The Wisconsin Sea Grant (WSG) 2010-14 Strategic Plan includes among its focus areas one termed Enhance Coastal Community Sustainability and Resilience, which aligns with the national program’s Sustainable Coastal Development Focus Area. WSG folded the national Hazard Resilience in Coastal Communities Focus Area into the sustainable coastal one to better meet Wisconsin’s needs. In fact, it appears the National Sea Grant Office recognizes the wisdom of this formal linkage and its draft 2014-18 strategic plan joins the two focus areas into one. Impacts, accomplishments, and program measures and objectives are being reported solely to the Sustainable Coastal Development review team.

WSG impacts and major accomplishments for 2008 through early 2012 either met or are on track to realize the strategies laid out in the 2010-14 strategic plan, which fall under the work areas of: (1) sustainable development, (2) sustainable economies, (3) resilient communities, and (4) education and outreach.

SUSTAINABLE DEVELOPMENT STRATEGIES

- Support research to predict and prolong the life of coastal infrastructure and determine the positive and negative effects.

- Develop state-of-the-art “Smart Growth” coastal development planning tools.

- Integrate remote sensing data to improve our understanding of the physical, chemical, biological and geological coupling at the land-water interface.

- Support the development of regional coastal observation systems.
SUSTAINABLE ECONOMIES STRATEGIES

- Evaluate and communicate the local, state and regional value of Great Lakes and coastal businesses, property, infrastructure and facilities.

- Support research to improve cost efficiencies, enhance energy conservation and develop environmentally sound alternative energy sources.

RESILIENT COMMUNITIES STRATEGIES

- Utilize GIS, visualization technology and computer-aided designs to determine the effects of climate change; evaluate the economic impacts of extreme water level changes and means to reduce these risks.

- Conduct research to assess hazard-related risks and increase the availability and usefulness of hazard-related information and forecasting.

- Work with coastal businesses to assess the risks associated with doing business in coastal areas in the context of severe coastal storms, climate-related changes, and dramatic changes in port and international trade activities.

EDUCATION AND OUTREACH STRATEGIES

- Educate community planners, local and tribal government officials and decision makers about the ecosystem effects of urban areas and development in coastal watersheds and how to integrate land use planning, zoning and future development planning for environmentally safe, sustainable economies; communicate Smart Growth techniques that integrate habitat protection and rehabilitation into coastal development plans and infrastructure design.

- Communicate information about the effects of climate change on Great Lakes and stormwater hydrology and water quality.

- Work with federal partners to develop, test and promote beneficial uses for dredged material and the reuse of clean dredged material.

- Work with the NOAA Climate Change Program and other public and private sector partners to develop and deliver comprehensive education/literacy programs on the immediate and long-term effects of climate-related changes, and other hazardous events, on human safety and property along the coast, and how to prepare for and survive them.

In carrying out strategies that fall under all four strategy areas outlined above, WSG is providing real-time data to a broad suite of users. Great Lakes coastal resource managers, researchers, those in the shipping industry and those with homeland security interests are able to use satellite imagery for Wisconsin and the Great Lakes through interoperable Web mapping services within the Wisconsin Coastal Atlas (wicoastalatlas.net; see also page 1 of the PRP report). The site facilitates information sharing, informs decision-making and promotes greater understanding of the basin.

Among other things, visitors to the site can:

- View and download oblique aerial photos, allowing for a virtual tour of the coast. The photos feature both current and historical images.

- Assess coastal hazards.
- Track land-use data.
- Discover tourist destinations.

WSG also ensures other real-time data reaches those who can benefit from it, including recreational boaters. Boating on the Great Lakes is big business. The Great Lakes Commission estimates there are 4.3 million recreational boats registered in the eight Great Lakes states, which generate nearly $16 billion in related annual spending. WSG has developed HarborView, an integrated map viewer that supports safe and efficient recreational boating throughout the Great Lakes. It meshes current National Oceanic and Atmospheric Administration (NOAA) observations with information about coastal attractions at a local scale so boaters can be informed about weather conditions and the characteristics of their destination.

A so-called Solstice Storm hit Superior, Wis., in June 2012. Using blog posts, our GIS outreach specialist helped visualize the storm’s effect. One coastal community suffered extensive damage from flooding and a silt plume from flooding runoff fanned outward from the big lake’s shores.

WSG also transfers mapping knowledge to coastal managers. The program has conducted trainings with more than 100 Great Lakes resource managers and educators through workshops and webinars. Sixty-eight percent of those who participated said they then applied their new knowledge to integrate maps and data, and developed their own tools. Another 77 percent said they shared what they learned with colleagues.

In carrying out strategies that fall under all four strategy areas outlined above, WSG has addressed global warming and other aspects of climatic change, which will have significant effects on Wisconsin’s Great Lakes and its communities. WSG has provided state, regional and national tools. Within the state, WSG funded researchers (see page 4 of the PRP report) to statistically and dynamically analyze downscaled climate hindcasts and forecasts with a focus on identifying models of future change. Additionally, researchers met one-on-one with five Great Lakes engineers—and hundreds more in larger settings—to present managers, planners and local governmental decision makers with synthesized data and adaptation recommendations.

WSG staff are integral members of the Wisconsin Initiative on Climate Change Impacts (WICCI), serving on the organizing Science Council and chairing several theme-related working groups. WICCI is a statewide collaborative of scientists and stakeholders representing more than 70 entities from UW System’s schools, tribes, state and federal agencies, businesses and non-profit groups.

The first WICCI assessment “Wisconsin’s Changing Climate: Impacts and Adaptation” was published in 2011 and featured four WSG co-authors. Over the past three years, WSG’s sister institute, the UW Water
Resources Institute, dedicated its entire research budget from USGS to support climate-related water resources research. Investigators were required to use regionally downscaled climate data from WICCI to form the basis of their research to forecast climate effects on our water resources.

