville, Vice President representing the Eastern Region and Executive Director of the Port of Pittsburgh Commission; Dr. Robert Engler, Vice President representing the Central Region and Senior Environmental Scientist, Moffatt and Nichol; Dr. Robert H. Randall, Texas A&M University; Mr. John Headland, Senior Vice President and Regional Manager, Moffatt and Nichol; Mr. Dave Sanford, Director of Navigation Policy and Legislation, American Association of Port Authorities; Dr. Craig E. Philip, President and CEO, Ingram Barge Company; and Mr. Dominic Izzo, Project Director, KBR.

PIANC Activities: In July of 2008, the US Section of PIANC held its Annual Membership Meeting in Alexandria, VA, at the Institute for Water Resources. More than seventy PIANC USA members participated

in the full day meeting which included technical presentations including “Climate Change and Navigation” and “Developments in the Automation and Remote Operation of Locks and Bridges”. The 2008 PIANC USA winner of the DePaepe-Willems Paper Competition presented his winning paper on “Subsurface 3D Modeling: An Application to Waterfront Project Planning and Site Evaluation.” A networking dinner was held that evening, including a PIANC Young Professionals meeting.

In May of 2008, the PIANC International Annual General Assembly (AGA) was held in Beijing, China. Members of the U.S. delegation included Mr. John P. Woodley, Jr., MG Don T. Riley, Ms. Anne Cann, Mr. Shiv Batra, Dr. Robert Engler, Mr. James McCarville, Dr. Craig E. Philip, Mr. John Headland, Mr. E. R. Heiberg, LTG ret., and Mr. Harry Cook. Two technical papers, prepared by members of the staff of IWR, were presented at the International Navigation Seminar following the AGA. Mr. David Grier presented a paper entitled “*U.S. Harbor Improvements: Are They Critical to Trade with China?*”, and Mr. John P. Woodley, Jr. and Ms. Anne Cann coauthored and presented “*Balancing Inland Navigation with Flood Control and Environmental Needs in the United States.*”

As part of the U.S. Section’s Latin American outreach activities, Ms. Lillian Almodovar and Mr. David Grier, USACE IWR, participated in the Third Hemispheric Conference on Port Security, organized by the Organization of American States, Inter-American Committee on Ports (OAS-CIP), held in Punta Cana, Dominican Republic in April, 2008. Mr. Grier also attended the Caribbean Shipping Association (CSA) Annual Meeting held in Trinidad in October, 2008. At the meeting the CSA signed an MOU with OAS-CIP Executive Secretary Carlos Gallegos. The U.S. Section PIANC signed an MOU with OAS-CIP in 2005.

The U.S. Section produces a quarterly newsletter, *PIANC Bulletin*, containing U.S. Section information and industry news. (<<http://www.pianc.iwr.usace.army.mil/nenewsletter.cfm>>). Edmond J. Russo, Jr., U.S. Army Corps of Engineers, ERDC, is the editor of the PIANC Bulletin.

In recognition of its outstanding contributions both within the U.S. and around the globe, the U.S. Section of PIANC received the 2008 Award as the PIANC’s Outstanding Section worldwide.

PIANC Executive Committee (ExCom): PIANC International’s Executive Committee ensures the

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executive management of the Association and monitors the decisions and directives of the AGA and the Council. The U.S. representative on the ExCom is Mr. Shiv Batra, President, INCA Engineers, Inc. (Vice President of Western Hemisphere).

Representatives to Committees and Commissions: The principal business of PIANC is the sponsorship of technical working groups. The U.S. Section is represented by Principal and Co-Principal Members of the Commissions managing technical working group activities. The U.S. representatives were:

Environmental Commission — Dr. Susan Rees, U.S. Army Corps of Engineers, Mobile District; Dr. Todd Bridges, U.S. Army Corps of Engineers, ERDC

Inland Navigation Commission — Mr. John Clarkson, U.S. Army Corps of Engineers, Huntington District; Mr. William Ronald Coles, WR Coles and Associates

Maritime Navigation Commission — Mr. E. Dan Allen, Moffatt and Nichol

Recreational Navigation Commission — Mr. Bob Nathan, Moffatt and Nichol; Mr. Jack C. Cox, HDR

International Cooperation Commission — Mr. John Headland, Moffatt and Nichol; Bengt Bostrom, Consultant

Promotion Commission — Dr. Thomas Wakeman, Stevens Institute of Technology

Young Professionals Commission — Ms. Jessica McIntyre, Moffatt and Nichol

New Technical Working Groups: In 2008, eleven new Working Groups were formed. The groups are listed below along with the name of the U.S. Representatives.

