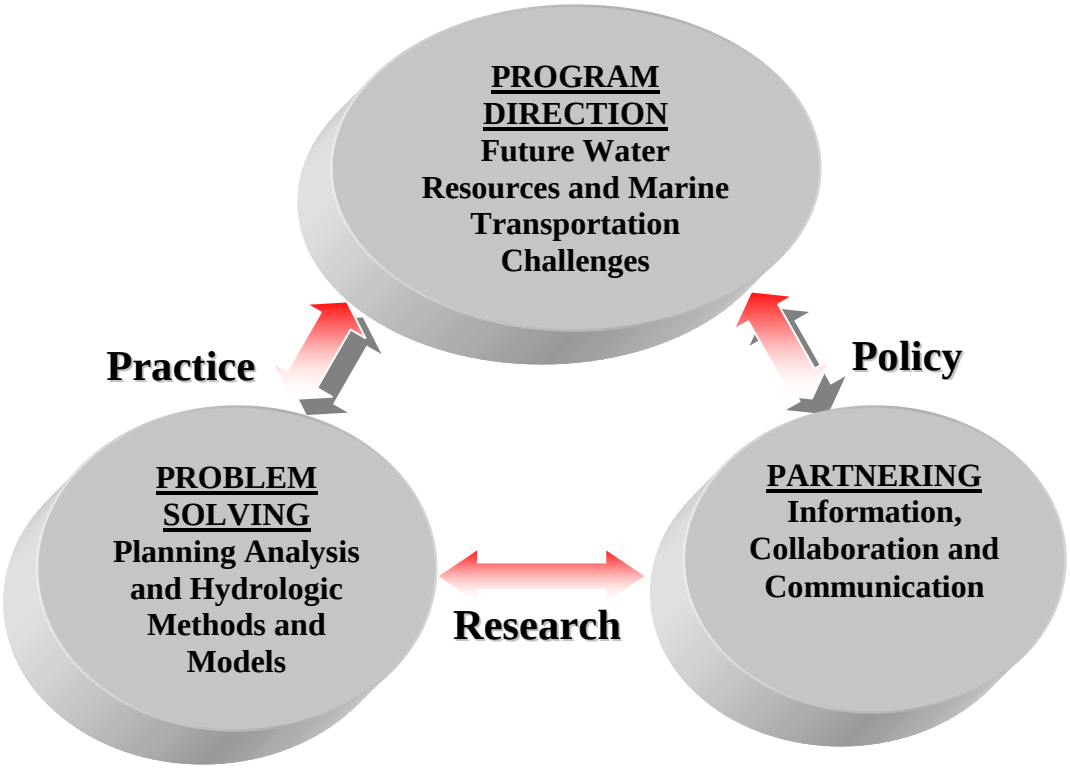
US Army Corps
of Engineers®

ANNUAL REPORT
ACTIVITIES OF THE
INSTITUTE FOR WATER RESOURCES
FISCAL YEAR 2010



IWR Headquarters - National Capital Region Office

Casey Building
7701 Telegraph Road
Alexandria, Virginia 22315

IWR OFFICES and MISSION SPECIALTIES

Risk Management Center
Denver, CO & Pittsburgh, PA

40 FTE

Hydrologic Engineering Center
Davis, CA

40 FTE

Dam and Levee Safety
- Risk Assessment methodologies

80 FTE

IWR - NCR Office
Fort Belvoir, VA

38 FTE

Waterborne Commerce Statistics Center
New Orleans, LA

H&H Methods and Models
- Surface Hydrology
- Hydrologic Statistics
- River Hydraulics
- Ecosystem Function Models
- River Forecasting
- Reservoir Systems and Water Management

Waterborne Commerce Statistics
- Foreign Trade
- Domestic Commerce

Navigation Infrastructure

Dredging and Lock Performance

Civil Works Business Information

Program Direction
- Water Resource Trends and Emerging Issues
- Support on CW Strategic Plan
- Policy Development Support
- National Studies

Problem Solving
- Investment Decision Support Methods and Models
- Multi-Objective/Integrated Water Resource Management (IWRM)
- Plan Formulation
- Socio-Economic Analyses
- Environmental Evaluation
- Global Climate Change
- Technical Assistance and Capacity Development

Partnering
- Collaborative Planning
- Public Involvement
- Alternative Dispute Resolution
- National Interface
- International Outreach

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

INSTITUTE FOR WATER RESOURCES
ANNUAL REPORT FISCAL YEAR 2010

BACKGROUND

The U.S. Army Engineer Institute for Water Resources (IWR) is a field operating activity under the staff supervision of the Deputy Commanding General for Civil and Emergency Operations and 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, conflict resolution and public participation, 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, hydrologic engineering and risk assessment methods, models, training, and custom applications; and (c) national data management of results-oriented program and project information across Civil Works business lines.

The Institute is a member of the Federal Laboratory Consortium for Technology Transfer (FLC), a nationwide network of over 250 federal institutions chartered by the Federal Technology Transfer Act of 1986. IWR also has a cooperative relationship with the National Institutes for Water Resources (NIWR), which represents fifty-four State and U.S. territorial university-based water centers through the U.S. Department of the Interior, U.S. Geological Survey (USGS). The FLC and NIWR provides USACE with the framework for developing technology transfer strategies and opportunities by promoting and facilitating technical cooperation in cooperation with Corps Districts and Expertise Centers and among federal laboratories, industry, academia, and state and local governments.

IWR CENTERS

IWR has offices at five 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; the *Waterborne Commerce Statistics Center* (a unit of the Navigation Data Center) in New Orleans, Louisiana and the *Risk Management Center* (RMC) which has offices in Denver, Colorado and Pittsburgh, Pennsylvania.

The *Risk Management Center* (RMC) is IWR's newest remote center, established in 2009 and specializing in providing USACE with a critical mass of 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, conflict resolution and public participation, 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 and navigation system applications; interact with national and

international members of the water resources community, 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)*. In February 2008, 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 June 2008, ICIWaRM's nomination as an international water center was endorsed by the governing body of UNESCO's International Hydrological Programme (IHP), and in September 2009 the nomination of ICIWaRM was endorsed by the UNESCO Executive Board. The nomination was approved by all 193 member states at the UNESCO General Conference in Paris in October 2009. Official designation as a UNESCO Category II Centre took place at a ceremony at UNESCO Headquarters in New York City on October 29, 2009.

Also residing at IWR's NCR office is the *Center of Expertise in Conflict Resolution and Public Participation (CPC)* which focuses 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 2010 IWR was actively involved in supporting USACE MSC's and district offices, the International Joint Commission (IJC), and a host 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 and its individual organizational units can be found at 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 and 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 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, environmental flows, 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.

Conflict Resolution and Public Participation Center (CPC): To assist the Corps in implementing a collaborative approach to executing its water resources missions, in 2008, the Corps created the **C**onflict-Resolution and Public-Participation Center to serve as a center of expertise and a directory of expertise. CPC's mission is to help Corps staff anticipate, prevent, and manage water conflicts, ensuring that the interests of the public are addressed in Corps decision making. CPC achieves this mission by developing and expanding the application of collaborative tools to improve water resources decision making. The CPC is an interdisciplinary team at IWR supplemented by designated Corps personnel in each Division working to enable USACE to engage in effective public participation, collaboration, and conflict resolution. The Center relies on an internal Public Participation Community of Practice comprised of over 250 professionals, and supplements internal Corps resources through contracts with the private sector and close interaction with specialists from other US Government agencies. By focusing on its five goals of consultation services, capacity building, information exchange, policy support, and research, CPC supports implementation of USACE Campaign Plan Objective 2b "Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders" and Objective 4b "Communicate strategically and transparently". Collaborative process areas addressed by CPC include: Collaborative process design; Conflict assessment, prevention and management techniques; and Decision-making methods. Collaborative modeling support is developed through CPC's Shared Vision Planning program (www.SharedVisionPlanning.us) and includes applications of collaborative simulation and visualization to water planning issues, development of best practices for collaborative modeling, and the use of new technologies in environmental conflict resolution. Additional information about CPC and its services is available on its web site at www.iwr.usace.army.mil/cpc.

International Center for Integrated Water Resources Management (ICIWaRM)

The mission of the International Center for Integrated Water Resources Management (ICIWaRM) is the advancement of the science and practice of integrated water resources management (IWRM) to address water security and other water-related challenges by regional and global action, through new knowledge, innovative technologies, collaborative interdisciplinary scientific research, networking, training, and capacity development.
The objectives of ICIWaRM are focused on its principal purpose – to develop, promote and infuse sound practices for integrated water resources management around the globe. They include:

- To contribute to the development and advocacy of IWRM principles and best management practices, focusing on issues of governance (institutional frameworks), engineering, planning, and evaluation;

- To foster research, technological development, and technology transfer, as appropriate, of models and methods that enhance IWRM, and to effectively disseminate "toolkits"; and,

- To undertake capacity-building efforts in accordance with Commission/Committee guidance and IHP programmes, focusing on training for implementing IWRM at both watershed and national levels, particularly in Latin American and Africa, and to enhance collaboration among UNESCO centers towards joint problem-solving.

The scope of activities to be undertaken by the Center includes:

- Focusing on practical science, applied research and technology development embodied in the UNESCO-International Hydrological Programme (IHP) that can be readily transferred to improve IWRM through USACE Civil Works activities for developing countries;

- Partnering with, and providing or exchanging technical support for existing UNESCO-IHP programs which serve to implement IHP objectives related to attaining IWRM objectives; and

- Collaborating on joint, applied research, capacity-building and training programs through other UNESCO IHP centers (both category 1 and 2 centers) and established programs, initially with emphasis on the Western Hemisphere (Central America, South America, and the Caribbean) and Africa.

Risk Management Center (RMC): The newest organizational element of IWR is the Risk Management Center (RMC). It is headquartered in Denver, Colorado, with a satellite office in Pittsburgh, Pennsylvania. Established in

2009, the Risk Management Center is a center of expertise designed to improve the technical and policy oversight of infrastructure decisions, serve as an independent advisor to senior leadership, maintain and develop risk competencies, and ensure consistency in processes, application of criteria and decision-making.

The mission of the Risk Management Center is to support the Civil Works program by providing a nationally consistent context for managing and assessing risks for dams and levee systems across the Corps, to support dam and levee safety activities throughout the Corps, and to develop policies, methods, tools, and systems to enhance those activities.

The goals of the Center are to (1) ensure that risks are managed corporately and reduced in the most efficient matter practicable; (2) lead efforts to support consistent risk-informed dam and levee decisions across the Corps; (3) ensure that consistent processes, policies, and methods are used across the Corps to evaluate risks; and (4) lead strategic planning efforts for risk management.

The Center serves as a USACE-wide resource for risk-related tools, assessments, knowledge and methods. It offers a national perspective as well as supports routine District and MSC dam and levee safety activities. The Center offers services to support dam safety; levee safety; and the Modeling, Mapping, and Consequence Production Center of Expertise.

The roles of the Center include serving as a Corps-wide resource for risk-related tools, assessments, knowledge, and methods; serving as a technical center of expertise for infrastructure risk management and dam and levee engineering; provide a national perspective while working with USACE Communities of Practices and Districts; supporting routine district and MSC dam safety activities and supporting technical activities relating to dam and levee safety.

Information about the services provided by the Center, including about the interaction between the Center and other partnering organizations, such as the U.S. Bureau of Reclamation, the Federal Energy Regulatory Commission; the Association of State Dam Safety Officials, the U.S. Society of Dams, and the Association of Engineering Geologists, is provided at the Institute's website: http://www.iwr.usace.army.mil/rmc/.

FY 2010 SUMMARY

The Institute's FY 2010 program continued to underline IWR's status as an essential institutional asset to USACE, serving as the intellectual foundation to the future direction of the Corps Civil Works program and the overarching USACE missions, including international water security and communicating the value of the Corps contribution to the Nation's water resources. The robust mix of planning, policy and engineering initiatives that IWR executed in FY2010 was strategically targeted to anticipate a renewed national emphasis on adaptation to climate change, water resources systems (i.e., regional and watershed level planning), the need for stronger collaborative relationships between Federal and State governments and other stakeholders in solving water resources at the regional scale, and the 21st century challenge of recapitalizing the Corps aging portfolio of Civil Works infrastructure. This contemporary focus on integrated water resource management in conjunction with the enactment of the Water Resources Development Act of 2007 ("WRDA 2007", Public Law 110-114, November 8, 2007), the standup of thirteen Council of Environmental Quality (CEQ) led interagency working groups on the adaptation to climate change, and the development of CEQ's draft Principles and Standards for water resources planning provided the foundation for the 2010 Institute's program.

Overall, in FY 2010 IWR executed a record program of approximately $88 million with 178 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 was the Institute's corporate focus on recruitment, with over 90 new hires (almost one-half of the workforce) made across IWR in 2008-2010, including the hiring of over 40 engineers by the Risk Management Center, and the active use of Federal vehicles such as the Presidential Management Fellows (PMF) Program, and the National Academy of Sciences' Research Assistantship Program (RAP) to bring on recent post-Doctoral graduates as water resources specialists.

Many of the technical and policy development challenges faced in FY 2010 reflect the continued need to transform Federal water resources programs to emphasize 21st Century perspectives, policies and approaches in view of the program and policy reforms ushered through the enactment of the WRDA 2007 and the ongoing revision of the Water Resources Principles and Standards. In particular, the enactment of a number of WRDA provisions directly shaped many of IWR's FY 2010 activities, illustrated by the following examples:

- The revised cost-sharing provisions for watershed studies (WRDA 2007, Sec. 2010) served to further align the Civil Works program with integrated water resources management. To facilitate this alignment, the Institute continued work on the development of an enterprise wide geographic information system (GIS) based Watershed Investment Decision Tool (WIDT), on advancements to the Watershed Assessment Tool (HEC-WAT) and the Reservoir Simulation Model (HEC-ResSim), and policy and programmatic initiatives to assist 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 importance of 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. global center for integrated water resource management under the auspices of UNESCO's International Hydrological Programme (IHP). IWR was officially designated as a UNESCO global water center (ICIWaRM) in FY 2010 (October 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. IWR staff composed the bulk of the subject matter experts serving on the Corps internal Principles and Guidelines review team, and assisted the OASA(CW) in drafting a proposed revision. The Council on Environmental Quality (CEQ) assumed leadership of the activity and published a draft revision of the Principles and Guidelines in the Federal Register on July 1, 2009. IWR staff summarized hundreds of public comments on the CEQ draft. This summary served as a basis for the Administration's efforts to prepare a revised draft in 2010. IWR staff supported HQ and OASA(CW) in analyzing and responding to various CEQ proposals.

- In anticipation of the upcoming revision to the P&G, IWR completed 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, Section 2034 concerning **Independent External Peer Review** (IEPR) resulted in IWR support to HQUSACE in scoping new review procedures and requirements, and the initiation of a new national contracting vehicle administered by the Institute for procuring IEPR services on a consistent basis across USASCE; 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's approval in 2008 for establishing the Risk Management Center (RMC) within IWR to provide nationally consistent safety assessment tools, approaches and outcomes for dams, levees, and other engineered structures.

IWR 40th Anniversary Celebration

Fiscal Year 2010 marked the 40th anniversary of the founding of the Institute in 1969. During FY 2010 the Institute recognized this milestone with a seminar series on subjects that the Institute has focused on over its 40 year history and a one day symposium whose theme was "IWR 2020: Adapting the Corps Role to a Changing Environment."

The seminar series presentations included the following:

- "Conflict Resolution and Public Participation at IWR and the Corps: A Proud History, An Exciting Future" by Dr. Hal Cardwell and Dr. Jerry Delli Priscoli

- "From Flood Control to Risk Management and What Does Risk Management Really Mean?" by Dr. Gerry Galloway and Mr. Nate Snorteland

- "A History of the Navigation Data Center" by Mr. David Lichy

- "The Evolution of Hydrologic Software Development and the Hydrologic Engineering Center" by Mr. Chris Dunn

- "IWR and International Activities" by Dr. Jerry Delli Priscoli and Dr. Gene Stahkiv.

The one day symposium was held on April 12, 2010 at the National Capital Region offices of the Institute at Fort Belvoir, Virginia and included introductory remarks by the Assistant Secretary of the Army (Civil Works) Ms. Jo-Ellen Darcy who spoke of the history of the Institute and its achievements over the past 40 years and then focused her remarks on the future and the continued need for high quality planning and policy analysis to address future issues facing water resources development. The Director of Civil Works, Mr. Steven Stockton, offered remarks on the value and contributions of the Institute.

Four former Institute leaders were inducted into the Institute's Gallery of Distinguished Employees: Mr. Kyle Schilling, Director of the Institute from 1990 to 1999; Mr. Arlen D. Feldman, leader of the Hydrologic Engineering Center Research Program for over 20 years; Mr. Michael R. Krouse, Chief of the Planning Methodologies and Decision Support Research Program at the Institute; and Mr. Michael R. Walsh, former Senior Business Manager at the Institute.

Following this ceremony was a panel discussion on the topic "IWR 2020: Adapting the Corps Role to a Changing Environment" moderated by Dr. Len Shabman of the Resources for the Future. Panelists included Dr. John Boland of Johns Hopkins University, Dr. Denise Reed of the University of New Orleans, and Dr. Gerry Galloway of the University of Maryland.

Following the symposium, in the evening there was a dinner at Ft. Belvoir celebrating the 40th anniversary of the Institute. The guest speaker was former Chief of Engineers, Lieutenant General (Retired) Henry J. Hatch. LTG Hatch spoke on the subject of the current state of water resources, both in the United States and abroad and discussed those factors affecting water development including the potential impacts associated with climate change, economic and population growth, increased demand in places where water is in short supply, and the national security implications associated with water resources development.

Civil Works Strategic Planning and Future Directions Efforts

IWR continues to make significant contributions to the ongoing revision of the Army Civil Works Strategic Plan, *"Sustainable Solutions to America's Water Resources Needs: Civil Works Strategic Plan 2011-2015."* The direction for this revision began with the development and analysis of four future scenarios, which was followed by a stakeholder outreach. The results of these efforts led to an update of the strategic plan goals to reflect: 1) assist in providing for safe and resilient communities and infrastructure; 2) help facilitate commercial navigation in an environmentally and economically sustainable fashion; 3) restore degraded aquatic ecosystems and prevent future environmental losses; 4) implement effective, reliable, and adaptive life-cycle performance management of infrastructure; and 5) build and sustain a high quality, highly dedicated workforce.

The Institute's Future Directions activities include the identification of emerging water challenges and opportunities and the engagement of the OASA (CW) and USACE senior leaders to stimulate strategic thinking. IWR employed a variety of approaches in 2010 to encourage strategic thinking, including the development of papers on innovative water resources concepts, academic research, and senior leader discussions.

During FY 2010, IWR worked with the National Institutes for Water Resources (NIWR) and the US Geological Survey (USGS) to solicit proposals on applied scholarly investigation related to critical water policy issues.

In a similar initiative, the Future Directions staff has taken a lead role in special topic support to HQUSACE and on behalf of the OASA(CW) with regard to the collaboration with other Federal agencies on Administration initiatives such as climate change adaptation, energy and water sustainability, ecosystem services market development, floodplain management, urban water renewal, and development of new concepts in critical infrastructure and infrastructure sustainability through non-governmental organizations such as the American Society of Civil Engineers (ASCE), The Infrastructure Security Partnership (TISP), and Domestic Preparedness (DomPrep).

American Reinvestment and Recovery Activities

In February 2009 the Congress passed and the President signed into law the American Recovery and Reinvestment Act (Public Law 111-5, dated February 17, 2009). The law provided appropriations for the purpose of job creation and preservation, infrastructure investment, increased energy efficiency through advancements in science and technology, investments in transportation, environmental protection, and other types of infrastructure that will yield long term economic benefits, and stabilize the fiscal condition of State and local governments.

In FY 2009 the Institute received approximately $10.0 million to carry out Recovery Act related activities. A portion of these funds were used to conduct a comprehensive study for estimating the employment impacts and associated secondary economic impacts associated with Recovery Act expenditures. The objective of the *Economic Modeling for Estimating Jobs Project* was to ensure that USACE provides accurate estimates of local employment generation or preservation and associated economic measures, including income and sales. The Regional Economic System (RECONS) was developed and a roll-out workshop was held in September 2010 for USACE economists and planners. This modeling tool automates calculations and generates estimates of jobs and other economic measures such as income and sales associated with USACE's ARRA spending, annual Civil Works program spending, and other applicable economic activities resulting from Corps Civil Work programs. This model is currently undergoing an internal review process.

A second Recovery Act initiative, the *Accelerated Corps Water Management System Project*, was conducted through the use of three engineering consulting firms working with the Hydrologic Engineering Center. Using three engineering consulting firms that had an existing contract with the Bonneville Power Authority, 11 major watersheds in 11 District offices were modeled with hydrologic/hydraulic models within the Corps Water Management System (CWMS). These models will allow Corps water managers to better operate reservoirs and other projects in real-time. The models will provide short-term hydrologic forecasts (about 1 week) and simulate reservoir operations for those forecasts to determine the best operations to maximize the effective use of the reservoirs. CWMS also allows for different "what-if" scenarios, so that water managers can compare different rainfall forecasts and operational scenarios to evaluate to potential impacts. The models can also be used in Corps planning studies for alternative analyses. Watersheds modeled include the Red River of the North, where there has been substantial snow melt flooding in the recent past , the Cumberland and Ohio Rivers, site of the floods in Tennessee including Nashville in the spring of 2010, the American and Santa Ana rivers in California, the Apalachicola, Chattahoochee and Flint (ACF), as well as several others. The project was funded with $5.0 million and completed on schedule.

A third Recovery Act initiative, the *Climate Change Downscaling Projections Project* will produce and distribute a comprehensive library of fine-resolution simulations of historical and future climate, for use by decision-makers who need local/regional-scale climate information. Using two empirical methods that use fine-scale observations to add spatial detail to climate model results, the project will produce fine-resolution climate results spanning 1950-2100, based on results from the full suite of climate models for use in USACE projects that must evaluate climate impacts to project performance and resilience. This library of fine-resolution climate projections will be distributed by the

Lawrence Livermore National Laboratory through the same portal that will distribute IPCC climate model results. The results will thus be available to other federal agencies, state and local governments, and the general public.

Global Climate Change Science and Responses to Climate Change

During FY 2010 IWR continued to be heavily involved in the U.S. Government's efforts in the advancement of global climate change science and the development of policies to address adaptation to global warming. The objectives of the initiative are to understand how climate is changing, describe and characterize climate impacts to USACE missions, operations, programs, and projects, and develop consistent water resources management adaptation policies and approaches throughout USACE Civil Works and in partnership with other Federal water resources agencies. The project will provide recommendations for policy and guidance to prepare for, and respond to, climate change and variability.