**Wisconsin’s Great Lakes ports pack an economic punch, supporting 8,777 jobs and generating more than $1.4 billion each year. We provide coastal engineering advisory services to Wisconsin facilities, as well as others in the Great Lakes basin, to keep navigation channels clear, maintain infrastructure and adapt to the effects of climate change**

On a national level, WSG led a team that developed a multimedia self-guided education module series accessible at meted.ucar.edu/climate/coastalclimate/index.htm targeted at communicators and extension educators—and those civic leaders and resource managers who live and work in coastal areas. Partners included the University Corporation for Atmospheric Research’s COMET® program, NOAA’s Climate Program Office’s Sectoral Applications Research Program, and many Sea Grant programs and their universities.

In 2009, WSG also established a wiki to facilitate information sharing. At coastalclimatewiki.org, users can find slide sets, video and blog posts from the 2010 U.N. Convention on Climate Change in Cancun, Mexico. WSG’s then assistant director, and now director, attended that meeting and blogged about his experiences.

WSG advisory services staff have created economic tools, or scalable models, for evaluating the potential Great Lakes economic impacts to navigation and port, harbor and marina infrastructure due to climate-induced variations. Other staff members are conducting key informant interviews to assess local coastal needs and how best to address them. They have or expect to visit as many as 35 cities and villages in 11 different counties located on Wisconsin’s Lake Michigan coast.

Employing resilient communities’ strategies, WSG offers coastal engineering assistance to communities. As outlined on page 12 of the PRP report, one example is Engineer Gene Clark’s work that has saved the Twin Ports of Duluth-Superior millions because of his role in analyzing and mitigating an unusual harbor infrastructure corrosion problem.

As part of employing an education and outreach strategy, Clark also co-chairs the Great Lakes Dredging Team that ensures smooth commercial shipping operations. In 2010 and ‘11, his outreach informed and helped initiate 10 beneficial use dredging projects in the Great Lakes basin. In addition, in 2011 alone, Clark organized and conducted six beneficial use of dredged material workshops.

Furthermore, Clark structured and presented a 2011 workshop on Great Lakes bluff stabilization, a crucial need in the face of increased development pressures on towering bluffs along the lakes with variable
water levels due to climate change. His workshop—attended by county planning and zoning managers, and Wisconsin Department of Natural Resources (WDNR) water management specialists—was so successful, he was urged to offer three additional ones. These will occur throughout 2012 and will be targeted toward additional WDNR staff and private contractors and engineers. This work is a continuation of WSG's long history of providing coastal engineering assistance to property owners and local communities to better use and preserve their bluffs. WSG also offers online and downloadable publications on the subject, with both sources proving perennially popular with stakeholders.

Kayaking is big recreational business on Lake Superior, but can be hazardous. WSG has stepped in with a wave-height alert system. WSG collaborates with the Wisconsin Historical Society to map shipwrecks and share the social science behind them.

To carry out strategies of sustainable economies, WSG has worked to enhance the experience of and ensure the safety of those who visit coastal communities, adding to those communities' economic sustainability. One long-term effort was a 37-year physiology research program that wrapped up in 2008. It led to significant improvements in the prevention, diagnosis and treatment of decompression sickness, including the discovery that short, deep “bounce” dives can cause bone necrosis, “the chokes” and paralyzing spinal cord damage among recreational as well as commercial and military divers. Related sports psychology research developed a predictive test that is accurate in identifying nine out of 10 divers prone to panic, a leading cause of fatalities among novice and experienced divers alike.

Diving, of an archaeological nature, has also contributed to the economies and local pride of coastal communities. WSG has maintained a long-term and successful partnership with the Wisconsin Historical Society to map and shine a spotlight on the shipwrecks that litter the Great Lakes, and encompass a culture built on the waters (see page 15 of the PRP report). Wisconsin has more shipwrecks listed on the National Historical Register than any other state and on-land maritime trails draw tourists to communities to learn more, and boost the economy.

Wisconsin’s coastal economies are also sustainably supported by fishing, kayaking, beach recreation and boating. WSG has conducted research, and employed education and outreach strategies to ensure sustainable economies regarding all these activities.

The water draws tourists and local recreationalists alike in revenue-generating activities. While participating, though, they need to be safe. A WSG researcher and Clark are making Lake Superior kayakers more aware of wave and water conditions, critically important due to the often-frigid water that can induce hypothermia within minutes. See page 16 of the PRP report for more.
WSG also works toward the safety of recreational fishers who must balance their pursuit of Lake Michigan fish with that of commercial interests whose large trap nets across the lakebed in warm months. The nets trap whitefish and release other species. Sport fishers’ equipment can become entangled in the trap nets, causing expensive loss, and perhaps posing a safety risk.

WSG conducts extensive awareness-building regarding trap net location. This includes posting to websites and distributing maps at coastal community bait shops and boat landings. In the last four years, fewer than 20 anglers contacted WSG regarding lost equipment in a trap net. Online traffic to two websites where the map locations were posted generated nearly 10,000 visitors. In coastal communities, roughly 4,000 trap-net-location maps were distributed.

A researcher based in Milwaukee has discovered and employed rapid DNA-based water and sand tests to determine the causes of beach closings, which speeds the mitigation process. In some cases, water-quality problems can be quickly resolved. In other cases, longer-term modifications are put in place. In each instance, though, those beaches again attract tourists, and employ workers to keep a community’s beach-related economy humming.

WSG outreach staff have partnered with the Wisconsin Marina Association and instituted a voluntary Clean Marina program. In less than three years, 19 state marinas have been certified for integrating environmentally safe practices into their businesses, which can attract more “green” boaters, and lessen cleanup and insurance costs.