InCom 127 (Fish Passage) — Mark Cornish, John Plump, and YP Aaron Buesing

InCom 128 (Alternate Bank Protection Methods for Inland Waterways) — S. Kyle McKay

InCom 129 (Waterway Infrastructure Asset Maintenance Management) — José E. Sánchez and James R. Fisher

MarCom 135 (Design Principles for Container Terminals in Small and Medium Ports) — Dimitris Pachakis, Laurence Emsley and Steven Gray

RecCom 130 (Anti-sedimentation Systems for Marinas and Yacht Harbors) — Richard Dornhelm

RecCom 131 (Catalogue of Marina Construction Elements) — no U.S. representative

RecCom 132 (Dry Stack Storage) — Tonu Mets

RecCom 133 (Economic Aspects of Recreational Navigation) — Michael Herrman

RecCom 134 (Design and Operational Guidelines for Superyacht facilities) — Mark Pirrello

EnviCom 136 (Recommendations for Sustainable Maritime Navigation) — David Moore

CoCom 126 (Training in Ports and Waterways) — Dr. Billy Edge

Working Group Reports Published in 2008: In 2008, eight Working Group Reports were published. The Reports are listed below along with the name of the U.S. Representatives. PIANC changed the Working Group/Report numbering system in 2008.

InCom 99 (old #27) (Guidelines for Environmental Impacts of Vessels) — Dr. Thomas Keevin and Stephen Maynard

InCom 96 (old #28) (Developments in Automation and the Remote Control of River Works) — Ashok Kumar

MarCom 103 (old #42) (Life Cycle Management of Port Structures — Recommended Practice for Implementation) — Ron Heffron and Valery M. Buslov

MarCom 102 (old #43) (Minimizing Harbor Siltation) — John Headland and William McAnally

RecCom 98 (old #16) (Protecting Water Quality in Marinas) — Jack Cox

EnviCom 100 (old #13) (Environmental Benefits of Waterborne Transport) — Dr. Douglas Clarke and Thomas Wang

EnviCom 104 (old #14) (Dredged Material Beneficial Use Options and Constraints) — Richard Gorini and Jack Word

CoCom 97 (old #1) (CoCom 1-IAPH Joint Working Group on Small Island Ports) — Bengt Bostrom

2008 Active Working Groups and the names of the U. S. Representatives:

InCom 29 (Innovations in Navigation Lock Design) — Dale Miller and YP Michael Tarpey

InCom 30 (Inventory of Inspection and Repair Techniques of Navigation Structures) — Robert Willis, Ron Heffron, and YP Chad Linna

InCom 31 (Organization and Management of River Ports) — Jim McCarville

InCom 32 (Performance Indicators for Inland Waterways Transport) — William Harder

InCom 127 (Fish Passage) — Mark Cornish, John Plump, and YP Aaron Buesing

InCom 128 (Alternate Bank Protection Methods for Inland Waterways) — S. Kyle McKay

InCom 129 (Waterway Infrastructure Asset Maintenance Management) — José E. Sánchez and James R. Fisher

InCom Permanent RIS WG (River Information Services) — Richard Lockwood and Jeff Fritz

MarCom 39 (Monitoring of Breakwaters) — James D. Prehn

MarCom 46 (Maritime Freight Transshipment) - Doris Bautch

MarCom 47 (Criteria for the Selection of Breakwater Types and their Optimum Damage Risk Level) — Dr. Jeffrey A. Melby

MarCom 48 (Guidelines for Port Constructions, Related to Bowthrusters) — Marcel Hermans and Gary Greene