FY 2010 activities of note include the following:

- The Director of the Institute served along with ASA(CW) and the PDASA(CW) on the Council of Environmental Quality (CEQ) Interagency Climate Change Adaptation Task Force;

- IWR staff continued supporting the White House Council on Environmental Quality (CEQ) and the Interagency Climate Change Adaptation Task Force to develop federal recommendations for adapting to climate change impacts both domestically and internationally. IWR provided representatives on working groups on Adaptation Science Inputs for Policy, Agency Adaptation Processes, and Water Resources. IWR staff supported the development of a Report to the President entitled, "*Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy*", scheduled to be released in October 2010. The goals of the effort are to make recommendations toward a national adaptation strategy that utilizes a set of best practices, to integrate climate change resilience and adaptive capacity into federal government operations and coordinate interagency preparations, and to develop informed communities that understand their vulnerability to climate impacts.

- IWR scientists continued to play an active role on the Climate Change and Water Working Group (CCAWWG), an interagency group established 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 was 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. In FY 2010 the CCAWWG added representatives from the Federal Emergency Management Agency (FEMA) and the Environmental Protection Agency (EPA).

- In FY 2010, the CCAWWG addressed the concerns that water resources management agencies face with two major workshops. The first, hosted by the USACE and held in January 2010, entitle "Workshop on Nonstationarity, Hydrologic Frequency Analysis, and Water Management" addressed the concept of nonstationarity on hydrologic records, which makes it difficult to project future conditions based on the past record. Dr. Rolf Olsen was the lead of the interagency organizing committee for this workshop, which included national and international experts and will result in a special issue of the Journal of the American Water Resources Association (Proceedings, are at http://www.cwi.colostate.edu/NonstationarityWorkshop/index.shtml).

- During FY 2010, IWR staff worked in conjunction with members of the U. S. Bureau of Reclamation on a follow-up study to their February 2009 report *"Climate Change and Water Resources Management: A Federal Perspective"*. The new report entitled *"Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information"* was undergoing internal and external review in FY 2010 and will be published in FY 2011.

- IWR staff members also participated in another interagency group that include representatives from 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.

- The IWR Responses to Climate Change effort continues to work closely with the IPET/HPDC Lessons Learned Implementation Team to develop detailed Civil Works Technical guidance on Procedures to Evaluate Sea Level Change Impacts, Responses, and Adaptation. This new guidance is being led by district staff (with the support of IWR planners, economists, engineers and scientists), and includes members of the USGS, NOAA, FEMA, the Bureau of Reclamation, Federal Highway Administration, the Navy, the U.S. Naval Academy, and others, including two experts from the United Kingdom. The team held a workshop in April 2010 at NOAA's Silver Spring office.

Updating and Expanding "Value to the Nation" Materials

In Fiscal Year 2010, the Institute, in support of the Office of the Secretary of the Army for Civil Works and USACE headquarters, initiated work to update and expand the focus of the Civil Works "Value to the Nation" materials, a series of brochures and an associated website which communicate the value of the Civil Works program to the Nation and the general public.

The huge investment in the Nation's public works infrastructure made during the 20th century resulted in the world's premier Civil Works infrastructure system which has served as the foundation for America's civil society for well over a century. This national water resources infrastructure portfolio has facilitated economic growth and connected vast stretches of the nation by means of highways, waterways, and rail systems; promoted the efficient movement of people and goods; protected natural and wilderness areas; advanced and enhanced the health, safety and quality of life of the citizens of the Nation; promoted the development of the energy resources of the Nation; and supported the economic security and defense of the Nation.

However, despite the successes associated with this sustained large national investment in our infrastructure, the nation's water resources capital stock infrastructure is now suffering a critical lack of attention. The Corps is the Nation's leading provider of infrastructure against floods (programmatic area: flood risk management), coastal harbor development and inland waterways infrastructure through an extensive series of locks and dams on some 12,000 miles of navigable inland waterways (programmatic area: navigation), development and management of ecosystem restoration and wetlands (programmatic area: ecosystem restoration), hydropower development, recreational opportunities, and water supply for drinking and agriculture; yet, the majority of the public doesn't recognize this.

The Corps Civil Works Program faces the same challenge that nearly every Federal infrastructure, water resources, or engineering agencies are confronted with: how to document and communicate the value of the many and varied programs and structures that have been implemented by USACE and continue to provide critically needed services and outputs to the Nation now and in the future. The means to effectively analyze and communicate the implications of the information for three purposes:

- In support of program development and budget prioritization decision-support processes within the Executive branch and Congress;

- In support of more effective management of the existing civil works capital stock portfolio in conjunction with the Corps Asset Management Program (by facilitating the linkage of OMBIL performance data and engineering condition information); and,

- In support of more effectively communicating with project sponsors, stakeholders and the general public on the value of the CW program.

One of the major accomplishments of this work activity in FY 2010 was an update of the value of the capital stock of the Corps physical infrastructure. Unfortunately, the value of the Corps capital stock has continued to decline in value as the result of an increasing pace of depreciation due in increasing age versus a slower rate of new capital investment. As a means of context, the Corps capital stock reached its highest value around 1980, and has since declined annually.

A second major accomplishment during FY 2010 was the development of a regional economic development model which is able to generate estimates of employment impacts, sales associated and induced economic impacts associated with increased Corps of Engineers expenditures.

As recapitalization of the Corps current capital stock becomes a more pressing issue it will be faced with the need to establish a robust asset management framework not simply based on physical condition assessment, but also on reasonable performance and service delivery thresholds, contemporary renewals engineering and deterioration science, and a risk characterization such as "tolerable risk" over the project life-cycle.

The Institute, working in coordination with various offices at Corps headquarters, is continuing to update the existing Value to the Nation brochures, the Value to the Nation web site, and related information and products to develop targeted outreach material. The Corps' ability to provide timely, clear, direct and accurate answers to the inevitable range of questions and inquiries that will flow from a diverse array of groups and interests will have an impact on the development and direction of the future Civil Works program.

Integrated Water Resources Management

During FY 2010, IWR staff continued to play central roles in advancing the practice of IWRM through numerous technical efforts, including the following:

- Directing and managing the activities of the International Upper Great Lakes Study under the auspices of the International Joint Commission (IJC). The Study was initiated in 2007 under a Memorandum of Agreement (MOA) between IWR and the International Joint Commission (IJC). IWR is leading the U.S. contributions to the study. IUGLS began in 2007 to investigate the possible factors responsible for recent declining Upper Great Lakes levels (Phase 1) and to formulate alternative plans for Lake Superior outflow regulation with the goal of providing benefits to existing and emerging interests (Phase 2).

On December 15, 2009, the final Phase 1 Report was released describing the investigations by dozens of scientists from U.S. and Canadian government and non-government agencies and universities around the Great Lakes, and is available at the Study's website: www.iugls.org. The study investigators found that over the last four decades, the conveyance of the St. Clair River has changed due to man-made factors. However, they also determined that the declining lake levels were due primarily to climatic variability and glacial isostatic rebound.

- An IWR senior scientist 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. IWR staff continued to support development of a technical framework for the Gulf Region Sediment Management Master Plan in support of the Gulf of Mexico Alliance. Staff helped to ensure that new Gulf region forums such as the Council on Environmental Quality Workgroup on Louisiana and Mississippi Coastal Ecosystem Restoration, and the new Gulf of Mexico Ecosystem Restoration Task Force, were aware of this initiative and related information. The Gulf of Mexico Restoration Task Force was established by Executive Order 13554, partially in response to the Deepwater Horizon spill. Its objective is to assist the Gulf coast communities in efforts to conserve and restore resilient and healthy Gulf ecosystems that support the diverse economies, communities and cultures in the region.

- IWR staff continued support to ERDC and the Philadelphia District as part of the Delaware Estuary RSM Plan project. Covering an area that is home to 6.4 million people, the Delaware Estuary is the second largest estuary in the United States. With the participation of more than 20 resource agencies and environmental organizations, the development of the RSM Plan uses a system-based approach and incorporates the various competing demands for sediment resources, such as wetlands protection, coastal development, fisheries management, and port management.

- IWR and HEC specialists continued to provide technical assistance on several pilot project partnerships with The Nature Conservancy on their Sustainable Rivers Program.

- IWR researchers worked to continue advancing IWRM planning, economic and hydrologic and hydraulic engineering tools, resulting in the 2010 release of IWR-Planning Suite software, Version 2.0.6.0, 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 full 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.

Collaborative Planning and Partnering Efforts

Through the Institute's role in supporting the USACE-wide implementation of the Civil Works Strategic Plan (2004-2009) and ongoing revision of the Army Civil Works Strategic Plan, *"Sustainable Solutions to America's Water Resources Needs: Civil Works Strategic Plan 2011-2015"* in accordance with the Government Performance and Results Act (GPRA), IWR continues 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 FY 2010 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 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. IWR represents Army Civil Works on the Ocean Resource Management Interagency Policy Committee (ORM-IPC) and the Ocean Science and Technology Interagency Policy Committee (OST-IPC).

In the advancement of collaborative planning models and guidance, IWR's National Cooperative Modeling and Collaborative Planning and Management Demonstration programs work 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.

During FY 2010, 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.

The staff of the Conflict Resolution and Public Participation Center prepared the *4th Annual Report on Environmental Conflict Resolution* for the Council on Environmental Quality, on the behalf of the Office of the Assistant Secretary of the Army for Civil Works;

The Center published two reports on Shared Vision Planning entitled "*Analysis of Process Issues in Shared Vision Planning Cases*" (IWR Publication 2009-R-05, dated September 2009) and "*Performance Measures to Assess the Benefits of Shared Vision Planning and Other Collaborative Modeling Processes*" (IWR Publication 2009-R-07, dated November 2009).

A dramatic expansion of 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, with the number of operational regional teams in FY 2010 growing to 16 states, and with an additional four state teams in various stages of development towards the ultimate goal of offering at least one interagency team within every state.

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).

During FY 2010, efforts continued in establishing new Memoranda of Understanding (MOU's) with universities and other professional organizations. These new MOUs will facilitate cooperation in science, technology, and research in aspects of integrated water resource management and capacity building in developing nations and countries in transition.

International Water Resources Initiatives

FY 2010 will stand out as a milestone in the history of the Institute for the receipt of the official designation of the International Center for Integrated Water Resources Management as a Category II Center under the auspices of UNESCO, the first such center in North America as well as its expansion of international activities.

The International Center for Integrated Water Resources Management was selected as the U.S. Government nominee for consideration as a UNESCO Category II Centre in February 2008 after a national-level competition. With the support of the U.S. National Commission for UNESCO, 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, approved by the IHP Bureau in March 2008, and endorsed by IHP's 36-member nation Intergovernmental Council (IGC) in June 2008. The nomination of ICIWaRM was endorsed by the UNESCO Executive Board in September 2009. Approval by all 193 member states took place at the UNESCO General Conference in Paris in October 2009. Official designation as a UNESCO Category II Centre was performed at a ceremony at UNESCO Headquarters in New York City in late October 2009.

Other notable international activities during FY 2010 included the following:

Mr. Robert Pietrowsky, Director of the Institute, continued his service as a member of the Governing Board of UNESCO-IHE and Mr. Eugene Stakhiv served as chair of the Advisory Board of ICHARM and the Steering Committee of the Global Water Partnership (GWP).

Dr. Eugene Stakhiv continued to co-chair a UNESCO Sponsored Steering Committee tasked with preparing guidelines to assist water resources practitioners in finding better and more efficient solutions to water resource problems.

ICIWaRM staff members are leading an effort to translate into Spanish the committee's publication series *IWRM Guidelines at River Basin Level*. UNESCO's Regional Office for Latin America and the Caribbean, and the Inter-American Development Bank, are partners in this effort.

UNESCO-IHP has chosen ICIWaRM as the global technical secretariat for its global network "Water and Development Information for Arid Lands," or G-WADI. The program aims to strengthen global capacity to manage water resources in arid and semi-arid regions by building an effective global community.

ICIWaRM provided extensive support to the World Water Assessment Programme (WWAP) in FY 2010. WWAP is the flagship programme of UN-Water. Housed in UNESCO, it monitors freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at a national level and inform the decision-making process.

ICIWaRM sponsored the North American HELP (Hydrology for the Environment, Life and Policy program) Basin Organizations *Workshop on Lessons Learned* (May 2010, Portland). The event brought together Federal, state, and local governments along with NGOs and academic partners working on IWRM in seven basins in the U.S. and Panama.

ICIWaRM continued work on the development of a non-proprietary Drought Atlas software product that will be freely available to countries that may need such a product, particularly countries in transition located in arid or semi-arid areas. In partnership with fellow Category 2 center, the Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean, ICIWaRM will be using the resulting product to create a complete drought atlas of Latin America.

ICIWaRM also continued support of the Modernization of Management of Water Resources Project (PMGRH) in Peru. ICIWaRM is providing technical advice and capacity building in coordination with the National Water Authority (ANA) and the project lenders, the World Bank and the Inter-American Development Bank.

In collaboration with the Global Water Partnership and the National Academy of Sciences, ICIWaRM organized the first inter-academic U.S.-Ukrainian meeting on scientific approaches to adaptation to climate change in the water sector, including flood protection activities in the Carpathian region.

Through a continuing collaboration between ICIWaRM academic partner University of Arizona and the International Senegal Basin Authority (Organisation pour la Mise en Valeur du Fleuve Senegal), ICIWaRM is developing a near real-time streamflow forecasting system using satellite precipitation measurements in the Senegal River Basin.

ICIWaRM has been a strong participant in the USAID-led effort to create the Middle East North Africa Network of Water Centers of Excellence (MENA-NWC) throughout the year. This network will bring together water centers throughout the MENA region along with U.S. government agencies and universities to address some of the region's most challenging water problems.

During FY 2010, staff from the Hydrologic Engineering Center participated in the Watershed Assessments for Afghanistan Project. The watershed assessment for Afghanistan project is a collaborative project led by the Corps Transatlantic Division office with multiple districts participating and local experts with the objective of locating and analyzing potential dam and reservoir sites. HEC is analyzing potential dam and reservoir sites in the Helmand basin. Results of the study are due in FY 2011.

In November 2009, the HEC Director Mr. Chris Dunn, gave a keynote presentation at the 1st International Conference on Policy and Research for Global Disaster Management (PR4GDM) in Seoul, South Korea. The conference was hosted by the Korean National Emergency Management Agency (NEMA). The conference aimed to strengthen disaster response through disaster management technology and international research and development sharing and to discuss the feasibility of a collaborative international research and development program for global disaster management.

While in Korea, HEC met with representatives of NEMA's National Institute for Disaster Prevention, the Korean Institute of Construction Technology (KICT), and K-water (formerly known as KOWACO) to explore areas of common interest. It is interesting to note that both KICT and K-water had previously approached the Corps at the 5th World Water Forum in Istanbul, Turkey in March 2009 to explore joint opportunities. As a result of HEC's participation in the PR4GDM conference, HEC was invited and agreed to participate in the 8th International Conference on EcoHydraulics in September 2010 in Seoul, South Korea.

In September, 2010, HEC again was invited to South Korea, this time to participate in the 8th International Symposium on Ecohydraulics Conference in Seoul, present a one day symposium on Integrated Water Resources Management (IWRM) with K-water, in Daejeon, South Korea, and to assist in hydrologic and hydraulic engineering efforts regarding the Camp Humphreys development plan.

HEC also represented USACE on the USG delegation attending the Flood Forecasting Initiative Workshop at the World Meteorological Organization (WMO) headquarters in Geneva, Switzerland in December 2009. WMO established the Flood Forecasting Initiative to assist member nations, especially the developing nations, by improving their flood forecasting capabilities. Utilizing his experience as lead developer of the Hydrologic Modeling System (HEC-HMS), Dr. William Scharffenberg will be working with several experts from the workshop to develop a proposal for a comparison of hydrologic forecasting models. The comparison will assist developing countries in selecting the best hydrologic forecasting model for their unique needs.

As a result of HEC's involvement with the WMO, HEC's Dr. Scharffenberg has been designated as the USACE representative on WMO's Committee on Hydrology.

HEC has entered into a contractual agreement with an American firm, Exponent, Inc., to support to the second phase of the Strategy for Water and Land Resources of Iraq (SWLRI). The objective of the SWRLI project is to define the strategy and the related investment plan that will guide the sustainable management and development of the water and land resources of Iraq for the next two decades (from 2010 to 2030). HEC will assist in providing technical assistance on the use of the hydrologic and hydraulic analysis tools previously developed by HEC for real-time forecasting and water management operation.

In October 2010, HEC participated in a training course held in Ulaanbaatar City, Mongolia. This class provided GIS training. During the training, HEC personnel had the opportunity to go into the field to collect data for use in developing HEC-HMS (Hydrologic Modeling System) rainfall-runoff model and HEC-RAS (River Analysis System) hydraulic model. These models were scheduled to be delivered to the Mongolians in the second quarter of FY 2011.

HEC also represented USACE at the UNESCO International Workshop on Challenges and Solutions for Dam Re-operation held at UNESCO Headquarters in Paris in October 2010. The workshop consisted of a small group of professionals from around the world working with reservoir operations for environmental purposes presenting their efforts in hopes of identifying characteristics that are common to successes and failures. HEC and the Nature Conservancy presented the Sustainable Rivers Project as a case study for North American Rivers/Flood Control Reservoirs.

HEC is a participating study team member for the Columbia River Treaty (CRT) 2014/2024 Study. The CRT is an agreement between the United States and Canada. The purpose of the CRT, which became effective in 1964, is to provide flood control and power benefits to U.S. and Canadian regions. HEC supports the study project development team, including the Hydrology and Hydraulics, Plan Formulation and Integration sub-teams, provides technical and policy guidance, coordination and development of the HEC-FRM and HEC-ResSim software features specific to CRT and provides overall risk assessment methods to the CRT team.

In November 2009, several members of the Taiwan Water Resources Agency (WRA) visited the Hydrologic Engineering Center (HEC). Their interest was for HEC to come to Taiwan to perform training on the HEC software products. Since that time, HEC has been coordinating with HQUSACE and the U.S. State Department to investigate which process might be of use to allow this cooperative effort to occur. The WRA has invited HEC to come to Taiwan to provide recommendations on methods they may employ to help with flood modeling. It is anticipated that such a meeting will take place sometime in FY 2011.

HEC Senior Hydraulic Engineers were invited to Hungary by the Ministry of Environment and Water to conduct training on HEC's River Analysis System (HEC-RAS). The HEC-RAS modeling conference was held in Szolnok, Hungary and was used to raise public awareness of flooding issues and highlight the completion of an offline storage facility on the Tisza River near the town of Tiszaroff. The modeling conference was organized by the Middle Tisza District and RBF Consulting. It was announced at the conference that the Hungary Ministry of Environment and Water has officially adopted the HEC-RAS program for performing all their river modeling. It was very important for the Ministry management personnel to hear directly from HEC about the future of HEC-RAS, because they have made a five-year commitment to exclusively use RAS for river modeling. Approximately 40 Hungarian engineers from the various water Districts attended the latter portion of the conference for HEC-RAS training where HEC engineers provided hands-on training on several specific HEC-RAS topics.

Technological Advancements

During FY 2010, technical advancements occurred in a number of areas including the following:

<u>Sustainability of Freshwater Species</u>

The Institute completed a landmark study by Dr. Richard Cole that examined data on freshwater species, the history of species decline, and species associations with Federal water resources projects, including Corps of Engineers projects. The study concluded that Federal water development projects have played a role in the species decline, but that agriculture, invasive species and other impacts have cumulatively contributed most to past species extinctions. Estimated extinction rates have decline in recent decades as stronger environmental laws have taken effect, and the Corps has complied with the Endangered Species Act (ESA) and participated in numerous species recovery plans. Despite those actions, recovery of imperiled species to a sustainable state has been slow and, with additional action, anticipated environmental change threatens accelerated extinction. The number of vulnerable freshwater species is several times that of vulnerable terrestrial species. A large and growing fraction of amphibian, fish, molluscan and crustacean species are now vulnerable and approaching a threshold for ESA listing.

National Weather Service Adopts HEC-RAS

The National Weather Service (NWS) has adopted HEC-RAS (River Analysis System) as its Unsteady Flow hydraulics model for Real Time River Forecasting. The NWS evaluated and tested several pieces of software for inclusion in their new real time forecasting system CHPS (Community Hydrologic Prediction System). The NWS model evaluation team concluded that HEC-RAS was the model they wanted to go forward with in the development of their real time forecasting system.

The integration of HEC-RAS into the NWS CHPS system is now complete and is currently in testing phase. Several of the existing models currently being used by the NWS have been converted to HEC-RAS models and have been found to give as good or better results. The NWS developed a set of software and guidelines for converting existing models to HEC-RAS. Many of the models currently in use are being converted to HEC-RAS and some new models are being developed by the NWS river forecast centers across the country.

One such model for the Ohio River System is jointly being developed between the NWS, Ohio River Forecast Center and the USACE, Great Lakes and Ohio River Division. This model consists of the entire Ohio River (1100 miles), and its major tributaries, as well as 200 miles of the Mississippi River (100 miles upstream and downstream of the junction with the Ohio River.) The model also included 20 locks and dams, levee systems, and many bridge crossings. The model will be used by the NWS and USACE for Real Time River Forecasting and operations of the dams located on the tributaries.

Savannah Harbor Expansion Project Study

During Fiscal Year 2010, IWR staff continued to work closely with the Savannah and Mobile districts and the Deep Draft Navigation Planning Center of Expertise on the economic analysis for a General Evaluation Report for expansion of Savannah Harbor. IWR developed a new economic evaluation model for containerships to be used in the evaluation of deepening Savannah Harbor from 42 feet up to a depth of 48 feet. The development and implementation of the new model also involved documentation and training of Mobile district staff in its use, as well as numerous presentations to agency technical review, external independent peer review, and headquarters policy review staffs. The new evaluation tool and lessons learned on the Savannah Harbor Expansion Project study are being leveraged with other research and development efforts underway as part of the Transportation Systems Program and the Optimization Tools for Navigation program.

Hydrologic Engineering Center Models

- **HEC-HMS, Hydrologic Modeling System, Version 3.5**. New simulation features were added to the HEC- HMS Version 3.5 software.

- **HEC-FDA, Flood Damage Reduction Analysis, Version 1.2.5**. This version replaces version 1.2.4 which was released in 2008. 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.

- **HEC-SSP, Statistical Software Package, Version 2.0**. This is a new release of the HEC-SSP software. It includes enhancements to existing capabilities and new capabilities. Enhancements were added to the General Frequency and Volume Frequency analyses along with continued improvements for customization of output graphs.