MarCom 49 (Horizontal and Vertical Dimensions of Fairways) — Michael J. Briggs

MarCom 50 (General Principles for the Design of Maritime Structures) — Bill Papis

MarCom 51 (Water Injection Dredging) — Timothy L. Welp

MarCom 52 (Criteria for the (Un-)Loading of Container Ships) — Dan Allen

MarCom 53 (Design and Construction of Maritime Structures in Tsunami Prone Areas) — John R. Headland and Michael J. Briggs

MarCom 54 (Use of Hydro/Meteo Information to Optimize Safe Port Access) — Robert Weeks and Majid Yavary

MarCom 55 (Safety Aspects of Berthing Operations of Oil and Gas Tankers) — Larry Cunningham, Sarah Rollings, and YP Larry Wise

MarCom 56 (Application of Geotextiles in Waterfront Protection) — Doug Gaffney

MarCom 57 (Stability of Pattern Placed Revetment Elements) — Margaret Boshek

MarCom 135 (Design Principles for Container Terminals in Small and Medium Ports) - Dimitris Pachakis, Laurence Emsley and Steven Gray

RecCom 15 (The Use of Alternative Materials in Marina Construction) — Terrence Browne

RecCom 17 (Guidelines for Marina Design) — Dennis Kissman

RecCom 130 (Anti-sedimentation Systems for Marinas and Yacht Harbors) - Richard Dornhelm

RecCom 131 (Catalogue of Marina Construction Elements) – no U.S. representative

RecCom 132 (Dry Stack Storage) – Tonu Mets

RecCom 133 (Economic Aspects of Recreational Navigation) – Michael Herrman

RecCom 134 (Design and Operational Guidelines for Superyacht facilities) – Mark Pirrello

EnviCom 11 (Management, Dredged Material Re-use and Transformation of Existing Confined Disposal Facilities) — Dr. Michael Palermo and Dr. Paul Schroeder

EnviCom 12 (Sustainable Waterways within the Context of Navigation and Flood Management) — Dr. Craig Fischenich and John Clarkson

EnviCom Expert Group 2 (Environmental Benefits of Waterborne Transport) — Keith Hofseth (chair), Alfred Cofrancesco and Nick Pansic

EnviCom 15 (Environmental Aspects of Dredging and Port Construction Around Coral Reefs and Cold Water Hard Bottom Benthic Communities) — Dr. Mark Sudol and Russ Kaiser

EnviCom 16 (Management of Ports and Waterways for Fish and Shellfish Habitat) — Dr. Douglas Clarke

EnviCom Expert Group 3 (Climate Change and Navigation) — Dr. James Corbett

EnviCom 136 (Recommendations for Sustainable Maritime Navigation) – David Moore

CoCom 2 (Best Practice for Shoreline Stabilization Methods) — Lesley Ewing

CoCom 126 (Training in Ports and Waterways) – Dr. Billy Edge

IWR and U.S. Section PIANC Coordination with the Organization of American States, Inter-American Committee on Ports: IWR, through the U.S. Section-PIANC, participated in the Third Hemispheric Conference on Port Security of the OAS Inter-American Committee on Ports (OAS-CIP) during FY 2008 held in April 2008 in Punta Cana, Dominican Republic. The CIP serves as a permanent Inter-American forum for port related issues among the 34 member states of the OAS. Its purposes include serving as the principal advisory body of the OAS on all topics concerning development in the port sector. It proposes and promotes hemispheric cooperation policies, improvements and port sector cooperation agreements, and the collection and dissemination of data and information. The U.S. delegation to the OAS-CIP is led by the Maritime Administration, USDOT, under guidance of the State Department, and with participation by the Coast Guard, EPA, and the Corps (through observer status for PIANC-US). The CIP currently has four active Technical Advisory Groups (TAGs). These include Port Operations, Port Security (chaired by the U.S.), Navigation Safety, and Environmental Protection. The U.S. became a new member of the TAG on Environmental Protection in 2007 and is now a member of all four TAGs. The U.S. Section-PIANC is engaging the CIP to explore opportunities to share expertise on port management, development of common standards, improving dredging technology, addressing ballast water issues, and potentially assist plans for inland waterway development in the Amazon and Parana-Paraguay basins. IWR, through PIANC-US, will participate in two CIP meetings in FY 2009, including the Executive Board in Buenos Aires, Argentina, in April 2009 and the full CIP all-delegations meeting in El Salvador in September 2009.