- **HEC-EFM, Ecosystem Functions Model, Version 2.0**. EFM is designed to help determine ecosystem responses to changes in the 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 4.1**. HEC-RAS Version 4.1 was released in March of 2009 to the general public. Several new simulation features have been added to the program since that time.

- **HEC-WAT, Watershed Analysis Tool, Version 1.0** (not yet released) The Watershed Analysis Tool (HEC-WAT) software was created to help USACE study teams conduct watershed and water resources studies in an integrated, comprehensive and systems based analyses. A beta version of the WAT was released in FY 2008 and is available for use and testing. Official release of this software is expected in early 2011.

- **HEC-FIA, Flood Impact Analysis, Version 2.2** (not yet released). HEC-FIA evaluates impacts using either continuously observed or forecasted hydrographs (hydrograph-based) or depth grids (GIS-based). Official release of this software is expected in early 2011.

IWR Planning Suite

In FY 2010 the Planning Suite was updated to include a module to annualize costs and benefits in accordance with Corps policy and guidance (Version 2.0.6.0) and was certified by HQUSACE in compliance with the requirements of the Planning Model Improvement Program (PMIP) guidance. 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. This model is a water resources investment decision support tool that performs computations associated with cost-effectiveness and incremental cost analyses used during the formulation and evaluation of planning alternatives that involve monetary and non-monetary costs and benefits.

Container Model Suite of Tools

The Container Model Suite of Tools are a set of IWR-developed desktop computer programs and associated databases designed to assist Corps' planners and analysts investigating improvements to the Nation's ports. The tools have stand-alone application, and are also integrated with HarborSym, for which they provide data for the HarborSym widening model.

A suite of tools have been developed to date:

- IWR Tide Tool – providing simple access to information on astronomical tides at tidal stations around the world. The IWR Tide Tool makes use of standard astronomical tidal prediction techniques and databases of tidal stations. The Tide Tool generates tidal height and current information for primary and secondary tidal stations as well as statistics on tidal availability, for example the cumulative distribution function of tidal availability at a location. A geographical interface making use of Google Earth™ allows for simple identification of tidal stations, and supports creation of secondary tidal stations for use in HarborSym. Output can be generated and saved in standard spreadsheet formats.

- Loading Generators – supporting analysis and generation of consistent vessel call lists for use by HarborSym, for both bulk and container traffic. Two Loading Generators exist – one for bulk cargo (Bulk Loading Tool) and one for containerized cargo (Container Loading Tool). Each generator takes user input on fleet availability, efficiency of vessels, vessel classes, commodity forecasts, and port depth characteristics and uses this information to generate consistent synthetic vessel call lists (dock visits and commodity transfers by individual

vessels over a defined period) that can be used with HarborSym for analysis of alternative fleet, commodity, and port infrastructure scenarios.

- W-DAPP (Waterborne Data Analyzer and Pre-Processor) – providing planners with direct access to WCSC data in useful formats for a particular port. The W-DAPP, designed in concert with the Waterborne Commerce Statistics Center, provides planners with direct access to WCSC vessel data for a set of user-specified docks via a visual interface through Google Earth™. Once the user identifies docks at a port for which information is to be acquired, the information is brought down to the user desktop and stored in a local database in formats that replicate WCSC formats and structures. A wide variety of information is available, as well as statistical analysis capabilities. In conjunction with the AIS-DAPP, W-DAPP generates historic vessel call lists for use with HarborSym.

- AIS-DAPP (Automated Information System Data Analyzer and Pre-Processor) – generating analysis of trade routes and vessel statistics at a port for container vessels, based on detailed vessel movement data for container vessels. The AIS-DAPP is an advanced spatial analytic tool that operates on information from the vessel automated identification system (AIS). The AIS provides location, destination, sailing draft, and vessel speed data over time as vessels move. The AIS-DAPP acquires and organizes this information into a usable database structure, and provides analytic tools for identification of vessel statistics for a port and determination of global service routes for individual vessels. It is used in conjunction with W-DAPP to provide arrival draft information for vessel call lists for HarborSym.

- HarborSym – the HarborSym widening model was modified to account for the ocean leg of vessel calls. This extends the HarborSym model's functionality to include channel deepening studies.

Visiting Scholars Program

The Institute benefits from supporting a number of Visiting Scholar programs which bring the foremost water resources experts from academia, private industry and other agencies and laboratories to residence at IWR for periods of six months to one year. FY 2010 marked the ninth 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.

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

FY 2010 marked the second year of the Frederick J. Clarke Visiting Scholar program, named in honor of Lieutenant General Frederick J. Clarke, Chief of Engineers from 1969-1973. Lieutenant General Clarke was instrumental in securing expert, independent advice on environmental issues facing the Corps by founding the Environmental Advisory Board. The Frederick J. Clarke Visiting Scholar program will provide scholars the opportunity to advise the Corps on important policy issues related to the Corps environmental mission.

Dr. Martin Doyle, Associate Professor in the Department of Geography at the University of North Carolina at Chapel Hill, was the inaugural Frederick J. Clarke Visiting Scholar during the period 2009-2010. While at IWR, Dr. Doyle's research focused on the determination of the optimal scale for geographic service areas in compensatory mitigation; infrastructure decommissioning; and the evolving political economy of rivers.

The 2010-2011 Frederick J. Clarke Visiting Scholar is Dr. G. Mathias (Matt) Kondolf, professor of Landscape Architecture and Geography at the University of California, Berkeley, who is focusing on the technical and policy advancement of Regional Sediment Management.

IWR's specific accomplishments during FY 2010 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 engagement of the Office of the Assistant Secretary of the Army (Civil Works) (OASA (CW)) and USACE senior leaders to stimulate "strategic thinking". Such critical thinking is an essential prerequisite in the formation of organizational strategic direction and the implementation of new initiatives. IWR employs a variety of approaches to encourage strategic thinking, including the development of papers on innovative water resources concepts, academic research, and senior leader discussions. During FY 2010, IWR worked with the National Institutes for Water Resources (NIWR) and the US Geological Survey (USGS) to solicit proposals on applied scholarly investigation related to critical water policy issues. One grant was awarded for a collaborative effort between the Water Resources Centers from Minnesota, Oklahoma, South Carolina, and Arkansas to develop recommendations for Federal agencies and federal-state partnerships to effectively conduct adaptive management within the field of water resources. This engagement with NIWR is engaging some of the brightest and most talented individuals working in the water resources area while establishing working relationships on emerging topics of the future. In a similar initiative, the Future Directions staff has taken a lead role in special topic support to the HQUSACE on strategic initiatives such as development of the USACE Civil Works Strategic Plan; interaction on behalf of the OASA(CW) with other Federal agencies for support of Administration initiatives such as climate change adaptation, energy and water sustainability, ecosystem markets development, floodplain management, and urban water renewal; and development of new concepts in critical infrastructure and infrastructure sustainability through non-governmental organizations such as the American Society of Civil Engineers (ASCE), The Infrastructure Security Partnership (TISP), and Domestic Preparedness (DomPrep).

Strategic Planning: IWR continues to make significant contributions to the ongoing revision of the Army Civil Works Strategic Plan, "*Sustainable Solutions to America's Water Resources Needs: Civil Works Strategic Plan 2011-2015*." The direction for this revision began with the development and analysis of four future scenarios during 2007, which was followed by a stakeholder outreach session that same year. The results of these efforts led to an update of the strategic plan goals to reflect: 1) assist in providing for safe and resilient communities and infrastructure; 2) help facilitate commercial navigation in an environmentally and economically sustainable fashion; 3) restore degraded aquatic ecosystems and prevent future environmental losses; 4) implement effective, reliable, and adaptive life-cycle performance management of infrastructure; and 5) build and sustain a high quality, highly dedicated workforce.

To achieve these goals, an overarching strategy of Integrated Water Resources Management (IWRM) as a means to embrace holistic and collaborative planning was adopted. This overarching strategy is supported by a series of cross-cutting strategies or methods that operationalize the qualities of a technically competent and forward looking organization. The resulting six cross-cutting strategies include the application of: 1) systems approaches; 2) collaboration and partnering; 3) risk informed decision making and communication; 4) innovative financing; 5) adaptive management; and 6) state-of-the-art technology.

The Institute's staff and USACE's Operations and Maintenance Business Information Link (OMBIL) national data management systems continue to support formulation of yearly budget guidance. In addition, significant progress in the refinement of the Army Civil Works performance metrics were implemented in 2009, along with a commensurate improvement in performance across the Civil Works program, particularly in the area of inland navigation. Finally, select members of IWR are providing staff support to the Office of the Assistant Secretary of the Army for Civil Works as rotating detailees working on a wide range of policy related initiatives.

Policy Development: The Water Resources Development Act of 2007 (Public Law 110-114, Section 2031) broadened national policy for water resources projects to include environmental and social as well as economic objectives and stressed preservation and protection of natural resources. To implement these changes, the law directed the Secretary of the Army to revise the 1983 Principles and Guidelines (P&G) to comport with the new policy. The 1983 P&G consists of Principles, Standards and Procedures which state how water resources implementation agencies should pursue policy. Each P&G section contains additional details on formulating, evaluating and recommending water resources projects.

In order to secure P&G application to agencies beyond those covered by the 1983 P&G, the Council on Environmental Quality (CEQ) assumed leadership of P&G revision. In December, 2009, the CEQ published a draft Principles and Standards (P&S) in the Federal Register requesting public comments and National Academy of

Sciences peer review. Simultaneously with P&S publication, CEQ assembled an Interagency Team to develop the Procedures (sometimes denoted as "Guidelines").

During FY 2010 IWR staff served on the Interagency Team that explored the implications of new concepts contained in the P&S and drafted Procedures to implement the P&S. Additionally, IWR staff supported USACE headquarters and ASA (CW) in analyzing various CEQ Principles and Standards proposals issued in response to concerns of the Administration, National Academy of Science and the public.

IPET/HPDC (Interagency Performance Evaluation Task Force/ Hurricane Protection Decision Chronology) Lessons Learned Implementation Team (formerly Actions for Change): The IPET/HPDC Lessons Learned Implementation Team was developed to address the lessons learned from the Hurricane Katrina and Rita events. The goals of the effort are to improve public safety and the Nation's water resources infrastructure by providing expert and professional services to the Nation. The team was 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.

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 partnering with the National Flood Risk Management team to develop a framework for public involvement in flood risk management decision making.

Responses to Climate Change: During FY 2010, IWR continued making progress on its work to address USACE responses to climate change. The objectives of the initiative are to understand how climate is changing, describe and characterize climate impacts to USACE missions, operations, programs, and projects, and develop consistent water resources management adaptation policies and approaches throughout USACE Civil Works and in partnership with other Federal water resources agencies. The project will provide recommendations for policy and guidance to prepare for, and respond to, climate change and variability.

Prior year accomplishments, leveraging work begun under the Interagency Performance Evaluation Task Force/Hurricane Protection Decision Chronology (IPET-HPDC) Lessons Learned Implementation Team, resulted in the publication of a February 2009 report entitled, "*Climate Change and Water Resources Management: A Federal Perspective*" as USGS Circular 1331. This report was authored by an interagency group composed of representatives from USACE, the U.S. Geological Survey (USGS), the U.S. Bureau of Reclamation, and the National Oceanic and Atmospheric Administration (NOAA). These agencies formed the nucleus of the Climate Change and Water Working Group (CCAWWG), whose aims are to collaborate on user needs and actionable science to help water managers prepare for and adapt to the effects of climate change on the nation's water resources.

In FY 2010, the CCAWWG added team members FEMA and EPA. IWR staff worked in conjunction with members of the U.S. Bureau of Reclamation on a follow-on study to USGS Circular 1331, entitled *"Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information."* IWR and Bureau of Reclamation staff drafted the report, conducted internal and external review,

resolved review comments, and obtained perspectives from other water managers with similar needs. This information was incorporated in the report. The report will be published in FY 2011.

Throughout FY 2010, IWR staff continued supporting the White House Council on Environmental Quality (CEQ) and the Interagency Climate Change Adaptation Task Force to develop federal recommendations for adapting to climate change impacts both domestically and internationally. IWR provided representatives on working groups on Adaptation Science Inputs for Policy, Agency Adaptation Processes, and Water Resources. IWR staff supported the development of a Report to the President entitled, "*Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy*" released in October 2010 (see http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation). The goals of the effort are to make recommendations toward a national adaptation strategy that utilizes a set of best practices, to integrate climate change resilience and adaptive capacity into federal government operations and coordinate interagency preparations, and to develop informed communities that understand their vulnerability to climate impacts.

In FY 2010, the CCAWWG addressed the concerns that water resources management agencies face with two major workshops. The first, hosted by the USACE and held in January 2010, leveraged funding from the IPET-HPDC Lessons Learned Implementation Team. The "Workshop on Nonstationarity, Hydrologic Frequency Analysis, and Water Management" addressed the concept of nonstationarity on hydrologic records, which makes it difficult to project future conditions based on the past record. Dr. Rolf Olsen of IWR was the lead of the interagency organizing committee for this workshop, which included national and international experts and will result in a special issue of the Journal of the American Water Resources Association (Proceedings, are at http://www.cwi.colostate.edu/NonstationarityWorkshop/index.shtml).

A November 2010 workshop also hosted by the USACE was the first in a series of activities intended to ultimately develop best practice guidelines to assess the large and varied portfolio of possible approaches for producing and using actionable climate science for water resource adaptation questions. The head of the organizing committee for this workshop was Dr. Jeff Arnold (see http://www.corpsclimate.us/assessingportfolioworkshop.cfm).

The IWR Responses to Climate Change effort continues to work closely with the IPET/HPDC Lessons Learned Implementation Team to develop detailed Civil Works Technical guidance on Procedures to Evaluate Sea Level Change Impacts, Responses, and Adaptation. This new guidance is being led by district staff (with the support of IWR planners, economists, engineers and scientists), and includes members of the USGS, NOAA, FEMA, the Bureau of Reclamation, Federal Highway Administration, the Navy, the U.S. Naval Academy, and others, including two experts from the United Kingdom. The team held a workshop in April 2010 at NOAA's Silver Spring office.

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.

In FY 2010 the study team developed draft reports on (1) a quick assessment of the Eastern coastal regions with preliminary recommendations, and (2) a detailed assessment of the North Atlantic regions. In addition, a report entitled "Dynamic Sustainability: Shoreline Management on Maryland's Atlantic Coast" details the history of Ocean City and Assateague Island, Maryland and examines the ways in which residents and officials have managed the issues inherent to living next to an ocean and how the U.S. Army Corps of Engineers has participated in these management efforts.

USACE Chief Economist: Dr. David Moser of IWR is the USACE Chief Economist and leader of the Economics Community of Practice (CoP). During FY 2010, the Chief Economist also continued to direct Theme 2, Risk-Informed Decision Making Theme of the IPET/HPDC Lessons Learned Implantation Implementation activities. He

also continued involvement in developing tolerable risk guidelines for both dam safety and levee safety policy and procedures 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 database is being transformed to be web accessible to allow individual entry and update by field economists.

As a complementary activity to building capacity, IWR focused on enhancing technical guidelines and economic manuals available to field practitioners. In FY 2010 work proceeded on the update of water resources planning National Economic Development (NED) Manuals.

In FY 2010, the Chief Economist also continued as the National Team Lead for Theme 2 - Risk Informed Decision Making, as part of the IPET/HPDC Lessons Learned Implantation (formerly part of Actions for Change), which transitioned to the Civil Works Campaign Plan Goal 2a. 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 served on the team developing and implementing tolerable risk as part of the transitioning of dam safety to a risk analysis approach. Additionally, he worked as part of a team developing tolerable risk notions to levee safety. In that role, he served on the planning committee for an international workshop entitled "Exploration of Tolerable Risk Guidelines for the USACE Levee Safety Program" held March 17-18, 2010 in Washington, DC. The proceedings of the workshop were published as IWR Report 10-R-8, dated October 2010.

The Chief Economist was also was involved in issues relating to National Economic Development evaluation of navigation and other economic evaluation issues. Additionally, he was co-lead of effort developing improved modeling to estimate regional economic impacts of Corps spending and project operation. This model is currently undergoing model certification review.

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 2010 the Institute collaborated with multiple federal and state agencies to address critical issues. 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.

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's collaborative efforts extend to 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 2010 IWR entered into or laid the groundwork for establishing new MOU's with various federal and non-federal partners.

*Natural Resources Conservation Service Partnership***:** In FY 2010 work continued in support of a 2005 partnership agreement with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). The goal of the partnership is to promote a long-term working relationship to improve the management of water and related natural resources under the missions and authorities of NRCS and USACE. Collaboration continues to focus on four areas: (1) watershed planning and implementation; (2) wetlands creation, restoration and enhancement; (3) natural disaster recovery; and 4) coordination of other programs and activities, including the Wetland Conservation Compliance (the *Swampbuster* provision of the Food Security Act of 1985 and subsequent omnibus farm acts in 1990, 1996, and 2002) and the Regulatory Program (Section 404 of the Clean Water Act).

FY 2010 activities included: regular communications (monthly teleconferences, liaisons, partnership brochure, and website); data sharing (wetland reserve and floodplain easement locations in particular); and two Senior Leader Partnership Coordination Meetings (March and September of 2010). Additionally, NRCS and USACE liaisons made a joint presentation at the USACE Planning Community of Practice Conference in Orlando, Florida in June 2010.

A new initiative in 2010 was the development of a NRCS/USACE Partnership Handbook – A Field Guide to Working Together Toward Shared Goals. The purpose of the handbook is to stimulate and facilitate more on-the-ground active cooperation and collaboration between NRCS and USACE at the field level on water resource issues and problems. With this aim in mind, the document (to be published in 2011) is designed to convey to field staff of both NRCS and USACE basic information about each agency's missions, programs, capabilities, and modes of operation. It suggests which programs and authorities from both agencies might be leveraged toward these shared goals: wetland protection and restoration; flood risk management; wildlife habitat creation; sediment management; natural disaster recovery; and integrated water resources management.

U.S. Institute for Environmental Conflict Resolution (USIECR): In FY 2010 the Institute made active use of its 2008 Memorandum of Understanding (MOU) with USIECR. The USIECR is an independent federal entity that impartially assists in the resolution of federal environmental, natural resources and public land conflicts and controversies through facilitated negotiation, mediation, and collaborative problem solving. The most significant use of the IWR – USIECR MOU in FY 2010 was a detail of IWR's Maria Placht to the USIECR from May through August as part her Presidential Management Fellowship training program. While at USIECR Ms. Placht contributed to the USIECR's support of the Missouri River Recovery Implementation Committee, assisted in the development of federal-tribal government-to-government training curriculum, and was part of the facilitation team for the national NOAA Enforcement Summit held in August 2010 in Washington, D.C.

Other engagements with the USIECR during FY 2010 included IWR staff serving on the Steering Committee for the USICER-led Environmental Conflict Resolution Biennial Conference held in May 2010 in Tucson, Arizona; joint leadership on both the National Coordinating Committee for the Use of Technology in ECR and the National Collaborative Modeling for Decision Support Steering Committee; and joint sponsorship of the Second National Workshop on Computer Aided Dispute Resolution held in October 2009 in Denver, Colorado, the proceedings of which were published as IWR Report 10-R-5 entitled *"Computer Aided Dispute Resolution 2nd Workshop Summary and Strategy Plan"* dated April 2010.

U.S. Geological Survey Partnership: During FY 2010, significant activities associated with the U.S. Geological Survey (USGS) MOA included senior level meetings addressing national stream-gauge issues; climate change and related water management issues; the sharing of water data; coastal, geotechnical and biological research; and regional and international water studies, such as on the Great Lakes. The USGS is working with USACE on the Climate Change and Water Working Group (CCAWWG) with other Federal agencies including the U.S. Bureau of Reclamation, the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), and the National Aeronautics and Space Administration (NASA). The USGS worked closely with USACE to organize an international technical workshop entitled "Workshop on Nonstationarity, Hydrologic Frequency Analysis, and Water Management", held in January 2010 in Boulder, Colorado. The workshop brought together researchers and practitioners from the United States and international institutions. The workshop program included presentations by five Nobel Prize laureates who were lead authors on Intergovernmental Panel on Climate Change reports. International participants from Canada, the United Kingdom, Japan, Poland, Greece and Italy attended the workshop. The proceedings of the workshop are available at the Institute's website.

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: During FY 2010 USACE continued to work closely with the Bureau of Reclamation on the Climate Change and Water Working Group (CCAWWG), which also includes representation from the U.S. Geological Survey, NOAA, FEMA, EPA, and NASA. CCAWWG'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. During FY 2010, the Bureau and USACE worked on a joint report entitled "*Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information*." The report offers joint agency perspectives and identifies user needs to help meet the challenge of climate change for long-term water resources planning. The report will be published in FY 2011.

Oak Ridge National Laboratory Partnership: During FY 2010 IWR continued to implement a 2005 Memorandum of Understanding between the Institute, the Oak Ridge National Laboratory (ORNL) and the Engineer Research and Development Center that focuses on water resources, energy security, and environmental sustainability. FY 2010 activities included IWR support to USACE Headquarters as a panelist in a September 2010 ORNL-led workshop on basin-scale approach to environmentally friendly hydropower development. The workshop was conducted as a follow on to a March 24, 2010 Memorandum of Understanding between the U.S. Department of Energy, the U.S. Department of the Interior (through the Bureau of Reclamation) and the U.S. Army Corps of Engineers to promote the development of hydropower.

Sandia National Laboratory: Following the FY 2009 signing of a Memorandum of Understanding (MoU) with the Sandia National Laboratories, IWR has worked on pursuing opportunities in the application of Collaborative Modeling to integrated water resources management. Highlights of joint FY 2010 activities include the co-sponsorship of the Second National Conference on Computer Aided Dispute Resolution, held in October 2009 in Denver, Colorado, the proceedings of which were published as IWR Report 10-R-5 entitled *"Computer Aided Dispute Resolution 2nd Workshop Summary and Strategy Plan"* dated April 2010; the development of a book on the subject of computer aided dispute resolution, and joint leadership of a national steering committee on collaborative modeling. Planned FY 2011 activities include development of a monograph on the intersection of integrated water resources management and collaborative modeling and co-hosting an international symposium on the subject of integrated water resources management and collaborative modeling. IWR has in the past worked closely with Sandia National Laboratories through the Collaborative Planning and Management program and the National Cooperative Modeling Demonstration program.

National Flood Risk Management Program: In May 2006, in an IWR-led effort, the USACE established the *National Flood Risk Management Program* (NFRMP) 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 by:

- Improving capabilities to collaboratively deliver and sustain flood risk management and mitigation services to the nation,

- Improving public awareness and understanding of flood related hazards and risks, and

- Coordinating flood damage and flood risk reduction programs across Federal agencies and with local, state agencies and other non-Federal entities.