INTERNATIONAL BOUNDARY WATERS BOARDS

In order to carry out United States obligations under international agreements, the Office of the Chief of Engineers and several Corps divisions and districts with jurisdiction over areas bordering Canada have representation on numerous international boards, committees, and other groups. The majority of these boards were established by the International Joint Commission (IJC) as empowered in accordance with the provisions of the Boundary Waters Treaty of 1909 between the United States and Great Britain (for Canada). IJC boards fall into two broad categories: boards of control, which are more or less permanent and supervise compliance over an IJC order; and engineering, technical, or study boards, which are usually dissolved after completing and reporting on an investigation assignment.

In addition to boards created by the Commission, other international boards and committees are created by treaties or other arrangement in matters concerned with the water resources of joint interest, and the members report directly to the Governments or establishing agency. International boundary waters boards and committees having Corps of Engineers memberships during the fiscal

year are listed in Table 44-1. For an explanation of the constitution of the various boards and committees, see the annual reports, Volume II for fiscal years 1977 and 1980.

In recent years the IJC has adopted an ecosystem approach for its Boards with a view toward amalgamating a number of its Boards, where it makes sense to do so, as a first step in the development of international watershed Boards. This approach stemmed from the Commission's recommendations in its 1997 report to the governments of the United States and Canada. This report was provided at the request of governments for a proposal on how the IJC might best assist them to meet the environmental challenges of the 21st century. Subsequently, governments asked the Commission, in a reference dated 19 November 1998, to further define the framework for operation of international watershed boards as recommended by the IJC in its 1997 report. The IJC provided governments with status reports in December 2000 and June 2005 on the matter, and several of its boards have been amalgamated since 1998.

TABLE 44-1
International Boundary Waters Boards Having Corps of Engineers Members

<u>BOARD NAME</u>	<u>YEAR ESTABLISHED</u>	<u>UNITED STATES REPRESENTATION</u>
1. Intl. Lake Superior	1914	* Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer -- Designated Alternate
2. Intl. St. Croix River**	1915	*District Engineer, New England
3. Intl. Lake Memphremagog	1920	*District Engineer, New York
4. Intl. Lake of the Woods Control Board	1925	*District Engineer St. Paul
5. Intl. Lake Champlain	1937	*District Engineer, New York
6. Intl. Kootenay Lake	1938	*1. District Engineer, Seattle 2. Dept. of Interior, USGS, Boise, ID
7. Intl. Rainy Lake Board of Control	1941	*1. District Engineer, St. Paul 2. Resource Biologist
8. Intl. Osoyoos Lake	1943	1. District Engineer, Seattle 2. *Dept. of Interior, USGS, Tacoma, WA 3. Washington State Parks & Recreation Commission, Olympia, WA