FY 2010 program accomplishments include the following:

- Regional coordination outcomes achieved by the Regional Flood Risk Management Team (RFRMT) in the Upper Mississippi River basin. During FY 2010, the RFRMT conducted quarterly meetings providing the opportunity for coordination across Federal, state and local agencies to make the most of existing Federal programs to assist states and communities in managing flood risks. The team focus is on better integrating pre-flood

mitigation with a long-term strategy to plan and implement pre- and post-flood emergency actions. Through the RFRMT quarterly meetings, member agencies were able to regularly brief the group on developing policy issues and suggested policy improvements, interstate or interregional issues, state mitigation plans and initiatives, updates on relevant activities from external organizations, and any other proposal or initiative that may have relevance to the Regional Team mission. Additionally, the Team Charter provided a process for vetting and acting on specific project proposals, policy reforms or other initiatives recommended by a member organization. The Charter also provided a process for delegating responsibility for responding to requests for information from the Regional Team, and coordinating agency responses to such requests. As a direct result of team coordination efforts, a plan was developed and implemented to elevate or remove USACE lease cabins incurring repetitive losses and claims on the National Flood Insurance Program. The team also developed a white paper providing policy recommendations to FEMA, USACE and NRCS for implementation of resilient features during repair of damaged flood damage reduction projects and recommendations for improvements in policies for improved agency coordination for flood recovery activities.

- Conduct of National Flood Risk Management Program Workshop. USACE District and Division Flood Risk Managers, Silver Jackets team leads and representatives of multiple Federal agencies came together in June 2010 for the annual National Flood Risk Management Program (NFRMP) workshop. The four day program provided an opportunity to brief participants on the accomplishments, status and future goals of the Program, as well as to share the experiences, successes and challenges encountered as part of field level implementation of the NFRMP coordination framework and the Silver Jackets Program. Additionally, the Workshop provided a number of technical training session providing participants access to a variety of flood risk management related information and skills.

- International Flood Risk Management Workshop. The National Flood Risk Management Program hosted an international workshop entitled "International Flood Risk Management Approaches: From Theory to Practice" on November 30 and December 1, 2010 in Washington, DC. Attended by approximately 100 people, representing nearly 20 countries, the workshop provided an opportunity for attendees to share experiences in development and implementation of flood risk management approaches; learn what others have accomplished internationally (including through international river basin commissions); identify the strengths of these achievements; and highlight areas where partnerships can provide mutual advantage.

- Improved national coordination by reconvening the Federal Interagency Floodplain Management Task Force. Starting in November 2009, FEMA and USACE, through the NFRMP, made use of a standing authority provided by the 1968 National Flood Insurance Act to reconvene a Federal Interagency Floodplain Management Task Force (FIFM-TF), with the general intent of updating the Unified National Program for Floodplain Management; coordinating Federal agency policies for flood risk management; and identifying and recommending actions and policies by the Federal government necessary to reduce losses due to flooding and protect the safety of flood plain residents. Since then, representatives from a number of Federal agencies have met periodically, under the guidance of CEQ, to identify the purpose, vision and work plan for the FIFM-TF.

- Supported efforts of the California Levees Roundtable. In FY 2010, the NFRMP participated in the work of the California Levees Roundtable, a collaborative partnership of federal, State, and local agencies formed to address vegetation issues affecting the State-federal levee system in the Central Valley. The Roundtable recognized that vegetation management is only one of many issues that threaten levees and broadened its scope to address many threats to levee integrity. The Roundtable produced a document to present a short-term Framework for flood system improvements that are already underway or will be initiated before a comprehensive plan is ready in 2012. The Framework provides general guidelines for helping the State, in coordination with federal and local entities, to move forward while the comprehensive plan is being developed.

- 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.

- Completion of a two year policy study examining opportunities for improving public involvement in all USACE flood risk management related programs and activities. The study put forth a set of recommendations and framework for accomplishing the opportunities identified.

- 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.

Dam Safety Program: The Risk Management Center supported the USACE Dam Safety program in a number of ways in FY 2010. HQUSACE has been using a draft version of ER 1110-2-1156 to transition USACE to a nationally-led and managed dam safety program. The RMC has been instrumental towards implementing the guiding principles of that regulation. To support this effort the RMC initiated or completed the following activities:

- The RMC stood-up a small programs group to manage the funding priorities and funds used by HQUSACE to manage non-routine dam safety activities. This group successfully supported the execution of $49.1 Million in dam safety studies and $14.9 Million in training, methodology development, and Interim Risk Reduction Measures. In FY 2010, this group also reviewed more than 25 PMP's prepared by various Districts to support dam safety activities.

- The RMC led training efforts for dam safety and risk management throughout FY 2010. In FY 2010, more than 50 USACE staff attended Potential Failure Mode Assessment (PFMA) training and more than 30 USACE staff attended the Best Practices in Dam Safety Risk Analysis training course which is jointly taught between USACE, the Bureau of Reclamation, and the Federal Energy Regulatory Commission (FERC).

- USACE, the Bureau of Reclamation, the Federal Energy Regulatory Commission, the Tennessee Valley Authority (TVA), and the Federal Emergency Management Agency (FEMA) began discussions to unify the various dam safety policies, procedures, and guidelines. The Interagency Committee on Dam Safety Joint Federal Risk Management Workgroup had its first meeting in September 2010. The objectives of this effort are expected to include developing common procedures and methodologies, developing consistent policies, and developing similar methods to communicate risks. The Risk Management Center is leading the efforts on the behalf of HQUSACE in this workgroup.

- The Risk Management Center developed, implemented, and continued various efforts to increase the quality and consistency of dam safety products. The RMC worked with various Agency Technical Review (ATR) teams to support their reviews of dam safety products. The RMC also initiated an effort to augment internal reviews with national experts in dam safety specifically related to risk analysis. Each dam safety Issue Evaluation Study (IES) and Dam Safety Modification Study (DSMS) presented their report findings to a Quality Control and Consistency (QCC) review panel. The first QCC review was held in March 2010. Over the course of FY2010 12 additional reviews were completed. The QCC review was so successful; it was incorporated into the draft dam safety ER 1110-2-1156 as a required step before the Senior Oversight Group (SOG) review. The RMC also supported and participated in 3 SOG meetings in FY 2010.

- The Risk Management Center reviewed more than 50 Interim Risk Reduction Measure Plans (IRRMP) on the behalf of HQUSACE.

- The Risk Management Center supported Districts transitioning from the previous Periodic Inspection (PI) process for dams to the new Periodic Assessment (PA) process. In FY 2010, the Risk Management Center funded the Potential Failure Modes Assessment portion of PA's for more than 20 Districts.

- In FY 2010, the RMC provided at least one dedicated senior technical specialist to each dam safety construction project, projects that were in Planning, Engineering, and Design (PED), and critical Dam Safety Modification Studies. This was part of HQUSACE's overall effort to provide more consistent and recurring guidance and advice for projects moving through the non-routine dam safety processes. This significant activity was instrumental in ensuring safe activities were accomplished at USACE's high risk structures and that cost effective

solutions were planned or implemented. Along with the QCC reviews, this led to more than $1 Billion in cost savings versus originally-planned activities.

- The Risk Management Center funded and directed the activities of the Mapping, Modeling, and Consequence (MMC) production center. More than 30 inundation and consequence studies were completed in FY 2010. The Risk Management Center also chaired the steering committee for the MMC, which sets their priority and manages the strategic direction of the MMC.

- The Risk Management Center led, participated in, or supported more than 15 Issue Evaluation Studies for DSAC I and II dams in FY 2010. The Risk Management Center led, participated in, or supported more than 10 Dam Safety Modification Studies for DSAC I and II dams in FY 2010.

- The Risk Management Center led and participated in various activities as a part of the Dam Safety Policy and Procedures Team. The team was instrumental in developing the new dam safety ER 1110-2-1156 which is nearing completion. The team also helped improve various dam safety procedures, worked with Districts to improve their dam safety scorecard scores, and worked with HQUSACE to implement various risk management activities in FY 2010.

Levee Safety Program: The Risk Management Center supported the USACE Levee Safety program in a number of ways in FY 2010. HQUSACE is currently leading the development of a comprehensive levee safety policy document. The RMC has been heavily involved with the development of that policy. The RMC has also supported the following activities:

- The RMC was part of a team developing tolerable risk notions related to levee safety. Several RMC members participated in an international workshop entitled "Exploration of Tolerable Risk Guidelines for the USACE Levee Safety Program" held March 17-18, 2010 in Washington, DC. The proceedings of the workshop were published as IWR Report 10-R-8, dated October 2010.

- The RMC led the development of the Levee Screening Tool with HQUSACE and the Cold Regions Research and Engineering Laboratory (CRREL). The tool will be used to screen levee systems across the country and help inform a national prioritization of work related to levee safety. The tool is web-based and very user friendly. Users enter basic information about the design and performance. That information is analyzed and the results are compared with the other levee systems across the country.

- The RMC led a training course for 50 USACE employees on the use of the Levee Screening Tool in 2010. This was the first training course as the tool is rolled out to the entire organization.

Asset Management: In FY 2010, the Risk Management Center helped develop methodology to assess risk associated with electrical and mechanical components of USACE infrastructure with the goal of integrating this information into the asset management condition indices. The RMC also participated in a partnering workshop with asset management in June of 2010.

Silver Jackets Program: The *Silver Jackets Program* is a key mechanism for achieving the interagency coordination and collaboration 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. Silver Jackets teams facilitate strategic, life-cycle planning to reduce flood risk and provide assistance in implementing state-identified high-priority actions. At the end of FY 2009 there were six active state teams (Ohio, Indiana, Idaho, Iowa, Illinois, and Missouri) with an additional ten state teams (Minnesota, Wisconsin, North Dakota, Texas, Kansas, New Mexico, Arizona, Pennsylvania, Mississippi, and Georgia) in various stages of development. During FY 2010, all of these states, in

addition to Washington, Virginia, Kentucky, and South Carolina were active, for a total of twenty state-led teams. The Florida state team will become active early in FY 2011, and discussions are continuing with an additional 28 states to develop teams in FY 2011.

As these teams develop and mature, their capacity to manage their flood risk is increasing. Truly managing flood risk requires that both the probability of an event and the consequences of an event are continuously managed. However, the authorities to address both the probability and consequences are spread among many agencies and levels of government. As a result, the responsibility for managing the Nation's flood risks does not lie exclusively with USACE, or any other single Federal or non-Federal entity, but is shared among multiple Federal, State, and local government agencies, as well as with private citizens. All stakeholders have a part in reducing risk to a tolerable level. Currently there is a strong reliance on Federal response and an expectation of increased Federal funding, but Federal resources are strained. Through collaborative partnerships, the state Silver Jackets teams optimize the use of Federal resources, leverage additional state/local/Tribal resources, including talent, data/information and funding; and prevent duplication among agencies. The following case studies illustrate successes of individual state Silver Jackets teams.

Case Study: Louisa County, Iowa, #11 Levee District

Recurring significant flood events and resultant physical damages to levees throughout the Midwest region have increased interest in implementing non-structural alternatives to levee repairs. Public Law 84-99 ("Flood Control and Coastal Emergency Act", P.L. 84-99) provides USACE with the authority and responsibility to either repair flood-damaged levees enrolled in its levee program or to implement non-structural alternatives to those structural repairs. Following the Midwest floods of June 2008, the Iowa Interagency Levee Work Group (now Iowa Flood Risk Management Team [Iowa Silver Jackets]) identified and coordinated a precedent-setting non-structural alternative to full repair of the Louisa County, Iowa, #11 Levee District's levee system. The alternative is a combination of over 300 acres of Natural Resources Conservation Service (NRCS) flood plain easements with significantly reduced structural repairs to protect a state highway. The alternative required the cooperation of the levee's public sponsor, the county and state mitigation agencies, USACE and NRCS to implement. This non-structural alternative consisted of leaving five breaches in the lower end of the levee system open while repairing two breaches in the upper end of the system. The remaining increment of repaired levee will continue to provide flood deflection benefits for a major county road and approximately 400 acres of agricultural lands within the levee district. This alternative provides reconnection of nearly 3,200 acres of previously isolated floodplain with the Iowa River as well as increased flood storage benefits to downstream interests; construction is complete. As a result of collaboration, over 1200 acres of formerly protected area was returned to the floodway, gaining not only improved environmental habit but increased flood storage capacity while continuing to protect an important state road. The NRCS Emergency Watershed Program (EWP) easements were crucial in the sense that protection of those lands no longer provided benefits to support full structural repair. As implemented, the cost to PL 84-99 was estimated to be $187,000 less than the full structural repair.

The Iowa team was encouraged by this success and is currently working to implement another non-structural alternative with the Green Island Levee and Drainage District at the confluence of the Maquoketa and Mississippi Rivers (downstream of the [former] Lake Delhi Dam). USACE is providing assistance to NRCS in the development of a Wetlands Reserve Enhancement Program (WREP) project proposal request to acquire easements on nearly 1,400 acres of cropland previously protected by the Green Island levee.

Case Study: Real Time Flood Inundation Model, Indiana and Mississippi

Resolution of seemingly small issues can lead to greater collaboration. Team members were aware of differences between USACE and Indiana Department of Natural Resources (IDNR) data; differing boundaries used in the models produced elevation differences of up to two feet. The Silver Jackets team facilitated resolution, and within a short time, the data were aligned. Without Silver Jackets, neither agency would have pursued resolution. The state sees this as a valuable service; when all agencies can agree on a single set of data, the state mitigation program benefits.

Success in resolving these differences led to a discussion of current needs, and the team devised a real-time flood inundation model. The National Weather Service projections and hydrology from the Advanced Hydrologic

Prediction Service are combined with real-time gauge data from the USGS. Models create a real-time view of the location and depth of flooding. When overlaid with tax assessment data, construction data, and structural value information for residential and commercial structures, an accurate prediction of potential damage can be calculated, employing the USACE depth-damage curve and HAZUS modeling. Each database/model was written with a different digital structure. Through the Polis Center at the Indiana University Purdue University Indianapolis, a bridge program was written to draw the individual models and programs together under an open architecture format and allow a person to run the program automatically upon demand in real time.

The program, when river levels reach a set trigger point, will run automatically and provide both current inundation information and predictive information for response and mitigation actions. The project allows emergency management personnel and the public to view current and predicted extent and depth of flooding through a Web portal. The near real-time and forecast flood inundation mapping, in addition to being viewable through a Web portal, will be downloadable in the form of GIS files that can be imported into GIS applications such as the Federal Emergency Management Agency's HAZUS-MH hazard mitigation and loss estimation program. The overall cost for the pilot project was $750,000. No one single agency had the funding or the personnel to complete this project alone, yet with the collaboration of skills and funding, the pilot project was created using a minimal investment. The state of Indiana is now planning to utilize recently awarded Housing and Urban Development Community Development Block Grant (CDBG) funds to apply the tool state-wide. The opportunity for major cost savings from damages avoided is tremendous. The effort provides a better predictive capacity, which will assist in zoning and planning, as well as targeting areas for mitigation such as acquisition or elevation.

After talking with the Indiana Silver Jackets team, the Mississippi "Camo" Jackets team has begun a similar effort. While no technical assistance funding is provided by USACE, the project was initiated due to Silver Jackets team collaboration. The Forrest (MS) County Board of Supervisors entered into a joint funding agreement with the U.S. Geological Survey (USGS) to initiate a cooperative program for flood inundation mapping with the Cities of Hattiesburg and Petal and the Forrest County Emergency Management District. Flood inundation maps show the extent of flooding that is expected over a given area. Through assistance of the National Weather Service, this data is provided online and can indicate which community structures are likely to be impacted by floodwaters. Inundation maps also provide local officials additional information needed to better mitigate the impacts of flooding and build more resilient communities. The first phase of a multi-year flood inundation mapping project will include the USGS evaluation of existing flood models on the Leaf River and the initial construction and instrumentation of a new flood-monitoring site on the Bouie River at Glendale Avenue in Hattiesburg, MS. The $26,000 cost will be shared equally by the USGS and Forrest County, with support from the cities of Hattiesburg and Petal. Hazard Mitigation Grant Program funds will be applied to assist with a portion of the local share. Upon completion of the project, both the Leaf and Bouie Rivers will provide real-time river stage data via the internet during flood hazard events, and local residents and emergency managers will have valuable information for hazard mitigation. Future agreements will fund the annual operation and maintenance of the flood-monitoring sites and the completion of the flood inundation maps.

Case Study: North Branch Elkhart River Project, Noble County, Indiana

This project evolved as the many participating agencies discussed a particular community's recurring efforts to resolve their flood risk management challenges. The community had sought studies and assistance from a number of state and federal agencies over many years, but none were coordinated, and little action followed. The Indiana Silver Jackets team brought together the Indiana Department of Natural Resources, the Indiana Department of Environmental Management, the Indiana Department of Homeland Security, USGS, USDA-NRCS and the US Army Corps of Engineers. Individually the agencies had invested several hundred thousand dollars in studies, stream clearing, snagging efforts, and other work in the area. Each agency reviewed available studies and information regarding the area of interest, and the interagency team compiled a single summary document that explained, in layman's terms, the geological and hydrologic conditions, the flood history of the area, and possible approaches to resolve the effects of flooding in the area. The report presented alternatives as well as warnings regarding actions that could exacerbate the situation. The findings were presented to the local steering committee and the community as a whole; public meetings were held to both inform the community and to foster acceptance of the findings. The community has since reported that they are following the first recommendation, the formation of a basin-wide planning team to examine the options not from a neighborhood perspective as had been done in the past, but from a watershed perspective considering all communities as a part of a solution. Although there were no direct

expenses to funding programs, the agencies invested staff time to research and write the report. Differences in the community were set aside, as the community implements a watershed approach to develop a basin-wide strategy based on common interests. Long-term, requests for funding will now focus on a holistic solution rather than individual parts.

Case Study: Leveraging programs: Orange County, Indiana and State-Wide LiDAR Mapping

In Orange County, Indiana, the Lost River flows through a Karst environment, often under the surface. Flooding occurs without warning. The Indiana Silver Jackets team has implemented an interagency approach and found a way to create a flood warning system. By linking a number of newly placed USGS stream gages with a USACE Planning Assistance to States Hydrology and Hydraulics study of the underlying Karst features, the community will receive automatic triggers when the water reaches levels corresponding to previously observed flooding. With the help of a Community Development Block Grant, the community will provide $75,000 for their cost-share and will conduct LiDAR flyovers. (LiDAR is an acronym for Light Detection and Ranging. LiDAR is a remote sensing system used to collect topographic data.). Thus the community will receive the work with minimal investment and the documentation provided will not only benefit this specific project for the community, but also will benefit future mitigation projects and provide future warning for the community of impending floods. Through the Silver Jackets program, the state of Indiana will be able to acquire LiDAR mapping for all 92 counties, leveraging interagency funds to map 12 counties and $13 million in CDBG funds to map 80 counties.

National Ocean Policy: During FY 2010, IWR staff continued the work that began in 2009 to coordinate USACE participation in the working groups supporting the ASA(CW) and HQUSACE participation on the Interagency Ocean Policy Task Force. President Obama signed Executive Order 13547 establishing a *National Policy for the Stewardship of the Oceans, Our Coasts and the Great Lakes* on July 19, 2010. That Executive Order adopts the final recommendations of the Interagency Ocean Policy Task Force and creates a National Ocean Council (NOC) to strengthen ocean governance and coordination. The final recommendations prioritize actions for the NOC to pursue and call for a flexible framework for coastal and marine spatial planning to address conservation, economic activity, user conflict, and sustainable use of the ocean, our coasts and the Great Lakes.

IWR staff is working to include or represent the breadth of Civil Works interests and contributions in initial efforts to facilitate coastal and marine spatial planning, which has the potential to provide a comprehensive, integrated approach to planning and managing uses and activities over the long term. IWR participants engaged other USACE staff at ERDC, HQUSACE, the Planning Centers of Expertise, and in District offices, depending on the issues raised to the subcommittees. Opportunities for collaborating with the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) on mapping and data related issues have been identified through this participation. Under the National Policy, coastal and marine spatial planning would be regional in scope, developed cooperatively among Federal, state, tribal and local authorities and include substantial stakeholder, scientific and public input. IWR represents Army Civil Works on the Ocean Resource Management Interagency Policy Committee (ORM-IPC) and the Ocean Science and Technology Interagency Policy Committee (OST-IPC). Major activity has been to update the Ocean Research Priorities Plan.

National Ocean Service Partnership: In FY 2010 close collaboration continued in support of an existing partnership agreement with the National Oceanic and Atmospheric Administration's National Ocean Service (NOS) most recently signed on May 19, 2008. This partnership recognizes the importance of leveraging each agency's programs and expertise through joint centers for coastal mapping, instrument testing, evaluation and training; improving and integrating ocean observing systems; coordinating vertical datum systems and improving tidal measurement and information; and improving natural hazard risk communication that incorporates consideration of community resilience. There have been mutually beneficial advances and synergies through this collaboration in FY 2010 as it focused on collaboration on addressing water quality challenges, formed a scientific working group (including US Geological Survey) on adopting NOAA Datums Standards, collaborated on an effort to focus on understanding climate change and variability in the Pacific and determined how best to apply the knowledge to coastal engineering planning and design. This partnership further expanded as a result of the creation of the National Ocean Council and its focus on strategy development to implement the nine national ocean priority objectives.

Regional Sediment Management: The USACE has adopted the Regional Sediment Management (RSM) approach in carrying out its programs and activities involving or affecting sediment. The RSM approach uses principles of

integrated water resources management, as well as the Civil Works watershed perspective. Sediment management spans the USACE Navigation, Flood and Coastal Storm Damage Reduction (Flood Risk Management), and Ecosystem Restoration missions and responsibilities. The USACE applies this perspective and approach as a major stakeholder and collaborative partner in many of the Nation's inland and coastal watersheds.

In FY 2010, IWR staff continued working with the District office personnel, the Engineer Research and Development Center (ERDC) staff, and USACE Headquarters staff on integration of the RSM approach through initiatives that both involve and affect Civil Works water resource projects and activities. IWR staff made presentations at conferences sponsored by the Western Dredging Association (WEDA), USACE Planning Community of Practice, and Partnership for the Delaware Estuary, to both inform participants about applications and evolving policy, as well as to gain additional perspectives on integration of this approach to different problem-solving and management applications. These and other opportunities for sharing experiences and assisting with application issues are helping to build capacity for RSM application at different scopes, scales and institutional situations.

Experiences with RSM applications were used to develop information for the National Shoreline Management Study regarding system approaches to sediment management. This information defined a systems approach to sand and sediment management, and provided information to inform the development of preliminary recommendations regarding systems approaches to sand management. This systems approach considers sediment system dynamics, projects and activities in a region, and the institutions associated with sediment in the region, as integrated components that vary by region. Examples of different applications of the system approach through RSM experiences in situations of different scopes and scales were also provided.

IWR staff also continued to support development of a technical framework for the Gulf Region Sediment Management Master Plan in support of the Gulf of Mexico Alliance. Staff helped to ensure that new Gulf region forums such as the Council on Environmental Quality Workgroup on Louisiana and Mississippi Coastal Ecosystem Restoration, and the new Gulf of Mexico Ecosystem Restoration Task Force, were aware of this initiative and related information. The Gulf of Mexico Restoration Task Force was established by Executive Order 13554, partially in response to the Deepwater Horizon spill. Its objective is to assist the Gulf coast communities in efforts to conserve and restore resilient and healthy Gulf ecosystems that support the diverse economies, communities and cultures in the region.

IWR staff continued support to ERDC and the Philadelphia District as part of the Delaware Estuary RSM Plan project. Covering an area that is home to 6.4 million people, the Delaware Estuary is the second largest estuary in the United States. With the participation of more than 20 resource agencies and environmental organizations, the development of the RSM Plan uses a system-based approach and incorporates the various competing demands for sediment resources, such as wetlands protection, coastal development, fisheries management, and port management.

Interagency Committee on the Marine Transportation System: USACE 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 Chief of Engineers 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 the Commandant of the Coast Guard in 2009. It rotated back to the Corps in 2010. 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 from 2008 through 2010. This effort included a main report and six supporting volumes on the challenges facing the MTS. The draft documents were completed in 2010. On July 19, 2010, President Obama signed an Executive Order establishing a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes. That Executive Order adopts the *Final Recommendations of the Interagency Ocean Policy Task Force* report, including nine national priority objectives and seven goals for coastal and marine spatial planning. The CMTS is specifically referenced in the Ocean Policy Task Force Report to coordinate with the National Ocean Council, albeit through the National Economic Council, a mechanism yet to be fully established. As such, the decision was made to re-direct the current MTS Assessment Integrated Action Team work toward the development of the proposed CMTS Ocean Policy

response. The Assessment IAT has collected extensive background information that will be utilized in the proposed CMTS Ocean Policy response.

Coastal Engineering Research Board: The Coastal Engineering Research Board (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 FY 2010 IWR supported the Director of Civil Works in organizing the November 2009 Executive Session of the Board in Washington, DC, whose purpose was to review a number of ongoing Board areas of interest including examining data needs to support systems models and decision making within a holistic systems approach to coastal protection and management and the June 2010 meeting of the Board in Jersey City, New Jersey, whose theme was "Climate Change and US Army Corps of Engineers (USACE) Mission Considerations" so as to explore and provide recommendations regarding the implications of projected climate change scenarios to USACE missions, assets, and responsibilities in the coastal and estuarine system.

Environmental Advisory Board: IWR has led the USACE technical team supporting the Chief of Engineers' Environmental Advisory Board (EAB) since FY 2004. In FY 2010, the EAB continued to explore field level outreach and internal implementation of the Corps *Environmental Operating Principles* (EOP). The Board held one public meeting in FY 2010 — 22 January 2010 in Mobile, Alabama — which provided the Board the opportunity to meet with Mobile District staff to discuss how the district has implemented the EOP's and how it has been able to utilize Research and Development products produced by the USACE laboratories. During the year, the Chief of Engineers has requested the Board's input on the Principles and Standards (P&S) and Principles and Guidelines (P&G). In response the Board provided comments by letter to the Council on Environmental Quality on their draft of the P&S. In addition, the Board provided requested comments to the Chief on short- and long-term environmental implications of the Deepwater Horizon Incident.

Inland Waterways Users Board: The Inland Waterways Users Board (IWUB) was established by Section 302 of the Water Resources Development Act of 1986 (P.L. 99-662) and pursuant to the Board's charter, approved by the Secretary of the Army on March 3, 1987. The principal responsibility of the Board is to recommend to the Congress, the Secretary of the Army, and the U.S. Army Corps of Engineers the prioritization of new and replacement navigation construction and major rehabilitation projects. The Board is a Federal advisory committee and as such subject to the requirements of the Federal Advisory Committee Act (P.L. 92-463, as amended).

During FY 2010, IWR continued its technical and administrative support of the Board, including the analysis of and reporting on the financial status and capability of the Inland Waterway Trust Fund, assisting in the preparation of the IWUB Annual Report to the Secretary of the Army and the Congress , evaluating potential candidates nominated for Board membership, and administration of two IWUB meetings including No. 62 on December 15, 2009 in New Orleans, LA and No. 63 on April 13, 2010 in Springfield, VA.

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 2010, 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.

The Institute is the home of the Corps Conflict Resolution and Public Participation Center. Designated as a Center of Expertise and Directory of Expertise in October 2008, the mission of the Center is to help Corps staff anticipate, prevent, and manage water conflicts, ensuring that the interests of the public are addressed in Corps decision making.

During FY 2010 the Center provided technical assistance to Districts and Divisions on collaborative processes, completed a baseline assessment of USACE collaborative capacity, released several reports on environmental conflict resolution and collaborative processes, and launched a Public Participation and Risk Communication Community of Practice (CoP).

By focusing on its five goals of consultation services, capacity building, information exchange, policy support, and research, the Center of Expertise contributes to both Goal 2 and 4 of the USACE Campaign Plan. The Center works

to “Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders” (Goal 2) and “Communicate strategically and transparently” (Objective 4b).

Highlights of FY 2010 activities include the following:

Consultation Services

- The Center supported USACE Headquarters Project Management and Planning senior leaders in developing and facilitating a Continuing Authorities Program Summit for approximately 60 Corps personnel from across the Corps;

- The Center designed and facilitated a two-day inter-agency technical working group meeting with USACE leadership for the Devils Lake Inter-Agency Initiative, which led to a draft report for Office of Management and Budget.

Capacity Building

- The Center conducted workshops for the Collaborative Capacity Assessment Initiative at five Division offices and Headquarters;

- In July 2010, members of the staff of the Center conducted a week long Shared Vision Planning workshop with stakeholders and the National Water Authority in the Chili River Basin, Arequipa Peru;

- In May 2010, the Center published a report entitled “*How to Conduct a Shared Vision Planning Process*” as IWR Publication 10-R-6.

Information Exchange

- The Center developed a Risk Communication and Public Participation (RCPP) Community of Practice SharePoint Site with over 230 members, including a network of USACE facilitators from across Corps divisions and business lines;

- The Center hosted a webinar series, including “Environmental Conflict Resolution in USACE”, “The Services and Strategic Plan of CPC”, and the “Risk Communication and Public Participation CoP”;

- The Center organized and led a presentation track on collaborative tools and processes, including Shared Vision Planning case studies, lessons learned, evaluation tools, and best practices at the World Environmental and Water Resources Congress 2010, sponsored by the Environmental and Water Resources Institute of the American Society of Civil Engineers in Providence, Rhode Island in May 2010.

Policy Support

- The staff of the Center compiled and published the *4th Annual Report on Environmental Conflict Resolution* for the Council on Environmental Quality, on behalf of the Office of the Assistant Secretary of the Army for Civil Works;

- The staff of the Center developed and improved a framework and methodologies to encourage public involvement in selecting the appropriate flood risk management plan, documented in the draft report “*Public Involvement Framework and Implementation Plan for Flood Risk Management*” for the Interagency Performance Evaluation Task Force Hurricane Protection Decision Chronology Implementation Team.

Research

- The Center convened a panel of experts from the Corps, academia, and other agencies to identify the challenges associated with communicating flood risk throughout the disaster cycle, and discussed principles and approaches for addressing these challenges within the context of the National Flood Risk Management Program;

- Members of the staff of the Center participated on the National Technology and Environmental Conflict Resolution coordinating committee to identify best practices and create an awards program for the use of technology in environmental conflict resolution processes;

- The Center published two reports on Shared Vision Planning entitled "*Analysis of Process Issues in Shared Vision Planning Cases*" (IWR Publication 2009-R-05, dated September 2009) and "*Performance Measures to Assess the Benefits of Shared Vision Planning and Other Collaborative Modeling Processes*" (IWR Publication 2009-R-07, dated November 2009).

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. The next USACE-TNC Partnership Conference is scheduled for the Fall of 2011 and will mark more than a decade of collaboration since the signing of a national memorandum of understanding between the two organizations in December 2000. An HEC Senior Hydraulic Engineer, is the Corps Technical Liaison with TNC on the SRP program. In that capacity he continues to foster the program by working with representatives from the Corps and TNC on technical and modeling issues.

Academic and Professional Practice Partnerships

Universities

In FY 2010 the Institute continued its efforts to expand its partnership with academic institutions and professional practice organizations. During 2010 the Institute signed Memoranda of Understanding (MoU) with two new partners, Florida International University (MoU signed January 12, 2010) and the National Institutes for Water Resources (MoU signed October 17, 2009).

Florida International University (FIU) is the lead institution of the Global Water for Sustainability (GLOWS) program, a consortium of U.S. and international organizations with extensive experience and expertise in integrated water resources management, financed by the United States Agency for International Development (USAID). FIU is also the home of the NASA sponsored WaterSCAPES University Research Center. WaterSCAPES (Science of Coupled Aquatic Processes in Ecosystems from Space) focuses on an integrated set of research and education activities centered on the interaction between the hydrologic cycle and vegetation dynamics at the scale of ecosystems, analyzing the spatial and temporal changes on this interaction and determining the influence of these changes on water cycling, vegetation structure, biomass dynamics and biodiversity. Collaboration between the Institute and FIU will focus on pursuing opportunities in the field of integrated water resources management, scientific research and capacity building for developing countries and countries in transition.

The National Institutes for Water Resources (NIWR) is a 501(c)4 organization that represents the 54 state and territorial Water Research Institutes and Centers in their collective activities to (1) advance competent research that addresses water problems or expands the understanding of water and water-related phenomena; (2) aids the entry of new research scientists into the water resources field; (3) helps train future water scientists and engineers; (4) infuses the results of sponsored research to water managers and the public; and (5) focuses on applied research, including

practical applications to improve water supply reliability and helps resolve water issues, working under the general guidance of the Secretary of the Interior, through the U.S. Geological Survey (USGS). NIWR networks these various Institutes into a coordinated unit, and facilitates, as appropriate, the response of the Water Research Institutes and its membership to other mutual concerns and interests in water. The Institute and the NIWR will use their best efforts to establish a long-term cooperation and partnership in the development and practice of integrated water resources management through scientific research and joint activities or programs that support National, regional, and local water resources needs.

The Institute has previously entered into Memoranda of Understanding with the following educational institutions. Each of the institutions has unique program features that compliment the strengths and talent of the Institute.

Colorado State University, Civil and Environmental Engineering Department/International School for Water Resources (MoU signed January 7, 2008). 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 change and its impacts on water resources, and methods for understanding and managing extreme hydrological events and related natural hazards and disaster preparedness.

The University of Arizona (MoU signed September 7, 2007) 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 (MoU signed September 14, 2007) Institute for the Study of Earth, Oceans, and Space, Water Systems Analysis Group, focuses on the understanding of water resources issues on a global scale and the application of technological improvements in water resource management, allowing for 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 (MoU signed September 20, 2007) Institute for Water and Watersheds, focuses on integrated water resource management, sustainable development, ecological design, ecosystem restoration, and environmental conflict resolution, allowing 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 2010 the Institute continued to explore cooperative opportunities with its various Professional Practice Organizations with whom it has entered into Memoranda of Understanding, including the Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers (ASCE) (MoU signed August 4, 2007), the American Water Resources Association (AWRA) (MoU signed December 20, 2007), and the Global Water Partnership (GWP) (MoU signed October 9, 2007).

The Institute and these organizations have a common interest in integrated water resources management, environmentally sustainable development, engineering and scientific excellence, water resources education, technology transfer and capacity building. MoU's with these organizations will further the Institute's and their efforts towards developing procedures and methods for integrated water resources management in support of sustainable development, adaptation to global climate change and its impact on water resources, energy and water sustainability, ecosystem markets development, development of new concepts and practices in the area of critical infrastructure sustainability and recapitalization, and establishing a long term basis for cooperative efforts in 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, training, and technology transfer.

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 2010 marked the ninth 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 — Professor Arthur Maass of Harvard University, and Professor Gilbert White of the University of Colorado.

Dr. Kenneth Strzepek, Professor of Civil, Environmental, and Architectural Engineering at the University of Colorado at Boulder, joined the Institute in 2009 as the Maass- White Visiting Scholar for 2009-2010. Dr. Strzepek brings valuable expertise in the field of climate change adaptation to the Institute's work in the field of climate change and adaptation of water resources management. Dr. Strzepek's previous experience with the World Bank will make him a valuable participant in the Corps' efforts to develop technically sound, practical plans and procedures for water adaptation to climate change.

FY 2010 marked the second year of the Frederick J. Clarke Visiting Scholar program, named in honor of Lieutenant General Frederick J. Clarke, Chief of Engineers from 1969-1973. Lieutenant General Clarke was instrumental in securing expert, independent advice on environmental issues facing the Corps by founding the Environmental Advisory Board. The Frederick J. Clarke Visiting Scholar program provides scholars the opportunity to advise the Corps on important policy issues related to the Corps environmental mission.

Dr. Martin Doyle, Associate Professor in the Department of Geography at the University of North Carolina at Chapel Hill, has been selected at the inaugural Frederick J. Clarke Visiting Scholar for 2009-2010. While at IWR, Dr. Doyle focused his research on the determination of the optimal scale for geographic service areas in compensatory mitigation; infrastructure decommissioning; and the evolving political economy of rivers.

The 2010-2011 Frederick J. Clarke Visiting Scholar is Dr. G. Mathias (Matt) Kondolf, Professor of Landscape Architecture and Geography at the University of California, Berkeley. While at IWR, Dr. Kondolf will focus his research on the technical and policy advancements of regional sediment management.

FY 2010 was the seventh year for two other designated visiting scholar positions: the Universities Council on Water Resources fellowship, a program established in partnership with the Universities Council on Water Resources (UCOWR), and the Leo R. Beard Visiting Scholar program at the Hydrologic Engineering Center, named in honor of the founding director of HEC. Mr. Beard had strong ties to scholars in the profession. As part of the part of the program, hydrologic and hydraulic professionals are invited to HEC to address critical issues or problems HEC and others within the Corps have encountered. Faculty from a number of universities, engineers from other agencies and members of the private sector have participated in the program. The experience and the exchange of ideas between HEC and the Visiting Scholars have proven to be intellectually satisfying and productive for both HEC and the visitors themselves.

During FY 2010, Dr. Eric Larsen from the University of California at Davis participated in the program. Among other things, Dr. Larsen performed a comparison of a number of pieces of software that could be used to study ecosystem responses to changing flow regimes. His research culminated in a report entitled "*Review Summary of Selected Software Packages for Ecosystem Habitat and Attribute Modeling*". HEC and others within the Corps will be able to use this report to help them decide which piece of software they should use to evaluate proposed ecosystem projects. Dr. Larsen also worked with the staff of the Center on sediment transport issues. In FY 2011, HEC expects to work with another Visiting Scholar who will investigate how to generate rainfall records from data available from satellite imagery.

FY 2010 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 visiting scholars and post-doctoral fellows programs.

During FY 2010 Dr. Guillermo Mendoza, a recipient of a Ph.D. in Bioresource Engineering from Cornell University in 2002, continued at the Institute as a National Research Council Research Associate after joining the Institute in 2009. Dr. Mendoza will support the work of the International Center for Integrated Water Resource Management (ICIWaRM) and the Center of Expertise on Conflict Resolution and Public Participation.

During FY 2010, Dr. Aleix Serrat-Capdevila, Research Assistant Professor at the Department of Hydrology and Water Resources, University of Arizona, joined the Institute as a NRC Research Associate for the period 2010-2011. Dr. Serrat-Capdevila will support the work of the International Center for Integrated Water Resource Management (ICIWaRM) and the Center of Expertise on Conflict Resolution and Public Participation.

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 Haimes, University of Virginia (2007-2008).
- UCOWR Fellow: Dr. Bruce Hooper, Southern Illinois University (2004-2005); Dr. Paul Kirshen, Tufts University (2007–2009).
- Leo R. Beard Visiting Scholar: Mr. William A. Thomas, founder and president of Mobile Boundary Hydraulics (2004-2005); Dr. Jery Stedinger, Cornell University (2005-2006); Dr. David W. Watkins, Jr., Michigan Technological University (2008).
- IWR NRC Research Associate: Dr. Peter Rogers, Colorado State University (2006-2007), Dr. Jason Giovannettone, Duke University (2006-2007, at HEC); Dr. Stacy Langsdale, University of British Columbia (2007-2009); Dr. Michael Deegan, University of Albany (2008-2009).
- AAAS Fellow: Dr. Alexey Voinov, University of Vermont, (2006-2007).

In September 2010, Dr. Peter Rogers, former Maass-White Visiting Scholar at the Institute and current Gordon McKay Professor of Environmental Engineering and Professor of City and Regional Planning at Harvard University co-authored with Ms. Susan Leal a book entitled *"Running Out Of Water: The Looming Crisis and Solutions to Conserve Out Most Precious Resource*." The book describes the scope of water supply issues facing the water as well as strategies for averting a water shortage crisis.

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: In compliance with HQUSACE guidance EC 1105-2-407, "Planning Models Improvement Program: Model Certification", IWR has established a model certification program and is actively pursuing the certification of existing and new models. In FY 2009, 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 2009, 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. Documentation for the review and certification of HEC-EFM (Ecosystems Function Model) was submitted to the Ecosystem Restoration Planning Center of Expertise and is awaiting review. HarborSym, a simulation model for the evaluation of widening of navigation channels, is currently under review for certification.

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

Navigation Economic Technologies Research Program: 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 of the Corps by developing state-of-the-art, credible, independently verified economic models, tools and techniques used by USACE 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.

The NETS program developed tools and techniques in the following areas of investigation:

- 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 district offices. Model certification has begun on the HarborSym channel widening model. The NETS team extended 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 completed a survey to estimate the shape of the shipper response curves on the Ohio River. The NETS team worked 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 developed techniques to evaluate and forecast container freight traffic.
- NETS researchers conducted event studies of the unplanned closure of lock structures at McAlpine Lock, Greenup Lock, Lock 27 on the Upper Mississippi River, and locks on the Upper Mississippi River in association with flood events in June 2008.

The NETS research program was concluded in FY 2009. The NETS web site www.nets.iwr.usace.army.mil is 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. A new metric for measuring the benefits from ecosystem restoration projects (the Biodiversity Security Index or BSI) was refined and published as ERDC Technical Report ERDC/EL TR-10-12 "*A New Nonmonetary Metric for Indicating Environmental Benefits from Ecosystem Restoration Projects of the U.S. Army Corps of Engineers*" dated July 2010. Another technical report on nonmonetary measurement of environmental benefits was nearing publication at the end of the year. An ERDC technical note on the BSI has been peer reviewed and submitted for final publication editing. A third ERDC technical report comparing the new metric with other metrics and a journal article on the new metric are in peer review. New research on the BSI was conducted in a case study comparison of it with a metric now used to set funding priorities for feasibility studies in the ecosystem restoration program. A draft ERDC technical report was submitted for peer review. Two USACE reports are in final review on sustainability concepts and principles are in final preparation for publication. An IWR report presenting a framework for achieving environmental sustainability by USACE was in final preparation for publication in September of 2009. Four papers on these topics were presented at national conferences.

IWR Planning Suite: In FY 2010 the Planning Suite was updated to include a module to annualize costs and benefits in accordance with Corps policy and guidance (Version 2.0.6.0) and was certified by HQUSACE in compliance with the requirements of the Planning Model Improvement Program (PMIP) guidance. 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. This model is a water resources investment decision support tool that performs computations associated with cost-effectiveness and incremental cost analyses used during the formulation and evaluation of planning

alternatives that involve monetary and non-monetary costs and benefits. Originally designed to assist with the development and comparison of alternative plans for ecosystem restoration and watershed planning studies, the program is a standard piece of software applied during integrated water resources planning activities to assist with identification of cost-efficient plans and sound financial investments. In addition to automating computations, the software facilitates synthesis of required standard charts and tables. Cost-effectiveness and Incremental Cost Analysis along with a software demonstration was provided at two PROSPECT training courses. The "Multi-Criteria Decision Analysis" module remains to be completed along with an updated users manual. A functional version is pending certification and associated funding. A preliminary version of an uncertainty module was developed to assist with decision-making. The functional alpha/beta test version of the uncertainty module provides users with opportunities to assign probability distributions to monetary and non-monetary costs and benefits, or individual variables comprising either, and implements Monte-Carlo analysis to yield risk-informed cost-effectiveness and incremental cost analysis (to identify which alternatives are most likely to be cost effective over the widest range of anticipated conditions and/or identified variability or uncertainties in costs and benefits). Further development and completion of the module is pending availability of funding.

Watershed Investment Decision Tool: The Watershed Based Investment Decision Tool (WIDT) is a web-based utility being developed by the U.S. Army Corps of Engineers to facilitate geospatial analyses and decision support nationwide and across all the Corps Civil Works business lines (ecosystem restoration, flood risk management and coastal storm damage reduction, hydropower, navigation, regulatory, recreation management, and emergency management). The WIDT links users with information residing in databases within and outside the Corps, and provides users with techniques for visually illustrating and summarizing multiple types of data important to Corps decision-makers at multiple reporting scales (National, District, Division, Basin). The Corps is partnering with the U.S. Forest Service and the University of Redlands (California) to integrate the strengths of Ecosystem Management Decision Support (EMDS) software to enable landscape-scale evaluations of potential actions based on management priorities. IWR is also working to improve the WIDT by incorporation of a Web based program that supports multi-factor analysis of large geospatial data sets at very fast processing speeds to improve performance. The WIDT will facilitate and expedite efforts to deliver knowledge-based decision support, ecological analyses, and assessments of asset/resource-stressor relationships at any geographic scale, under alternative future conditions and under alternative climate change scenarios.

IWR is spearheading a pilot application of the Watershed Investment Decision Tool (WIDT) in the Willamette Watershed for spillway gate overhaul that incorporates decision logic of the district into a model that sets a priority for gate overhaul based on downstream environmental consequences and gate condition. Selection criteria that are being incorporated into the WIDT include options to minimize loss of benefits during specific reservoir level restrictions, requirements of cost sharing agreements, engineering performance and reliability, and linkages to existing watershed plans including established Biological Opinions on identified endangered species. Currently, the WIDT team is working with the Portland District office to apply updated decision weights and business rules in a second iteration of the model. This partnership is critical in developing a robust and realistic logic engine into the WIDT to support this complex decision making process and provide valuable and accurate output. The application of this geospatial data analysis, decision-support technology through a real world District application illustrates its support across Campaign Plan Goal 2.