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<u>BOARD NAME</u>	<u>YEAR ESTABLISHED</u>	<u>UNITED STATES REPRESENTATION</u>
9. Intl. Red River Board ***	2000	<ol style="list-style-type: none"> 1. *District Engineer, St. Paul (as of Jan 2009) 2. Dept. of Interior, USBR, Billings, MT 3. Dept. of Interior, EPA, Denver, CO 4. Dept. of Interior, USGS, Bismarck, ND 5. Sand Hill River Watershed District, Fertile, MN 6. ND State Water Commission, West Fargo, ND 7. MN Pollution Control Agency, Detroit Lakes, MN 8. MN Dept. of Natural Resources, Bemidji, MN 9. ND Dept. of Health, Bismarck, ND
10. Intl. Niagara Board of Control (under IJC)	1953	<ol style="list-style-type: none"> 1. *Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer - Designated Alternate 2. Dept. of Energy, FERC, Wash., D.C.
11. Intl. St Lawrence River	1953	<ol style="list-style-type: none"> 1. *Division Engineer, Great Lakes and Ohio River Division Chicago District Engineer - Designated Alternate 2. Civil Engineer, Retired 3. Rochester Institute of Technology 4. Cornell University
12. Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data	1953	<ol style="list-style-type: none"> 1. Great Lakes and Ohio River Division 2. Dept. of Commerce, Ann Arbor, MI
13. Intl. Niagara Committee (reports to US State Dept)	1955	*Division Engineer, Great Lakes and Ohio River Division
14. Intl. Souris River Board ****	2001	<ol style="list-style-type: none"> 1. District Engineer, St. Paul 2. *ND State Engr., Bismark, ND 3. Dept. of Interior, USGS, Bismarck, ND
15. Columbia River Treaty Entities	1964	<ol style="list-style-type: none"> 1. Division Engineer, Northwestern Division 2. *Administrator of Bonneville Power Admin., Portland, OR
16. Columbia River Treaty, Permanent Energy Board	1964	<ol style="list-style-type: none"> 1. *HQUSACE, Deputy Director of Civil Works, Wash., D.C. 2. Department of Energy, Newberg, OR
17. Intl. Champlain-Richelieu	1975	<ol style="list-style-type: none"> 1. *New York Dept. Environmental Conservation 2. District Engineer, New York 3. Vermont Environmental Conservation Agency 4. New England River Basins Commission, Staff Associate 5. Dept. of Interior F&WS, Boston, MA
18. Lake Ontario - St. Lawrence River Study Board	2001	<ol style="list-style-type: none"> 1. * Institute for Water Resources (IWR) 2. NY Department of Environmental Conservation 3. Cornell University 4. Rochester Institute of Technology 5. Saint Regis Mohawk Tribe 6. Private Citizens (two)

INTERNATIONAL BOUNDARY WATERS BOARDS

<u>BOARD NAME</u>	<u>YEAR ESTABLISHED</u>	<u>UNITED STATES REPRESENTATION</u>
19. Intl. Upper Great Lakes Study	2007	1. *Institute for Water Resources (IWR) 2. MI Department of Environmental Quality 3. University of Michigan 4. Johns Hopkins University 5. Private Consultant

* Signifies U.S. Section Chairman

** In September 2000, the International Joint Commission formally combined its existing International St. Croix River Board of Control and its International Advisory Board on Pollution Control - St. Croix River and established the International St. Croix River Board.

*** Amalgamated Board Comprised of Former Intl. Red River Pollution Board and Red River Portion of Former Intl. Souris-Red Rivers Engineering Board

**** Amalgamated Board Comprised of Former Intl. Souris River Board of Control and Souris River Portion of Former Intl. Souris-Red Rivers Engineering Board

Comprehensive Study on Regulating Water Levels of Lake Ontario and in the St. Lawrence River

In FY2001, the International Joint Commission formed the Lake Ontario - St. Lawrence River Study Board to undertake a comprehensive five-year study to assess and evaluate the current criteria used for regulating water levels on Lake Ontario and in the St. Lawrence River. The Study Board engaged by the IJC is a bi-national group of diverse experts from government, academia, native communities, and interest groups representing the geographical, scientific and community concerns of the Lake Ontario - St. Lawrence River system. The U.S. Director of the Study is from IWR. The Corps of Engineers leads five of the nine Technical Work Groups, and participates on two others. The Board completed its work in FY2007.

The mission of the study was to consider, develop, evaluate and recommend updates and changes to the 1956 criteria for Lake Ontario-St. Lawrence River water levels and flow regulation, taking into account how water level fluctuations affect all interests; and also changing conditions in the system including climate change, all within the terms of the Boundary Waters Treaty. The Study Board completed its studies to provide the IJC with the information it needs to evaluate options for regulating levels and flows in the Lake Ontario-St. Lawrence River system in order to benefit affected interests and the system as a whole. These studies included:

- a. Reviewing the operation of structures controlling the levels and flows of the Lake Ontario-St. Lawrence River system in the light of the impacts of those operations on affected interests, including the environment;
- b. Assessing whether changes to the Order of Approval or regulation plan are warranted to meet contemporary and emerging needs, interests and preferences for managing the system in a sustainable manner; and
- c. Evaluating any options identified to improve the operating rules and criteria governing the system.