IWR Regulatory Support: IWR supports the Regulatory Sub-CoP through policy analysis and training. In FY 2010, IWR continued its support for the USACE headquarters implementation of the 2008 Mitigation Rule ("Compensatory Mitigation for Losses of Aquatic Resources: Final Rule, *Federal Register*, April 10, 2008, p. 19594). IWR drafted support documents for the rule, specifically a Financial Assurances Technical Document and a Real Estate/Site Protection Handbook, as well as continuing to conduct the Corps Regulatory Mitigation Workshops focusing on rule implementation. IWR continued its major role in teaching the interagency course entitled "Mitigation Banking Interagency Review Team Training" at the National Conservation Training Center in Shepherdstown, WV in June 2010.

IWR also continued its long-standing support to USACE headquarters in managing the Regulatory Branch Chief's Meeting and the Regulatory Executive Seminar, as well as the Leadership Development Seminar held in July 2010.

IWR oversaw the management and maintenance of the Corps regulatory database — ORM 2.0 — the second version of the OMBIL (Operations and Maintenance Business Information Link) Regulatory Module. In addition,

IWR continued to actively manage the Regional Internet Bank Information Transfer System (RIBITS), a compensatory mitigation bank data program, including providing training and district support. Important information regarding mitigation banks from a majority of USACE District offices is now available on-line in RIBITS.

During FY 2010, IWR, in coordination with ERDC, provided support for technical and scientific initiatives such as the publication of regional supplements to the 1987 Corps Wetlands Delineation Manual, a draft National Wetlands Plant List and a cumulative impacts analysis prototype using GIS data for the Appalachia region associated with surface mining activities.

Water supply permitting, including water supply and demand evaluations, continues to be of national importance. IWR has worked with District offices to identify local and national strategies and directed a private sector firm to prepare a report on how non-Federal agencies evaluate water supply and demand.

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 2010 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; updated world trade and commodity flow forecasts through 2028; distribution of updated materials and statistics from various maritime industry data subscriptions; renewal of new multi-year contracts for transportation, trade and economic forecasts from Informa Economics, Inc. and IHS Global Insight, and continued work on the development of cruise ship, Great Lakes and oceangoing barge vessel operating costs, and a containership trade model. The Global Insight service also includes updated barge and rail transportation modal cost models. Proposed future work if funding is available includes customization of Global Insight's "Trade Navigator" software to provide disaggregation of trade forecasts down to the individual port level.

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 2010, IWR initiated an expert elicitation to revise nonresidential damage functions with improved uncertainty data. Analysis was done for residential clean up costs, in preparation for an Economic Guidance Memorandum to include both residential and nonresidential cleanup cost. Work was initiated on the redesign of IWR-GeoFIT (Geospatial Floodplain Inventory Tool). The basic elements of a structure valuation and depreciation procedures have been completed. Basic elements of the software design have been identified.

System-Wide Water Resources Research (SWWRP): The System-Wide Water Resources Research (SWWRP) program is a joint effort between IWR, led by HEC, and ERDC, focusing 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), and HEC-WAT (Watershed Analysis Tool).

In addition to the HEC-developed software modeling applications, collaborative efforts are also underway between HEC and ERDC. One example is the integration of HEC-ResSim and the ERDC software CE-Qual-W2. A second example is the integration of HEC-RAS and ERDC's Adaptive Hydraulics software, ADH. (ADH is an adaptive hydraulics modeling system developed by ERDC's Coastal and Hydraulics laboratory capable of handling both saturated and unsaturated groundwater, overland flow, three-dimensional Navier-Stokes flow, and two- or three-dimensional shallow water problems.)

Also, the Nutrient Sub-Model, NSM, and a sediment library are being developed at ERDC's Environmental Laboratory. Both of these are being integrated with HEC-HMS and HEC-RAS models. Another collaborative effort between HEC and ERDC was the building of a Gridded Surface/Subsurface Hydrologic Analysis (GSSHA) model plug-in that is available in the HEC-WAT software. Details on these products are available on the HEC website http://www.hec.usace.army.mil/. The SWWRP program will conclude at the end of FY 2011.

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. HEC is the lead office within IWR with regards to the FCSDR Program. The FCSDR program supports the development of methods and tools to improve the analysis and modeling of flood damage and flood damage reduction techniques, including risk and uncertainty. Funds from FCSDR support the development of HEC-WAT (Watershed Analysis Tool), HEC-ResSIM (Reservoir Simulation Model), HEC-SSP (Statistical Software Package), FRM (Flood Risk Management) compute option within HEC-WAT, HEC-FDA (Flood Damage Analysis), and HEC-FIA (Flood Impact Analysis). Details on all of these products are available on the HEC website http://www.hec.usace.army.mil/.

- *IWR-HEC H&H and Risk and Uncertainty*: Funds from the FCSDR program support the development of the FRM (Flood Risk Management) compute option within HEC-WAT software. FRM is the next generation of the Hydrologic Engineering Center's Flood Damage Analysis (HEC-FDA) model. It is being constructed to include 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 will accommodate many, if not all, of the recommendations that the Corps concurred with from the National Research Council report "*Risk Analysis and Uncertainty in Flood Damage Reduction Studies"* (published by the National Academy Press in 2000) on the Corps' implementation of risk analysis for flood damage reduction and it will also aid in implementing the Chief of Engineers' Actions for Change initiative. The initial application of the FRM compute option will be on the Columbia River System as part of the Columbia River Treaty (CRT) study.

HEC is also working on modifications to various engineering guidance documents via the Guidance Update Management Program (GUMP) program. Among others these documents included Engineer Manual (EM) 1110-2-1413 "*Engineering and Design – Hydrologic Analysis of Interior Areas*", EM 1110-2-4000 "*Engineering and Design - Sedimentation Investigations of Rivers and Reservoirs*", Engineer Regulation (ER) 1110-2-1400 "*Reservoir/Water Control Centers*", Engineer Technical Letter (ETL) 1110-2- 299, "*Overtopping of Flood Control Levees and Floodwalls*", ER 1110-2-240 "*Engineering and Design - Water Control Management*", and ER 1110-2-241 "*Engineering and Design - Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects*" to include materials generated from research actions.

Ecosystem Management and Restoration Research Program (EMRRP): The Ecosystem Management and Restoration Research Program (EMRRP) is the Corps' tactical research and development response to the demand for new and expanding technologies to address the need for ecosystem assessment, restoration, and management activities at the project level. Technologies developed under the EMRRP build upon a sound understanding of ecosystem functions, which lead to sustainable stewardship of Corps resources. The EMMRP provides funds for the development of the HEC-EFM (Ecosystems Function Model) software. HEC-EFM is designed to help study teams determine ecosystem responses to changes in the flow regime of a river or connected wetlands. Using HEC-EFM, study teams are be able 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. Details on HEC-EFM are available on the HEC website http://www.hec.usace.army.mil/.

Planning Methodologies:

National Economic Development Manuals: IWR is continuing to update 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 to a diverse audience. In FY 2009 the Economics Primer and the Overview NED Manual were completed. Additionally, the NED manuals website (www.CorpsNEDManuals.us) has been expanded to include a web-version of the 2010 Deep Draft Navigation Manual. The Coastal Storm Risk Management Manual was sent for final review. Additionally, preliminary updates to the 2008 Flood Risk Management Manual were under development and are scheduled to be completed by Fiscal Year 2011 pending funding.

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 referenced 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 has revised the Policy Digest to bring the reference up to date. The updated Policy Digest has been internally reviewed and will be released as a web-based publication with hyperlinks to original policy sources in 2011.

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 has also been revised 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*" (published in August 2006) and a research report entitled "*Theoretical Underpinnings of the OSE Account*" (published in March 2007). The OSE Handbook, whose official title is "*Handbook on Applying 'Other Social Effects' Factors in Corps of Engineers Water Resources Planning*" was published in December 2009 as IWR Report 09-R-4 and is available on the IWR web site. An OSE training module has been completed and is being beta tested in selected Prospect training courses. A class exercise to accompany the training module is in development. An OSE questionnaire for OMB approval is also in development.

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 2009 and formally approved by IWR's Editorial Review Board in September 2010. It will be published in FY 2011.

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. HQUSACE and IWR recently made the decision to integrate this manual with a Plan Formulation Manual, which is expected to be completed during FY 2011.

NexGen Software: HEC continued to enhance many software products and introduce new products. Released in FY 2010 were:

- **HEC-HMS, Hydrologic Modeling System, Version 3.5**. New simulation features were added to the HEC- HMS Version 3.5 software. A generalized canopy module was added to the subbasin element for simulating the interception of precipitation. A generalized surface module was also added to the subbasin element for simulating the capture of transient water on the land surface, and allowing it to infiltrate. A specified diversion

method was added that is suitable for simulating the effect of a monitored withdrawal on system behavior. A gridded parameter implementation of the Green-Ampt infiltration method was added. Finally, the Muskingum-Cunge channel routing method was improved to better deal with very long simulation time periods.

- **HEC-FDA, Flood Damage Reduction Analysis, Version 1.2.5**. This version replaces version 1.2.4 which was released in 2008. Version 1.2.5 primarily addresses speed issues related to database operations for large data sets. 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 stage-aggregated damage, 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 2.0**. This is a new release of the HEC-SSP software. It includes enhancements to existing capabilities and new capabilities. Enhancements were added to the General Frequency and Volume Frequency analyses along with continued improvements for customization of output graphs. New statistical analyses include a Duration Analysis, Coincident Frequency Analysis, and Curve Combination Analysis. The duration analysis can be used to show the percent of time that a hydrologic variable is likely to equal or exceed some specific value of interest. The Coincident Frequency Analysis is designed following guidelines in EM 1110-2-1415, titled "Hydrologic Frequency Analysis". This analysis tool can be used to compute the exceedance frequency relationship for a variable that is a function of two other variables, e.g., interior pond elevation is a function of inflow into the pond and the exterior river stage. The curve combination analysis provides a tool for combining frequency curves from multiple sources into one frequency curve, such as observed historic measurements of annual maximum stage, results from a hydrology model, and an estimate of the maximum stage from the probable maximum flood. The curve combination tool can be used to develop one frequency curve that combines all these sources of information.

- **HEC-EFM, Ecosystem Functions Model, Version 2.0**. EFM is designed to help determine ecosystem responses to changes in the 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. Version 2.0 offers several new features and improved software behaviors, including expanded statistical capabilities, metric units, user controlled output options, and enhanced user guidance. This is also the first version of EFM that has HEC-EFM Plotter (1.0), which is an accessory for viewing, navigating, and interpreting output generated by EFM. HEC-EFM Plotter is also available for download via HEC's website.

- **HEC-RAS, River Analysis Systems Version 4.1**. HEC-RAS Version 4.1 was released in March of 2009 to the general public. Several new simulation features have been added to the program since that time. Version 4.2 of HEC-RAS will include the following new features:

- Automated Manning's n-value calibration;

- New Hydraulic Outlet Features for an HEC-RAS Inline Structure (Culverts, Rating Curves, and Time series Outlet);

- Linkages between HEC-RAS and the 2D ADH Hydrodynamics code from ERDC;

- Improved Sediment Transport capabilities and additional functionality;

- Advanced Rules capability for Pump Stations.

Other minor enhancements were also added. The development team has also continued careful and systematic testing of the program since the last release. The results of that testing in combination with reports from users has allowed the identification and repair of various problems. Some minor problems that did not affect results but caused problems in the program interface have been repaired without being specifically documented.

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

FY 2010 also saw improvements to:

- **HEC-WAT, Watershed Analysis Tool, Version 1.0** (not yet released) The Watershed Analysis Tool (HEC-WAT) software was created to help USACE study teams conduct watershed and water resources studies in an integrated, comprehensive and systems based analyses. HEC-WAT helps a study team perform the necessary hydrologic, hydraulic, environmental, and planning analyses by integrating the software that is commonly applied by the multi-disciplinary study team. The HEC-WAT framework uses software commonly applied by a study team when conducting a water resources study. Software such as HEC-HMS, HEC-SSP, HEC-RAS, HEC-ResSim, HEC-DSSVue, HEC-FIA, HEC-EFM, HEC-GeoRAS, and HEC-GeoHMS are currently implemented within HEC-WAT thus allowing a study team to perform many of the necessary hydrologic, hydraulic, and planning analyses all orchestrated from a single interface. A beta version of the WAT was released in FY 2008 and is available for use and testing. Official release of this software is expected in early 2011.

- **HEC-FIA, Flood Impact Analysis, Version 2.2** (not yet released). HEC-FIA evaluates impacts using either continuously observed or forecasted hydrographs (hydrograph-based) or depth grids (GIS-based). For a specified analysis, the program evaluates urban and agricultural flood damage, area inundated, number of structures inundated, and consequences. The consequences shall include economic, loss-of-life. HEC-FIA has a graphical user interface (GUI) that allows the user to enter and edit data necessary for impact analysis. Also, HEC-FIA is being used to develop the consequence models that are being used in the risk assessments that are being conducted under the dam safety program. Official release of this software is expected in early 2011.

Finally, HEC made progress on a number of other software development activities including HEC's and ERDC's continuing efforts to integrate HEC-ResSim and CE-QUAL-W2 for modeling of water-quality constraints on the operations of one or more reservoirs and HEC's and the USGS's continued work relationship with IHE-Deltares, to integrate HEC-RAS and the USGS MODFLOW software.

INTEGRATED CIVIL WORKS SYSTEMS

Performance based budgeting, performance measurement and program assessments 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.

Corps Water Management System (CWMS): The Corps Water Management System (CWMS) is a comprehensive data acquisition and hydrologic modeling system developed by HEC 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 by HEC in 2002. CWMS has been updated at roughly annual intervals at the thirty plus Corps offices with water control management responsibilities. HEC 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.

A major milestone was achieved in spring of 2010 when CWMS version 2.0 was fully deployed in the field. Fully deploying this version allows the field to make major revisions to the basic database structures, allows water control users more direct access to their data and enables them to make more effective use of the features inherent in the commercial Oracle database at the center of CWMS. CWMS Version 2.1 is scheduled to be released during the fourth quarter of FY 2011. Some of the improvements include data validation/transformation, report generation, and access to native model features. Other work under the aegis of CWMS includes national database and COOP design.

In addition to software development, HEC continues to be actively engaged with ACE-IT and the CWMS management team in standard hardware platform design and service requirements for CWMS and other water control programs. This platform is known as the Water Management Enterprise Architecture (WMeA) and includes data servers, storage devices, switches, and dataports. This effort has produced 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. The next major effort is to secure funding for a WMeA implementation project. Several field offices have already purchased equipment based on the WMeA design. The intent of the implementation project is to provide the field a standard template for setting up and configuring this equipment which would allow for efficiencies gains. Information about CWMS and other HEC software is available on the HEC web site http://www.hec.usace.army.mil.

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 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.

During FY 2010 IWR continued to support technology transfer and capacity building throughout the Corps through its engagement with the USACE **Pro**ponent **Sp**onsored **E**ngineer **C**orps **T**raining (PROSPECT) program. The National Capital Region office and the Hydrologic Engineering Center presented seventeen week-long courses (seven led by the IWR-NCR and ten by HEC). The PROSPECT courses covered a wide range of Civil Works water resources topics including plan formulation; collaborative planning; ecosystem restoration; flood risk management; hydrologic and hydraulic engineering; public involvement and team planning; public involvement and communications; water resources planning; and regulatory issues. Specialty workshops often use pieces of the PROSPECT training courses but generally, workshops are built specifically for the requesting office and often included topics outside of the normal PROSPECT training course curriculum.

Since FY 2007 the NCR office of IWR assumed responsibility for several of the Planners Core Curriculum (PCC) courses. These included Collaborative Planning, Environmental Considerations in Planning, and Plan Formulation.

Other IWR-NCR supported courses include Risk Analysis - Water Resources Planning and Management; Conflict Management and Dispute Resolution (taught primarily by consultants outside of the government); Public Involvement -Communications, (taught primarily by consultants outside of the government); Economic Analysis – WRP, Planning for Ecosystem Restoration as well as two Planners Core Curriculum courses, Plan Formulation and Environmental Considerations in Planning. In addition to the IWR sponsored courses, IWR staff members are active members in a number of other PROSPECT courses, teaching specialized topics such as Cost Effectiveness and Incremental Cost Analysis, Economics, Forecasting, Risk Analysis, and Environmental Benefits Evaluation.

IWR-NCR is also responsible for managing the Corps Planning Associates (PA) program, a ten month training program designed to provide comprehensive training to future leaders in the Planning Community of Practice. The PA 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.

Under the auspices of the PROSPECT program, HEC conducted the ecosystem-oriented training course “Water and the Watershed” and a full menu of hydrologic and hydraulic (H&H) engineering and planning analysis topics, including courses on H&H for Dam Safety Studies; Risk Analysis for Flood Damage Reduction Projects; Hydrologic Engineering Applications for GIS; Steady Flow Analysis with HEC-RAS; Unsteady Flow Analysis with HEC-RAS; Hydrologic Modeling with HEC-HMS; Reservoir System Analysis with HEC-ResSim; and Flood Frequency Analysis.

In addition to the PROSPECT training program, HEC conducts specialized training classes for a variety of clients. HEC support to the Civil Military Emergency Preparedness (CMEP) program continued in FY 2010 with a week-long training activity for Tajikistan water managers and emergency management officials. The workshop provided training on water management activities for flood prediction and levee management.

HEC conducted or contributed to courses about HEC-DSSVue in Pittsburgh; Advanced HEC-RAS in Portland; Steady Flow HEC-RAS in Jefferson, MO for St. Louis District; Unsteady Flow HEC-RAS in Detroit and Portland; Hydrologic Engineering Applications for GIS in Tulsa and Wall Walla; Hydrologic Modeling with HEC-HMS in Detroit; and a special Working Session for CWMS 2.0 for Northwest Division.

FY 2010 also marked a milestone in the history of the Institute as IWR received official designation as a UNESCO Category II Center as the Institute serves as the home to the International Center for Integrated Water Resources Management (ICIWaRM). The International Center for Integrated Water Resources Management is the first such UNESCO Category II Center in North America. As a UNESCO Category II Center it is anticipated that IWR-NCR and IWR-HEC will be called on to place even greater emphasis on water resources training and education, technology transfer, and capacity building for developing and emerging nations around the world.

Planning Excellence Program: Throughout FY 2010, IWR provided managerial and technical support to the 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 2010 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 four of the seven Planning Core Curriculum courses by the Corps Major Subordinate Commands (MSCs). These four 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: Environmental Considerations; Economic Analysis; Plan Formulation; and Public Involvement and Team Planning. IWR also supports to the local delivery of the Risk Analysis WRP&M course.

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.

REIMBURSABLE TECHNICAL ASSISTANCE

During FY 2010 the Institute performed a wide array of reimbursable project work 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; combatant commands of the U.S. Army; 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 (Section 211 of the Water Resources Development Act of 2000, Public Law 106-541) 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 modeling and water supply in support of interagency investigations.

IWR worked on a variety of projects including American Recovery and Reinvestment Act (Stimulus) activities; post-Hurricane Katrina Interagency Performance and Evaluation Taskforce (IPET) activities, 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-Tallapossa (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; working with the Buffalo District on the Cuyahoga River; working with Sonoma County to collect additional hydrologic and hydraulic (H&H) data, review of related H&H models, recalibration and refinement of H&H models, and development of sedimentation models; collaborating with the Jacksonville District on Herbert Hoover Dam; collaborating with Sacramento District on groundwater modeling of the Tooele River; collaborating with the Albuquerque District on the Upper Rio Grande River; collaborating with the Baltimore District on the Anacostia River; collaborating with the Rock Island District on the Des Moines River; collaborating with the Northwestern Division, Seattle District and Portland Districts and Bonneville Power Administration on the Columbia River Treaty (CRT) 2014/2024 Study; 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.

During FY 2010, staff from the Hydrologic Engineering Center participated in the Watershed Assessments for Afghanistan Project. The watershed assessment for Afghanistan project is a collaborative project led by the Corps Transatlantic Division office with multiple districts participating and local experts with the objective of locating and analyzing potential dam and reservoir sites. HEC is analyzing potential dam and reservoir sites in the Helmand basin. The goal of the project is to identify possible small dam sites (5- to 10-meter high) for impoundment of water for seasonal irrigation and micro-hydro power generation.

In September, 2010, the HEC Director and staff engineers travelled to South Korea to participate in the 8th International Symposium on Ecohydraulics Conference in Seoul, present a one day symposium on Integrated Water Resources Management (IWRM) and ecosystem planning and hydraulic analysis in support of ecosystem planning with K-water (formerly known as KOWACO) in Daejeon, South Korea, and to assist in hydrologic and hydraulic engineering efforts regarding the Camp Humphreys development plan.

HEC also participated in Civil-Military Emergency Preparedness (CMEP) activity in Guyana, funded through SOUTHCOM. HEC-RAS and HEC-HMS models were constructed and training provided on the use of these models and how to use some of the HEC GIS tools. Over the years, HEC has participated in several CMEP activities in various countries.

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) and Code of Federal Regulations pertaining to Corps navigation data reporting requirements by industry and the associated enforcement of those regulations. 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 2010, 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 2010 the ITDS funding was restored and forward progress with the initiative resumed. IWR continued working with CBP both directly and through the ITDS initiative. The highlight of 2010 was the development of a full data MOU with CBP and USACE. IWR also continued collaboration with CBP's Office of Field Operations (OFO) to improve the quality of vessel entrance and clearance data. Parties from both agencies developed an exchange process to keep information regarding docks and facilities synchronous between the two agency inventories.

E-Navigation Initiatives (E-Nav): E-Nav initiatives are those promoting efficiency, safety, security, and reliability in our Nation's waterways through seamless transfer of data and information among the navigation community. IWR supports several of these E-Nav initiatives.

- **River Information Services (RIS):** RIS will provide management, coordination and oversight for the development of the various E-Nav initiatives in which USACE participates. NDC representatives are part of the Corps wide RIS team that was established in FY 2010.

- **Lock Operations Management Application (LOMA):** IWR technical experts worked with ERDC to develop requirements for a tool that will provide navigation information to waterway users, including lock operators, Corps management and vessel operators.
- **Federal-Industry Logistics Standardization (FILS):** In FY 2010 the universal location code (ULC) developed and adopted by the FILS initiative was added as a requirement in the Coast Guard's encoding guide for reporting origin and destination for the Automated Identification System (AIS). Additionally, an interactive tool featuring geo-coded facilities and associated ULC's is under development which will allow companies to search for proper dock codes to report to the Federal Government online.

- **Federal Initiative for Navigation Data Enhancement (FINDE):** In FY 2010 the FINDE project team signed a project charter and MOA between USACE and USCG allowing for exchange of AIS and vessel information between the two agencies. The group also completed polygon definitions on all docks and piers in the New York Harbor prototype area, which improved the match rate of AIS stop events to docks and piers.