The Study Board provided its report to the IJC on 2 April 2006, with three candidate regulation plans for the IJC's consideration. Following public comment and Commission review in 2007, the IJC requested additional lake regulation plan development. As a result of this work, an updated version of one of the candidate plans was selected by the IJC and presented to the US and Canadian Governments, and to the public for comment in 2008. Subsequent to the comment period, the IJC concluded that the proposed alternative plan was not a practical option, and that a new plan should move towards more natural flows to benefit the environment, while respecting other interests. The IJC is proposing a Working Group to resolve outstanding issues, and the Board of Control is exploring how to consider the environment to the extent possible within its current authorities.

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Upper Great Lakes Plan of Study

In FY2007 the International Joint Commission formed the Upper Great Lakes Study Board to address evolving needs of the upper Great Lakes related to levels and flows. The Study Board's mandate is to undertake studies required to provide the Commission with the information it needs to evaluate options for regulating levels and flows in the Upper Great Lakes. Ongoing investigations include examining the physical processes and possible changes occurring in the St. Clair River, review of operational procedures for the control structures regulating Lake Superior outflow, assessment of the current regulation plan for Lake Superior, and examination of options to improve the IJC operating rules and criteria governing the Upper Great Lakes system. The Board's five year study will implement lessons learned from the Lake Ontario – St. Lawrence River Study.

At the IJC's request, the Study Board has accelerated the investigations examining physical processes and possible changes occurring in the St. Clair River. This effort is to address questions raised about the factors affecting changes in the difference in levels between Lakes Huron and Erie, purported changes in the conveyance capacity of the St. Clair River, and factors contributing to the current low lake levels of Lake Michigan and Lake Huron. A report on the findings of this investigation is expected to be released for public comment and review in June 2009.

The Corps Institute for Water Resources is both chairing the Study and managing its activities. Corps personnel are leading seven of the technical work groups.

Columbia River Treaty 2014/2024 Review

Since its ratification in 1964, the Columbia River Treaty has provided significant benefits to the United States and Canada through coordinated river management by the two countries. When the Treaty was negotiated, its goals were to provide significant flood control and power generation benefits to both countries. The Treaty contains two provisions; however, that may significantly change these benefits as early as the year 2024. In 2024 the 60 years of purchased flood control space in Canadian Treaty projects expires. Instead of a coordinated and managed plan to regulate both Canadian and U.S. projects for flood control, the Treaty calls for a shift to a Canadian operation under which the United States can call upon Canada for flood control assistance. The United States can request this "called upon" assistance as needed but only after making the most effective use of U.S. projects for flood control first. The U.S. will then have to reimburse Canada for its operational costs and any economic losses resulting from the called upon flood control operation.

The year 2024 is also important for a second reason; it is the first year the Treaty can possibly be terminated. While the Treaty has no specified end date, it does allow either Canada or the United States the option to terminate most of the provisions of the Treaty on or after 16 September 2024, with a minimum of 10 years' written advance notice—hence the significance of the year 2014. Unless the Treaty is terminated or the federal governments elect to modify the Treaty, its provisions continue indefinitely, except for flood control changes as already noted.

Given the significance of both of these provisions, it is important that the parties to the Treaty understand the implications for post-2024 Treaty planning and Columbia River operations. The U.S. Army Corps of Engineers and the Bonneville Power Administration, the agencies that implement the Treaty in the U.S. on behalf of the U.S. Entity, are conducting a multi-year effort to understand these implications. This effort is called the 2014/2024 Columbia River Treaty Review.

The Treaty is complex, and affects millions of people and a wide variety of issues on both sides of the border. Implementing the required changes in flood control provisions in 2024, and preparing for the possibility of Treaty termination, will be a major challenge for both countries. Due to the scope and complexity of these issues, the U.S. Entity is taking a phased approach to studying the Treaty and the issues related to its future. Each phase will provide valuable information, building toward a comprehensive and informed picture for evaluating the future of the Treaty. Phase I of the 2014/2024 Review was initiated in 2008. Phase 1 is the initial modeling phase. Its purpose is to provide fundamental information about post-2024 conditions both with and without the current Treaty, and only from the perspective of power and flood. Phase 1 is a joint modeling effort between the U.S. and Canadian Entities. These initial studies are not designed to establish future operating strategies, alternatives to the Treaty, or government policies, but simply to begin the learning process.

REGULATORY, SUNKEN VESSEL REMOVAL AND NATIONAL EMERGENCY PREPAREDNESS ACTIVITIES

1. Regulatory Activities

Authorities. The following authorities charge the Corps of Engineers with the regulation of various construction related activities in U. S. waters and wetlands: Sections 9 and 10 of the Rivers and Harbors Act of 1899 (structures in waterways and the alteration of waterways); Section 103 of the Marine, Protection, Research, and Sanctuaries Act of 1972 (Ocean Dumping); and Section 404 of the Clean Water Act (discharge of dredged or fill material).

Work Completed. During FY 2008, the Corps reviewed and authorized more than 56,000 permit activities, 80 percent of which were approved within 60 days. Approximately 5,000 projects were issued as individual permits, and the remaining 51,000 activities were reviewed and approved under regional or nationwide general permits. General permits are issued to the public at large and define types of minor activities with no more than minimal adverse effects on the aquatic environment, which do not usually require the extensive review necessary for projects authorized by individual permits. Use of general permits provides significant relief to the regulated public by avoiding red tape for small projects with minimal environmental impacts. The Corps modified over 2900 existing permits during FY 2008. These applications received previous authorization and, due to changes in the activity, there was a need to revise and modify the authorization. The Corps determined that no permit was required on 10,300 applications. This type of determination is made when the Corps has no regulatory authority over the site and/or the proposed work. The Corps denied approximately 330 permits during

FY 2008. Most projects which might otherwise have been denied a permit were either modified or conditioned to meet Corps requirements, scaled down to qualify for approval under general permits, or withdrawn. About 5,000 permit applications were withdrawn. Under the regulatory program, the Corps made over 86,000 jurisdictional determinations in FY 2008, many of which were made in response to requests from landowners who were not applying for permits

The Corps investigated approximately 2,700 alleged illegal activities, most of which were violations of Section 404 of the Clean Water Act. Under the regulatory program in FY 2008, the Corps authorized the filling of approximately 18,800 acres of wetlands but required the restoration, enhancement, or creation of more than 29,000 wetland acres, as well as utilized mitigation banks on more than 2500 projects. Additionally, over 13,000 acres of wetlands and wetland buffers were protected in perpetuity.

As required by section 314 of the National Defense Authorization Act for Fiscal Year 2004 (P.L. 108-136), the Corps, in cooperation with EPA, completed final regulations issued April 10 and effective June 9, 2008, establishing performance standards and criteria for compensatory mitigation when required by Department of the Army permits. These regulations apply equivalent standards, to the extent practicable, for compensatory mitigation done by permittees, under in-lieu fee agreements and by mitigation banks.

**TABLE A
GENERAL REGULATORY FUNCTIONS**

Obligations		
Unobligated Balance - 30 Sep 07	\$	10,118,360
Allotments	\$	159,163,180
Total Funds Available	\$	169,281,540
Obligations	\$	158,004,839
Unobligated Balance- 30 Sep 08	\$	11,276,701
Expenditures		
Unexpended Balance - 30 Sep 07	\$	16,987,990
Allotment	\$	159,163,180
Total Funds Available	\$	176,151,170
Expenditures	\$	157,102,821
Unexpended Balance - 30 Sep 08	\$	21,226,839

Investigation and Removal of Sunken Vessels

Under the authority of Sections 19 and 20 of the River and Harbor Act of 1899, the Corps of Engineers investigated sunken vessels in navigable waters and removed those obstructing navigation. For obligation expenditures, see Table B (next page)

TABLE B
REMOVAL OF SUNKEN VESSELS
 (\$000)

Obligations	
Unobligated Balance - 30 Sep 07	\$ 88,106
Allotment	\$ 467,000
Total Funds Available	\$ 555,106
Obligations	\$ 0
Unobligated Balance - 30 Sep 08	\$ 555,106
Expenditures	
Unexpended Balance - 30 Sep 07	\$ 88,106
Allotment	\$ 467,000
Total Funds Available	\$ 555,106
Expenditures	\$ 0
Unexpended Balance - 30 Sep 08	\$ 555,106