- **Inland Electronic Navigation Charts (IENC):** IWR technical experts worked with the Army Corps Geospatial Center (AGC) to harmonize navigation points of interest and data elements common to both AGC's IENC's and NDC's dock and facility inventory. The team completed the harmonization of river miles between the IENC's and the Master Docks Plus inventory system.

- **Lock Performance Management System (LPMS):** The LPMS team continued their development of a tool that captures real time vessel information at Corps locks to reduce the burden on the lock operators and to improve their capability to safely operate locks. The team was successful in moving data capture at the Inner Harbor Canal lock in New Orleans into production mode.

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 approximately 30,000 individual navigation points of interest (NPIs) are published on the Internet. Dock 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. Due to the dynamic and continuous update of the NPIs, the hard-copy **Port Series** books are no longer being published. Instead, an NPI search tool has been designed which will facilitate retrieval of information for specific NPIs.

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 NPIs with unique identification codes and accurate geo-location that both the public and private sector can use when communicating with each other. A list of NPIs is located on the Corps' NDC website: http://www.ndc.iwr.usace.army.mil/ports/data/published_nav_units.xls.

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 is now in production and daily use at all New Orleans navigation locks enabling the lock operator to better plan the locking sequence. To further the use of existing technology, selected timing events are automatically entered into the lock database as the vessel moves past designated trigger points in the locking process. This reduces the data entry demands on the operator and improves the accuracy of 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 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. National briefings with Corps and Industry employ the data from this central system and the database is used to generate specific reports such as 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. These reports are now available in downloadable spreadsheet format providing more functionality for report users. 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.

Recreation: Recreation data associated with the Corps' 4300 recreation areas are collected and maintained within the OMBIL database. An inventory of recreational physical features and structures including recreation areas, visitor centers, facilities, and amenities; outputs including a count of the number of visitors and visitor hours; and activities including citations and interpretive contacts, are combined with revenues and expenditures to produce performance measures that assist the Corps in making management decisions regarding 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 www.recreation.gov. In FY 2010, 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 IWR/ERDC.

A new regional economic development model was also developed in FY 2010 named RECONS (Regional Economic System). This modeling tool automates calculations and generates estimates of the employment impact and other economic measures such as income generated and sales associated with USACE's Civil Work program spending, as well as economic impacts of recreation visitor spending at Corps lakes.

IWR, in collaboration with ERDC, has provided additional technical support to Corps Recreation Business line activities. The activities that were accomplished in FY 2010 include continued support of the Performance Based Budget Development for Recreation Business line; Regional Economic Impact Analysis of Recreation; GIS mapping applications using the Google Map platform to inventory all Corps managed recreation areas and facilities, updating of the Google Earth application for all Corps Recreation projects; and other miscellaneous technical support to Corps Natural Resources management activities. Lastly, in FY 2010 IWR continued to provide 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 2010, all

five hydropower performance measures for the FY 2012 budget process were supplied by OMBIL hydropower data. Also included in OMBIL Plus is 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 associated with 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 and provide annual budget guidance to the MSCs, collect their data, prioritize it in conjunction with the seven other business lines and eight program areas, and 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 the Office of Management and Budget. 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. These databases were developed by paper drills to the districts. In fiscal year 2006 an effort was initiated in IWR to develop a Water Supply module in the Operations and Maintenance Business Information Link (OMBIL) system, and once developed and loaded with all the contractual data, will enable a continual update of water supply data, similar to some of the other business lines. There was no database update for fiscal years 2006 through 2008 due to the effort required to develop and load the OMBIL module. The fiscal year 2009 database is 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 2009 database (developed in Fiscal Year 2010) shows there are 133 Corps multipurpose projects which contain storage space for municipal and industrial (M&I) water supply. These projects are located in 26 states and in 22 of the 38 Corps districts. In these projects the Corps has 366 repayment agreements representing some 11.14 million acre-feet of storage space and an investment cost of $1.45 billion of which about $800 million has been repaid with interest to the U.S. Treasury. The storage space is capable of providing about 5.4 billion gallons of water per day for use by municipalities and industrial firms which have signed repayment agreements. This yield is capable of providing the indoor household needs of approximately 80 million people and represents about seven percent of the Nation's off stream municipal and industrial water supply needs.

In FY 2010, in addition to the normal activities of the Water Supply business line a number of initiatives were under taken:

- A Water Supply Community of Practice (CoP) was organized. This is a loosely organized group of individuals representing a broad spectrum of backgrounds and expertise, all of who are interested in the policies and procedures employed by the Corps of Engineers in the municipal and industrial (M&I) water supply mission. The membership of the work group currently comprised of approximately 100 Corps employees located in Headquarters, 7 division offices, 18 district offices and at IWR and HEC. The objectives of the work group are to: (1) strive to improve the M&I Water Supply Community of Practice; (2) develop/shorten lines of communication; (3) share knowledge, successes and experience; (4) maintain and build competency nationwide and (5) provide forums for group discussions and technology transfer.

- A global e-mail address link (CDL-Water-Supply-Work-Group) was established. This e-mail address distribution list contains all those in the water supply Community of Practice.

- The development of an OMBIL/Water Supply Users group charter was initiated. This is a small group of individuals, comprised of four Corps employees (three from IWR and one from the Tulsa District) and two contractors from a private sector firm which provides technical assistance and support to the Corps water supply program. This group is crucial to the refinement and future evolution of the water supply module of OMBIL so as to serve the needs of the water supply business line mission. The group will also provide organizational stability and institutional knowledge, while facilitating system maturity.

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 evaluation and management of the Corps' waterborne navigation operation and maintenance (O&M) program. Related initiatives include support for enhanced development and field testing of the Channel Analysis Design Evaluation Tool (CADET) in partnership with the Engineer Research and Development Center as technical scope and review lead and the Naval

Surface Warfare Center (NAVSEA-Carderock Division) as prime technical developer. Also supported is the 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") and investigations and research conducted in concert with the U.S. Naval Academy, to better quantify critical inputs for navigation analysis. Work completed in FY 2010 included an assessment expansion of NNOMPEAS toward integration with geographic information system (GIS) tools for reference and evaluation of systems for compilation of project related O&M expenditures. Work scheduled for FY 2011 includes efforts to initiate GIS and schematic mapping of coastal deep-draft waterway projects and modifications to root mean squared (RMS) for the compilation and access of project O&M costs on a life-cycle basis.

INTERNATIONAL WATER RESOURCES RELATED ACTIVITIES

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 include:

International Upper Great Lakes Study: Throughout FY 2010, IWR continued to play a major role in directing and managing the activities of the International Upper Great Lakes Study. The Study was initiated in 2007 under a Memorandum of Agreement (MOA) between IWR and the International Joint Commission (IJC) for a 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. Drs. Eugene Stakhiv and Anthony Eberhardt are the U.S. co-Director and co-Manager of the Study. IWR is leading the U.S. contributions to the study, as was the case with the last IJC Great Lakes Study, the International Lake Ontario-St. Lawrence River Study, completed in 2006.

IUGLS began in 2007 to investigate the possible factors responsible for recent declining Upper Great Lakes levels (Phase 1) and to formulate alternative plans for Lake Superior outflow regulation with the goal of providing benefits to existing and emerging interests (Phase 2). On December 15, 2009, the final Phase 1 Report was released describing the investigations by dozens of scientists from U.S. and Canadian government and non-government agencies and universities around the Great Lakes, and is available at the Study's website: www.iugls.org. The study investigators found that over the last four decades, the conveyance of the St. Clair River has changed due to man-made factors. However, they also determined that the declining lake levels were due primarily to climatic variability and glacial isostatic rebound.

With Phase 1 complete, during 2010 emphasis shifted to Phase 2. This phase is being conducted by scientists within six technical work groups (TWG) - coastal processes, commercial navigation, hydropower, municipal and industrial water uses, recreational boating, and ecosystems, which are selecting performance indicators to aid in the formulation of alternative plans. These performance indicators will be used in a shared vision planning framework to arrive at alternative plans. Interest input from "circles of influence" forums with stakeholder groups will also be considered in plan development. In addition to the performance indicator TWGs, there are also four integration TWGs - plan formulation and evaluation, hydroclimatic, adaptive management and information management.

Recognizing that improvements to the existing plan for Lake Superior regulation, Plan 1977-A, will be small considering a historic database and that in the upper Great Lakes, the outflow control is at the outlet of the upper most lake in the system, the Study Board developed an approach that considers the acceptable range of water levels for a given interest or sector and how those water level ranges may change in response to future climate variability. This approach uses coping zones to determine how acceptable a particular range is to an interest. The Hydroclimatic TWG was a key group during the first phase of the Study and will be essential in Phase 2 as various hydrologic scenarios are developed to test alternative regulation plan performance. Scenarios will be based on historic supplies, stochastically-generated supplies (likely 50,000 years or more of possible supply sequences, allowing testing of plans under extended droughts and wet periods) and climate change possibilities from the work of the Intergovernmental Panel on Climate Change (IPCC). Regional climate models for both comparative analyses and the development of climate change scenarios will be utilized.

The coping zones and the hydrology that will be considered will help formulate an adaptive management strategy that could be implemented beyond the Study's completion date in March 2012. Investigations are underway to determine future monitoring of conditions and to identify Great Lakes agencies that could partner with the IJC to implement such strategies.

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 banks 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. IWR's ongoing engagement with the WWC reached a new threshold in FY 2009 through numerous contributions to the *5th World Water Forum* (WWF) which was 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. Mr. Stockton was re-elected to the Board of Governors in November 2009. Dr. Jerry Delli Priscoli (IWR) serves as the alternate and is a representative on the WWC Executive Bureau. He is also the Editor in Chief of the peer reviewed *Water Policy*, the official journal of the World Water Council. Ongoing WWC activities involve close liaison with the U.S. State Department, 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.

The *6th World Water Forum* will be held in 2012 in Marseilles, France. Dr. Delli Priscoli has been appointed to serve on the international steering committee for this forum.

International Center for Integrated Water Resources Management (ICIWaRM) and UNESCO Partnerships:

A large number of UNESCO-related activities are sanctioned by the U.S. Government, in particular those related to the U.S. National Commission for UNESCO (USNC-UNESCO) and the U.S. National Committee for the International Hydrological Programme (USNC-IHP). IWR Director, Robert A. Pietrowsky, has been one of six permanent Federal agency members of the USNC-IHP, and he has been part of the USG delegations to UNESCO at the IHP Intergovernmental Council (IGC) meetings in 2004, 2006, 2008 and 2010.

One important step in USACE and IWR's increasingly active role in international water research and policy issues was the creation of the *International Center for Integrated Water Resources Management* (ICIWaRM). ICIWaRM had been selected for consideration as a UNESCO Category 2 Center "under the auspices of UNESCO" in February 2008 after a national competition, and its nomination had been endorsed by UNESCO Headquarters, the IHP Bureau, and the IHP-IGC later that year. With the assistance of the US Mission to UNESCO, its nomination was endorsed by the UNESCO Executive Board and unanimously approved by the 193 member states at UNESCO's General Conference in 2009. Official designation as a Category 2 Center took place at UNESCO Headquarters in New York City in October 2009, with MG Don T. Riley representing the U.S. Government and Director-General Koïchiro Matsuura representing UNESCO. ICIWaRM's Director Robert Pietrowsky and Technical Director Eugene Stakhiv also participated in the U.N. signing ceremony.

Partnerships

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 IWR agreements with ICHARM (International Center for Hazard and Risk Management) in Tsukuba, Japan; CAZALAC (Centre for Arid and Semi-arid Zones of Latin America and the Caribbean) in Chile; and CATHALAC (Water Center for Humid Tropics of Latin America and the Caribbean) in Panama.

In 2010, Mr. Robert Pietrowsky continued his service as a member of the Governing Board of UNESCO-IHE; Mr. Eugene Stakhiv served as chair of the Advisory Board of ICHARM and the Steering Committee of the Global Water Partnership (GWP). Additional MOUs are planned for FY 2011.

IWR also has an MOU with the Global Water Partnership (GWP)—an international NGO with the financial support of the European Union and the World Bank—and supports its efforts to implement Integrated Water Resources Management (IWRM) in developing countries. For example, IWR has been working with select members of GWP Technical Working groups to develop IWRM protocols.

Direct support of UNESCO programs

Dr. Eugene Stakhiv continued to co-chair a UNESCO Sponsored Steering Committee tasked with preparing *IWRM Guidelines at the River Basin Level* to assist water resources practitioners in finding better and more efficient solutions to water resource problems.

ICIWaRM staff members Dr. Guillermo Mendoza and Dr. Aleix Serrat Capdevila are leading an effort to translate into Spanish of the committee's publication series *IWRM Guidelines at the River Basin Level*. UNESCO's Regional Office for Latin America and the Caribbean, and the Inter-American Development Bank, are partners in this effort.

One significant development in 2010 was that UNESCO-IHP chose ICIWaRM as the technical secretariat for its global network *Water and Development Information for Arid Lands* or G-WADI. The program aims to strengthen global capacity to manage water resources in arid and semi-arid regions by building an effective global community. It integrates contributions from networks, organizations, individuals and UNESCO Category 2 centers. The G-WADI network features knowledge bases and products such as near real-time global satellite estimates of precipitation. Dr. Serrat Capdevila participated in and presented at in the G-WADI Workshop: Water – Science, Policy and Capacity Development held in Dakar, Senegal in May 2010.

ICIWaRM provided extensive support to the World Water Assessment Programme (WWAP) in 2010. WWAP is the flagship programme of UN-Water. Housed in UNESCO, it monitors freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at a national level and inform the decision-making process. ICIWaRM's support was primarily for its work in the areas of indicators, water policy, waterway transport and climate change adaptation. For example, IWR facilitated Dr. Gerald Galloway's work at co-chair of the WWAP Expert Group on Policy Relevance.

ICIWaRM sponsored the North American HELP (*Hydrology for the Environment, Life and Policy program*) Basin Organizations *Workshop on Lessons Learned*, held in Portland, Oregon, in May 2010. The event brought together Federal, state, and local governments along with NGOs and academic partners working on IWRM in seven basins in the U.S. and Panama. The Rock Island District of the Corps is an active partner in the Iowa-Cedar River basin.

Dr. Jason Giovannettone and Mr. Michael Wright continued work on the development of a non-proprietary Drought Atlas software product that will be freely available to countries that need such a product, particularly countries in transition located in arid or semi-arid areas. In partnership with a fellow Category 2 center CAZALAC, ICIWaRM is using the resulting product to create a complete drought atlas of Latin America. This entire 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.

In addition, ICIWaRM took part in a coordination meeting of programs, projects and work groups for IHP Latin America and the Caribbean. ICIWaRM also arranged for a UNESCO IHP staff member to participate in three-week program in the U.S. through the U.S. State Department's International Visitor Leadership Program.

Other activities and projects

During FY 2010, ICIWaRM continued support of the Modernization of Management of Water Resources Project (PMGRH) in Peru. Peru is undergoing a fundamental shift in the way it manages its water resources. In March 2009, a new water law was passed authorizing the creation of a National Water Authority (ANA) and River Basin Councils (RBC) to implement IWRM and planning at a national scale. ICIWaRM provided technical advice and capacity building in coordination with ANA and the project lenders, the World Bank and the Inter-American Development Bank. ICIWaRM's Drs. Guillermo Mendoza (IWR), Hal Cardwell (IWR) and Aleix Serrat-Capdevila (University of Arizona, *Center for Sustainability of Semi-Arid Hydrology and Riparian Areas*) developed the

materials and content for 'inception workshops' to prepare stakeholders at six pilot basins. ICIWaRM held the first such workshop in Arequipa, Peru, site of the Chili river basin, and helped build capacity of Peru's ANA staff. Four additional 'inception workshops' have since been held, with increasing leadership by ANA. These workshops introduced the participatory planning principles developed by IWR, and with input from ANA, to be implemented at each of the basins, and sought feedback from stakeholders. Stakeholders ranged from irrigation and municipal water sectors to subsistence alpaca herders of the highlands. ICIWaRM will likely continue in an advisory role, with capacity building, training and evaluation being important components of its work.

In collaboration with the Global Water Partnership and the National Academy of Sciences, ICIWaRM organized the first inter-academic U.S.-Ukrainian meeting on scientific approaches to adaptation to climate change in the water sector, including flood protection activities in the Carpathian region. Included on the agenda of the meeting were: Climate Change in the Black Sea Region as part of the Global Climate System; Climate Change and Floods; Reservoirs and Irrigation Systems Management; and Ground Water.

ICIWaRM co-organized the *International Workshop on Non-Stationarity, Hydrologic Frequency Analysis and Water Management* in Boulder, Colorado in January 2010. Participants explored alternatives to the assumption of stationarity in hydrologic frequency analysis and water management, and alternative technical and policy and paths ahead. This workshop helped address a recommendation of the High-Level Expert Panel on Water and Disaster (HLEP) of the UN Secretary-General's Advisory Board on Water and Sanitation. Proceedings are available at www.cwi.colostate.edu/NonstationarityWorkshop/proceedings.shtml.

Through a continuing collaboration between ICIWaRM academic partner University of Arizona and the International Senegal Basin Authority (Organisation pour la Mise en Valeur du Fleuve Senegal), ICIWaRM is developing a near real-time streamflow forecasting system using satellite precipitation measurements in the Senegal River Basin. Currently, there are no operational near real-time streamflow forecasts using satellite precipitation products in any large and poorly-gauged river basin. By using real-time spatially explicit precipitation measurements as input to rainfall-runoff hydrological models, the objective is to provide a daily operational forecast for the management of the Senegal Basin and its reservoirs.

ICIWaRM has been a strong participant in the USAID-led effort to create the President's *Middle East North Africa Network of Water Centers of Excellence* (MENA-NWC) throughout the year. This network will bring together water centers throughout the MENA region along with U.S. government agencies and universities to address some of the region's most challenging water problems.

Finally, ICIWaRM has written a series of reports on countries experiencing water stress amidst their other challenges, including "*Analysis and Capacity Building for Afghanistan Water Resources Development*", "*Assessment of Water Resources Assistance Projects and Donor Priorities in Haiti*", and "*Assessment of Pakistan's August 2010 Flood*". ICIWaRM members have also given invited presentations at the 2010 Kovacs Colloquium (*Hydrocomplexity: New Tools for Solving Wicked Water Problems*), the 2010 *Water for Food* conference, and others.

Dutch Rijkswaterstaat: The Corps signed an MOA with the Dutch Directorate for Public Works and Water Management (Rijkswaterstaat, "RWS"), part of the Ministry of Transport, Public Works, and Water Management 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.

This exchange of technical expertise has been particularly useful in the wake of coastal hurricanes in 2005 (Katrina and Rita) and 2008 (Gustav). The following are the main areas of focus.

- Dredging: The Dutch have extensive experience and a long history of the subject of dredging and dredging technologies, including the re-suspension of sediments as a result of dredging activity; handling and treatment of contaminated sediment; risk assessment and characterization, remediation options, confined disposal techniques, and beneficial use; and methods for reducing dredging costs.

- Coastal Zone Management: The Dutch have developed an extensive range of structural and non-structural approaches to coastal zone management, including an array of storm surge barriers, flood gates, reinforced levees and floods. In 2006 the Dutch government developed the "Room for the River" program which involves a number of innovative techniques designed to improve floodplain management. The program design presents an integrated spatial plan with the main objectives of flood protection, master land use planning, and an improvement of the overall environmental conditions.

- Risk and Reliability: The Dutch have worked closely with the Corps on post-Katrina support and they have developed a unique approach to addressing flood and storm safety. The United States and the Netherlands have much to share in terms of addressing the subject of risk and reliability. The exchange of ideas regarding the principles of risk and reliability has application to activities in many Corps district offices including New Orleans, Sacramento, and Jacksonville.

In 2010 several delegations from the U.S., including representatives from the USACE, visited the Netherlands to continue the technical exchange with the Dutch with respect to water management, climate change, dam and levee safety, and growth stewardship and provide technical exchange on the subject of the U.S. national response framework and the role of the Corps of Engineers in emergency preparedness, response, recovery and mitigation.

The first draft of a study comparing and contrasting water management trends in the United States and the Netherlands has been prepared and is undergoing review for publication in 2011.

In FY 2010 USACE realigned plans for a multilateral agreement with Japan and the Netherlands and the three nations are cooperating on the development of internationally agreed upon standards for levee evaluation and construction.

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 (TPO), responsible for the technical exchange on behalf of the USACE 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 MLIT, Mr. Leonard Hopkins, the USACE TPO, and Mr. Tom Evans of HEC Water Management Systems Division, took a 6-member USACE delegation headed by Mr. Lloyd Pike, HQUSACE, to Tokyo and Nagoya, Japan to attend a technical exchange meeting and site visits to and around Tokyo and the Kiso River estuary system. Topics discussed at technical sessions included Adaptive Management of Climate Change, Risk Management of Levee Systems, Disaster Response, and River Information Systems. Sites visited included the Shinden district "Super Levee', the Arakawa-Karyu River Office, and the Ukima district river disaster prevention station. The group also visited sites of centuries-old flood countermeasures in the Kiso River estuary system.

The U.S. and Japanese delegations agreed to hold their next meeting in Portland, Oregon in May 2011, with topics to include "Strategic O&M (including dams)"; "Effective Use of Existing Structures"; "Flood Risk Management, including measures in the floodplain"; and "Economic Evaluation of Flood Risk Management."

International Technical Reimbursable Activities: In FY 2010, HEC was involved in a wide range of international activities. Listed below are examples of a few of these activities.

Afghanistan: During FY 2010, staff from the Hydrologic Engineering Center participated in the Watershed Assessments for Afghanistan Project. The watershed assessment for Afghanistan project is a collaborative project led by the Corps Transatlantic Division office with multiple districts participating and local experts with the

objective of locating and analyzing potential dam and reservoir sites. HEC is analyzing potential dam and reservoir sites in the Helmand basin. The goal of the project is to identify possible small dam sites (5- to 10-meter high) for impoundment of water for seasonal irrigation and micro-hydro power generation. The location of the sites is being made based on snowmelt and precipitation records, and terrain, soils and land use data. The identification of the sites is preliminary, as a full geotechnical evaluation for proper site selection is not being performed at this time. The focus on the smaller basins is so that local communities can operate and maintain these structures. There is no intention of providing flood protection. Instead the idea is to retain a portion of the seasonal runoff that can then be metered out over a longer growing season for the production of more and better crops. Results of the study are due in FY 2011.