2. National Emergency Preparedness Activities

Authority. Executive Orders 10480 and 12656 and the Federal Emergency Management Agency (FEMA) under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 USC 5121 et seq. are the basis of the Federal Response Plan. The cited executive directives assign significant responsibilities for such preparation (planning, training, research and testing) to the Corps. This includes responsibility for development of comprehensive national level preparedness plans and guidance for response to all regional/national emergencies, whether caused by natural phenomena or acts of man, plans for response(s) to acts of terrorism, and the local preparedness necessary to support Corps continuity of operations. The Corps provides engineering and construction support to state and local governments in response to catastrophic natural/technological disasters. Rapid response to disasters of a regional/national magnitude requires that extensive pre-emergency planning and preparedness activities be conducted to assure the availability of a work force capable of shifting from routine missions to crisis operations and the organizational command and control structure(s) necessary to provide a coordinated and comprehensive response in the critical early stages of a catastrophic disaster.

Status. During FY 2008, the Corps of Engineers continued its effort to improve the command's readiness posture and its ability to respond to various national/regional catastrophic disasters to include terrorists' attacks. Emphasis has been on those activities to prepare for catastrophic natural and technological disasters requiring major Federal support of state and local governments overwhelmed by a disaster event, and for national level emergency water planning. The primary focus during FY 2008 continued to provide support to two major national level civil planning areas: (a) support to the nation's ability to mobilize national assets to meet national/regional level emergencies and (b) support to continuity of government and continuity of operations during national emergencies. Lessons learned from past hurricanes, floods, earthquakes, and events of September 11, 2001 as well as hurricanes Katrina and Rita, indicate that improvements in response to catastrophic disasters are still required. In this regard, the Corps continues to emphasize a program that uses the deliberate planning process to develop scenario specific catastrophic disaster plans. This will result in more detailed planning and should provide for a more comprehensive response to national/regional catastrophic disasters to include terrorist attacks. More extensive coordination with Federal, state and local entities will be incorporated into plan

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development. In this regard, following FEMA's program focus, USACE continues to play a key role in national security planning such as supporting Homeland Security strategic planning efforts, development of the National Capitol Region Response Plan and other plans as the New Madrid Earthquake, the South Florida Hurricane, the New Orleans Hurricane and other contingencies with national implications. Initial review of the Federal interagency community developed fifteen all-hazards planning scenarios (the National Planning Scenarios) for use in national, Federal, State, and local homeland security preparedness activities are underway. The Scenarios are planning tools and are representative of the range of potential terrorist attacks and natural disasters and the related impacts that face our nation.

Additional efforts focus on continuing to strengthen COOP readiness. Exercises, involving federal, state and local officials, contribute to a more timely and effective execution of Corps responsibilities during disasters that have national impacts. Continuing to capitalize on existing planning efforts and forums, and taking advantage of the current atmosphere of urgency regarding emergency preparedness will advance preparedness among all levels of government to improve response and ensure the health and safety of citizens, workers, and visitors in the metropolitan Washington region.

The Pacific Ocean division performed a Cold

Weather Exercise to determine requirements for personal deploying into severe cold weather and weather impacts that would be addressed during an actual event.

The New York District completed critical power assessments for New York City.

The North Atlantic Division took part in National Level Exercise 2008 (NLE-08) which was a National Exercise Program (NEP) White House Tier I (mandatory DOD/USACE participation) exercise that USACE participated in that focused on interagency coordination, communication and response that included deployment of federal and state resources in support of the local agencies and jurisdictions in response to a simulated terrorist attack. The Louisville District they participated in Modeling in support of National Level Exercise. Additionally, the Buffalo District partook in DHS National Level Exercise along with NORTHCON and ARNORTH.

The South Pacific Division conducted a Structures Specialists Cadre, Level 2 Training Session and participated in a Western Regional training session.

Louisville District members also attended a Hurricane Modeling workshop.