South Korea: In November 2009, HEC Director Mr. Chris Dunn gave a keynote presentation at the 1st International Conference on Policy and Research for Global Disaster Management (PR4GDM) in Seoul, South Korea. The conference was hosted by the Korean National Emergency Management Agency (NEMA). The conference aimed to strengthen disaster response through disaster management technology and international research and development sharing and to discuss the feasibility of a collaborative international research and development program for global disaster management. The PR4GDM Conference will be held every other year in the November time frame. The next conference is planned for November 2011 in Seoul, South Korea.

Mr. Dunn's presentation was entitled "Corps Water Management System (CWMS): Real Time Decision Support Modeling and Integration." The presentation highlighted how the Corps is proactively reducing threats to our nation's population and property by forecasting floods and reservoir operations, and in turn alerting emergency operations managers so that they can take the appropriate steps to reduce damage and loss-of-life.

While in Korea, Mr. Dunn and Dr. Jay Pak (former HEC hydraulic engineer and now working for the Corps in Korea) met with representatives of NEMA's National Institute for Disaster Prevention, the Korean Institute of Construction Technology (KICT), and K-water (formerly known as KOWACO) to explore areas of common interest. It is interesting to note that both KICT and K-water had previously approached the Corps at the 5th World Water Forum in Istanbul, Turkey in March 2009 to explore joint opportunities.
As a result of HEC's participation in the PR4GDM conference, HEC was invited and agreed to participate in the 8th International Conference on EcoHydraulics in September 2010 in Seoul, South Korea.

In September, 2010, HEC Director Chris Dunn and staff engineers John Hickey and Cameron Ackerman travelled to South Korea to participate in the 8th International Symposium on Ecohydraulics Conference in Seoul, present a one day symposium on Integrated Water Resources Management (IWRM) with K-water, in Daejeon, South Korea, and to assist in hydrologic and hydraulic engineering efforts regarding the Camp Humphreys development plan.

World Meteorological Organization: Dr. William Scharffenberg, Senior Hydraulic Engineer was the USACE representative to the Flood Forecasting Initiative Workshop at the World Meteorological Organization (WMO) headquarters in Geneva, Switzerland in December 2009. WMO established the Flood Forecasting Initiative to assist member nations, especially the developing nations, by improving their flood forecasting capabilities. The Initiative fits with WMO's mission because flood forecasting is tightly tied to short term weather and climate forecasting. Much of the Initiative's work focuses on supporting the improvement of stream flow monitoring networks and promoting the establishment of new networks. There is also a focus on technology transfer and capacity building where countries with established flood forecasting centers provide guidance and training to countries still working to build an effective forecasting capability. The workshop discussed ways to increase the capability of National Meteorological Hydrological Services (NMHSs) in the developing world to management hydrological data and produce flood forecasts. Utilizing his experience as lead developer of the Hydrologic Modeling System (HEC-HMS), Dr. Scharffenberg will be working with several experts from the workshop to develop a proposal for a comparison of hydrologic forecasting models. The comparison will assist developing countries in selecting the best hydrologic forecasting model for their unique needs.

Dr. Scharffenberg has been designated as the USACE representative on WMO's Committee on Hydrology.

Iraq: HEC has entered into a contractual agreement with an American firm, Exponent, Inc., to support to the second phase of the Strategy for Water and Land Resources of Iraq (SWLRI). The objective of the SWRLI project is to define the strategy and the related investment plan that will guide the sustainable management and development of

the water and land resources of Iraq for the next two decades (from 2010 to 2030). HEC will assist in providing technical assistance on the use of the hydrologic and hydraulic analysis tools previously developed by HEC for real-time forecasting and water management operation.

Mongolia: In October 2010, HEC participated in a training course held in Ulaanbaatar City, Mongolia. This class provided GIS training. During the training, HEC personnel had the opportunity to go into the field to collect data for use in developing HEC-HMS (Hydrologic Modeling System) rainfall-runoff model and HEC-RAS (River Analysis System) hydraulic model. These models were scheduled to be delivered to the Mongolians in the second quarter of FY 2011.

UNESCO: Mr. John Hickey, Senior Hydraulic Engineer attended the UNESCO International Workshop on Challenges and Solutions for Dam Re-operation held at UNESCO Headquarters in Paris in October 2010. The workshop consisted of a small group of professionals from around the world working with reservoir operations for environmental purposes presenting their efforts in hopes of identifying characteristics that are common to successes and failures. Mr. Hickey and Andy Warner of The Nature Conservancy presented the Sustainable Rivers Project as a case study for North American Rivers/Flood Control Reservoirs.

Columbia River Treaty: HEC is a participating study team member for the Columbia River Treaty (CRT) 2014/2024 Study. The CRT is an agreement between the United States and Canada. The purpose of the CRT, which became effective in 1964, is to provide flood control and power benefits to U.S. and Canadian regions. HEC supports the study project development team, including the Hydrology and Hydraulics, Plan Formulation and Integration sub-teams, provides technical and policy guidance, coordination and development of the HEC-FRM and HEC-ResSim software features specific to CRT and provides overall risk assessment methods to the CRT team.

International Joint Commission: HEC provided technical support to activities led by International Joint Commission (IJC) at the request of another Corps office. Since 2006 HEC has contributed specialized expertise to the International Upper Great Lakes Study, managed by IWR, for modeling of upper lakes routing and Lake Superior regulation and alternate plan formulation. In addition to project work through field offices and IWR, HEC supported other IJC initiatives. For example, HEC participated in a workshop regarding the IJC's International Watersheds Initiative.

Taiwan: In November 2009, several members of the Taiwan Water Resources Agency (WRA) visited the Hydrologic Engineering Center (HEC). Their interest was for HEC to come to Taiwan to perform training on the HEC software products. Since that time, HEC has been coordinating with HQUSACE and the U.S. State Department to investigate which process might be of use to allow this cooperative effort to occur. The WRA has invited HEC to come to Taiwan to provide recommendations on methods they may employ to help with flood modeling. It is anticipated that such a meeting will take place sometime in FY 2011.

Hungary**:** Two members of HEC, Mr. Cameron Ackerman and Mr. Mark Jensen, both Senior Hydraulic Engineers, were invited to Hungary by the Ministry of Environment and Water to conduct training on HEC's River Analysis System (HEC-RAS). The HEC-RAS modeling conference was held in Szolnok, Hungary and was used to raise public awareness of flooding issues and highlight the completion of an offline storage facility on the Tisza River near the town of Tiszaroff. The modeling conference was organized by Dr. Sándor Kovács of the Middle Tisza District and Pal Hegedus of RBF Consulting. Opening presentations to more than 150 attendees were provided by László Kóthay, State Secretary for Water and Attila Lovas, Director of the Middle Tisza District. Mr. Ackerman gave the keynote presentation on the status of affairs of HEC, highlighting the latest software development activities and, specifically, the future plans for HEC-RAS. It was announced at the conference that the Hungary Ministry of Environment and Water has officially adopted the HEC-RAS program for performing all one-dimensional river modeling. It was very important for the Ministry management personnel to hear directly from HEC about the future of HEC-RAS, because they have made a five-year commitment to exclusively use RAS for river modeling. They were also very excited to hear that HEC is investigating the inclusion of a two-dimensional spreading model.

Approximately 40 Hungarian engineers from the various water Districts attended the latter portion of the conference for HEC-RAS training. Mr. Ackerman and Mr. Jensen provided hands-on training on several specific HEC-RAS topics. Following the HEC-RAS training, Mr. Ackerman and Mr. Jensen were invited to the Middle Tisza District office in Szolnok, where they received a briefing on the District's responsibilities, water management activities, and

seasonal flood-fighting efforts. A site visit to various projects on the Tisza River followed the briefing at the District office.

The trip concluded with a visit to the Budapest University of Technology and Economics where Mr. Ackerman and Mr. Jensen met with Dr. János Józsa, Head of the Department for Hydraulic and Water Resources Engineering. Mr. Ackerman and Mr. Jensen engaged in discussions regarding the field of water resources, physics, and the history of water resources and education in Hungary. Mr. Ackerman and Mr. Jensen provided insight on HEC activities and suggested software programs that the department could use for research topics. Mr. Ackerman and Mr. Jensen were pleased to learn that the Budapest University uses HEC products in both their B.Sc. and M.Sc. programs as part of their standard curriculum.

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 38 qualifying members, two international river commissions, about 450 corporate members (private companies, harbor agencies, firms, laboratories, universities, etc.) and about 2,500 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 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, 2010 totaled 218, consisting of 191 individual members and 27 corporate members.

United States National Commission: The United States National Commission constitutes the governing body of the U.S. Section. In 2010 the ex-officio officers of the U.S. National Commission were: Chairman, The Honorable Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works); President, MG William Grisoli, Deputy Commanding General for Civil Works and Emergency Operations; Secretary, Ms. Anne Cann, an employee of IWR.

In 2010, U. S. National Commissioners were: Mr. Dale Miller, Vice President representing the Western Region and President, Tetra Tech INCA; Mr. 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; 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; Mr. Dominic Izzo, Project Director, KBR; and Ms. Helen Brohl, Director of the Executive Secretariat of the Committee on the Marine Transportation System.

PIANC Activities: PIANC USA again partnered with the American Society of Civil Engineers' (ASCE) Coasts, Oceans, Ports and Rivers Institute (COPRI) to organize another highly successful PORTS conference, held in Jacksonville, Florida (April 26 – 28, 2010). PORTS 2010 "Building on the Past, Respecting the Future" was the

twelfth in a series of international port and harbor development specialty conferences held by ASCE on a tri-annual basis since 1977. Over 600 ports and harbors professionals gathered to participate in the technical program which featured over 140 presentations, four pre-conference workshops, roundtable discussions on timely and practice-oriented topics, and a tour of JAXPORT and the St. John's River. U.S. Army Corps of Engineers' Major General Bo Temple delivered the keynote address at the PORTS opening plenary session. PIANC USA organized 'Meet the Author' sessions at its exhibit booth where U.S. members of the PIANC technical working groups were scheduled to appear during breaks and lunches to answer questions about the reports and promote their publication. Copies of the reports were available for attendees to examine.

In May of 2010, the PIANC World Congress and Annual General Assembly (AGA) were held in Liverpool, England. Members of the U.S. delegation included The Honorable Jo-Ellen Darcy, Ms. Anne Cann, Mr. Dale Miller, Mr. James McCarville, Dr. Robert Engler, Mr. John Headland, Dr. Craig E. Philip, Mr. Dominic Izzo, MG Vald Heiberg (ret.), Mr. Harry Cook, and Ms. Kelly Barnes. PIANC USA hosted a luncheon with members of the Delegation for local dignitaries, including Stephen Cork, HR Wallingford and Chairman, UK Section, and Mr. Mike Thorn, UK's Chief Government Delegate.

PIANC USA held its 2010 Annual Meeting on September 22, in Boston, Massachusetts. Over seventy people attended the one-day meeting which included seven technical sessions highlighting recently released PIANC working group reports and other topics of interest to the navigation community. The meeting was held in conjunction with the National Waterways Conference's 50th Anniversary Conference to capitalize on the large number of high level industry experts attending both meetings and to share expenses.

The PIANC Annual Meeting program included remarks by the MG William Grisoli, Deputy Commanding General for Civil and Emergency Operations, and Colonel Phillip T. Feir, Commander and District Engineer for the New England District. The Honorable Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works), gave a report on PIANC USA Activities over the past year. Technical presentations on PIANC reports included topics such as Innovations in Navigation Lock Design, Governance, Organization and Management of River Ports, and Sustainable Waterways within the Context of Navigation and Flood Management.

Mr. Dominic Izzo, KBR, organized the "Ecological Engineering in Navigation - Fluvial Geomorphological Restoration on the Upper Mississippi" session which was moderated by Mr. Chuck Spitzack, USACE. The session had panel members from US Geological Survey, US Fish and Wildlife Service, the Corps, and private industry (KBR), with each giving its perspective and demonstrating how they all worked together to apply sound ecosystem restoration, adaptive management and ecological engineering. This session was a real hit with the audience since it explored a range of issues including river processes, fish and wildlife resources, authorities for restoration and engineering solutions. Mr. John Headland, Moffatt and Nichol, organized the session on "Fluid Mud - Identifying the Bottom," which included experts from the US and the Netherlands. The session discussed the importance of navigable depth concepts and fluid mud science in navigation channels, as well as promoting new approaches to Dredged Material Management. Presentations by Mr. Han Winterwerp (Marine and Coastal Systems, The Netherlands), Mr. Steve Chatry (Weeks Construction), and Mr. Timothy Welp (USACE-ERDC) focused on recent developments in sedimentation/fluid mud modeling and fluid mud measurements/properties, as well as on water injection dredging technology.

Ten Young Professionals (YPs) gathered in the morning for a "Meet and Greet" coffee prior to the PIANC Annual Meeting, and four YPs participated on a panel entitled "Educating the Next Generation of Navigation Professionals" organized by Dr. Thomas Wakeman, Center for Maritime Systems, Stevens Institute of Technology. The PIANC USA meeting closed with a panel on Emerging Navigation Issues, moderated by Mr. Jim McCarville from the Port of Pittsburgh Commission.

PIANC USA participated in the 2010 World Canals Conference, held in Rochester, New York, September 14-19, 2010. The theme of the conference was "Canals in the Community Setting, New York State and Worldwide: Challenges and Opportunities." Over 90 speakers and more than 400 delegates attended from countries such as Belgium, Canada, China, France, Germany, India, Italy, Netherlands, Norway, Panama, Serbia, Sweden, U.K., West Africa, and the United States. U.S. Army Corps of Engineers MG William Grisoli gave a keynote address.

As part of the U.S. Section's Latin American outreach activities, PIANC USA participated in several conferences in conjunction with the OAS Inter-American Committee on Ports (OAS-CIP) during 2010. These meetings included the OAS-CIP Sixth General Assembly and Eleventh Executive Board Meeting, held in March in Panama City, Panama, and the 23rd National Waterborne Transport, Shipbuilding and Offshore Congress, sponsored by the Brazilian Society of Marine Engineers (SOBENA), in Rio de Janiero, Brazil at which a technical paper entitled "Coastal Shipping in the U.S.: Can Future Opportunities Revitalize the Trade?" was delivered. The CIP currently has four active Technical Advisory Groups (TAGs), including 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.

PIANC USA 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 river basins. Mr. David Grier, U.S. Army Corps of Engineers, serves as the PIANC USA Latin American liaison.

PIANC USA's recently redesigned website has information on issues and concerns of PIANC members and other USACE personnel working in the navigation industry. The website and bi-monthly electronic newsletter have a clean, contemporary look and are user-friendly and informative. Ms. Kelly J. Barnes, U.S. Army Corps of Engineers' Institute for Water Resources, is the editor of the PIANC Bulletin.

PIANC Executive Committee (ExCom): PIANC International's Executive Committee ensures the executive management of the Association and monitors the decisions and directives of the AGA and the Council. The U.S. representatives on the ExCom are Mr. Shiv Batra, President, INCA Engineers, Inc. (Vice President of Western Hemisphere), and Mr. Edward Schmeltz, AECOM (International Cooperation Commission Chair).

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 2010 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. Young Professional Representative: - Ms. Sandra Brasfield, 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, and Mr. Vahan Tanal, Vahan Tanal Consulting
Recreational Navigation Commission — Mr. Robert Nathan, Moffatt and Nichol; Mr. Jack C. Cox, HDR. Young Professional Representative: Ms. Jessica McIntyre, Moffatt and Nichol
International Cooperation Commission – Mr. David Grier, U.S. Army Corps of Engineers; Mr. Bengt Bostrom, Consultant. Mr. Edward Schmeltz, AECOM, serves as the Chair of the Commission
Promotion Commission – Mr. Nicholas Pansic, MWH; Ms. Kelly Barnes, U.S. Army Corps of Engineers
Young Professionals Commission – Ms. Jessica McIntyre, Moffatt and Nichol.

New Technical Working Groups: In 2010, nine new Working Groups were formed. The groups are listed below along with the name of the U.S. Representatives.

MarCom Permanent Task Group (Direct Access of Maritime Ports by Inland Waterway Vessels) – Dr. Thomas Wakeman, Stevens Institute of Technology
MarCom 146 (Recommendations for the Design and Operation of Solid Bulk Floating Marine or Estuarine Transshipment Terminals) – *no representative from the U.S.*
MarCom/RecCom 147 (Guidelines for Facilitation and Integration Among Recreational, Fishery and Commercial Navigation) – Mohammed Ibrahim, consultant
RecCom/EnviCom 148 (Environmental Impact Aspects of Recreational Navigation Infrastructures) – Dr. Yong H. Kim, Applied Science Associates, Inc., Dave Canfield, Applied Technology and Management, Inc.
RecCom 149 (Guidelines for Marina Design) – Craig Funston, Redpoint Structures, Tim Keogh, Marina Management Services, Inc., Michael Giovannozzi, USACE

EnviCom 150 (Green Ports, a Practical Guide for a Sustainable Seaport) – Carlos G. Peña, CLE Engineering, Joe Zelasney, Committee on the Marine Transportation System, Catherine Mulvey, USACE
InCom 151 (Impacts of Seismic Loads and Vessel Impact on Lock Gate) – James Costello, Tetra Tech INCA, Dr. Robert Ebeling, USACE
MarCom 152 (Guidelines for Cruise Terminals) – Gary Ledford, Halcrow, Don Oates, KPFF Consulting Engineers, Joe Zelasney, Committee on the Marine Transportation System
MarCom 153 (Recommendations for the Design of Marine Oil Terminals) – Gayle S. Johnson, Halcrow, Martin Eskijian, CA State Lands Commission, Rodney Hancock, Moffatt and Nichol. Chair is Ron Heffron, Moffatt and Nichol

Working Group Reports Published in 2010: In 2010, four 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 110 (old #31) (Governance Organization and Management of River Ports) — Jim McCarville, Port of Pittsburgh Commission, and Deidre McGowan, Inland Rivers Ports and Terminals, Inc.
InCom 111 (old #32) (Performance Indicators for Inland Waterways Transport) — Bruce Lambert, Institute for Trade and Transportation Studies, and William Harder, USACE
MarCom 112 (old #53) (Mitigation of Tsunami Disasters in Ports) — John Headland, Moffatt and Nichol, and Dr. Solomon Yim, Oregon State University
EnviCom 108 (old #15) (Dredging and Port Construction around Coral Reefs) — Mark Sudol, USACE, and Russ Kaiser, USACE

2010 Active Working Groups and the names of the U. S. Representatives:

InCom 30 (Inventory of Inspection and Repair Techniques of Navigation Structures) — Robert Willis, Ron Heffron, and YP Chad Linna
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
InCom 137 (Navigation Structures Resilience to Overloading) – David Sullivan (Chair), Dale Miller, and Kenton Braun (YP)
InCom 138 (Mechanical and Electrical Engineering Lessons Learnt from Navigation Structures) – Brenden McKinley, Tim Paulus
InCom 139 (Values of Inland Waterways) – David Grier
InCom 140 (Semi-Probabilistic Design Concept for Inland Hydraulic Structures) – Andy Harkness, Robert Patev, Anjana Chudgar and Perry Cole
InCom 141 (Design Guidelines for Inland Waterways) – Elizabeth C. Burg
InCom 142 (Inland Navigation Safety) – John Clarkson (Chair), Jeff Lillycrop, Joshua VerDught (YP)
InCom 151 (Impacts of Seismic Loads and Vessel Impact on Lock Gate) – James Costello, Tetra Tech INCA, Dr. Robert Ebeling, USACE
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 Paparis
MarCom 51 (Water Injection Dredging) — Timothy L. Welp
MarCom 52 (Criteria for the (Un-)Loading of Container Ships) — Dan Allen
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
MarCom 144 (Classification of Soils and Rocks for the Maritime Dredging Process) – Majid Yavary, Greg Sraders
MarCom 145 (Berthing Velocities and Fender Design) – Cliff Ohl, Elizabeth Burkhart, Kevin Matakis
MarCom 146 (Recommendations for the Design and Operation of Solid Bulk Floating Marine or Estuarine Transshipment Terminals) – *no representative from the U.S.*
MarCom/RecCom 147 (Guidelines for Facilitation and Integration Among Recreational, Fishery and Commercial Navigation) – Mohammed Ibrahim, consultant
MarCom 152 (Guidelines for Cruise Terminals) – Gary Ledford, Halcrow, Don Oates, KPFF Consulting Engineers, Joe Zelasney, Committee on the Marine Transportation System
MarCom 153 (Recommendations for the Design of Marine Oil Terminals) – Gayle S. Johnson, Halcrow, Martin Eskijian, CA State Lands Commission, Rodney Hancock, Moffatt and Nichol. Chair is Ron Heffron, Moffatt and Nichol
MarCom Permanent Task Group (Direct Access of Maritime Ports by Inland Waterway Vessels) – Dr. Thomas Wakeman, Stevens Institute of Technology
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
RecCom/EnviCom 148 (Environmental Impact Aspects of Recreational Navigation Infrastructures) – Dr. Yong H. Kim, Applied Science Associates, Inc., Dave Canfield, Applied Technology and Management, Inc.
RecCom 149 (Guidelines for Marina Design) – Craig Funston, Redpoint Structures, Tim Keogh, Marina Management Services, Inc., Michael Giovannozzi, USACE
EnviCom Expert Group 2 (Environmental Benefits of Waterborne Transport) — Keith Hofseth (chair), Alfred Cofrancesco and Nick Pansic
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
EnviCom 143 (Screening Evaluation of Environmental Effects of Navigation and Infrastructure Projects) – Igor Linkov, Burton Suedel, Sandra Brasfield (YP)
EnviCom 150 (Green Ports, a Practical Guide for a Sustainable Seaport) – Carlos G. Peña, CLE Engineering, Joe Zelasney, Committee on the Marine Transportation System, Catherine Mulvey, USACE
EnviCom Permanent Task Group (Climate Change Permanent Task Group) – Dr. Kate White, Rolf Olsen, Jason Giovannettone (YP)
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: During FY 2010, members of the Institute, through the U.S. Section-PIANC, participated in several conferences in conjunction with the OAS Inter-American Committee on Ports (OAS-CIP). These meetings included the OAS-CIP Sixth General Assembly and Eleventh Executive Board Meeting, held in March 2010 in Panama City, Panama and the 23rd National Waterborne Transport, Shipbuilding and Offshore Congress, sponsored by the Brazilian Society of Marine Engineers (SOBENA), in Rio de Janiero, Brazil in October 2010, at which a technical paper entitled "Coastal Shipping in the U.S.: Can Future Opportunities Revitalize the Trade?" was delivered.

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 U.S. Maritime Administration (MARAD), 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 river basins. IWR, through PIANC-US, will participate in two CIP meetings in FY 2011, including the First Hemispheric Convention on Port Logistics and Competitiveness in Ixtapa, Mexico, scheduled to take place in November 2010, and the Twelfth Meeting of the CIP Executive Board in Vina del Mar, Chile in March 2011.