A Newsletter from the Connecticut Department of Energy & Environmental Protection
Exploring Long Island Sound - Issues and Opportunities

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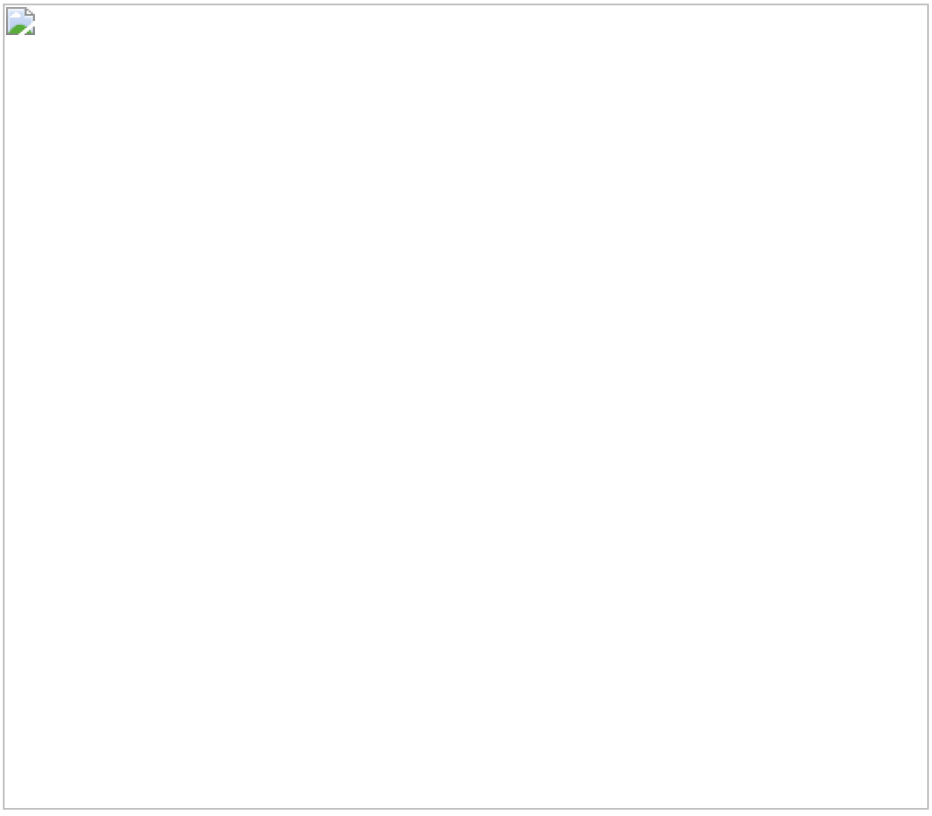
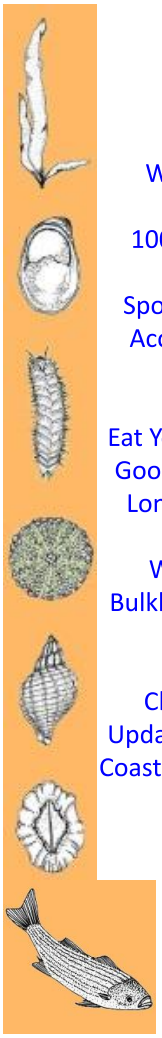
When It Comes to Rainfall, 100 is the New 50

We've all seen the news reports this past summer. Heavy rains in Baltimore, Maryland on April 29 and 30, 2014 resulted in the collapse of a retaining wall, swallowing cars parked along 26th Street and dropping them onto the railroad tracks below.



Retaining wall on 26th Street in Baltimore collapses after 2 days of heavy rain.
Photo credit: NBC News/Baltimore



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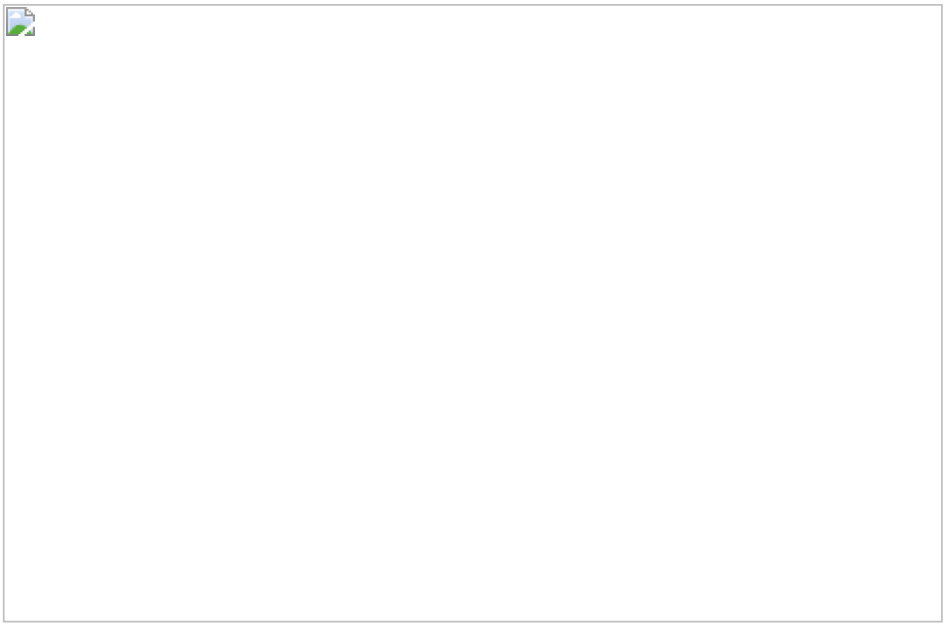
Sound Tips:

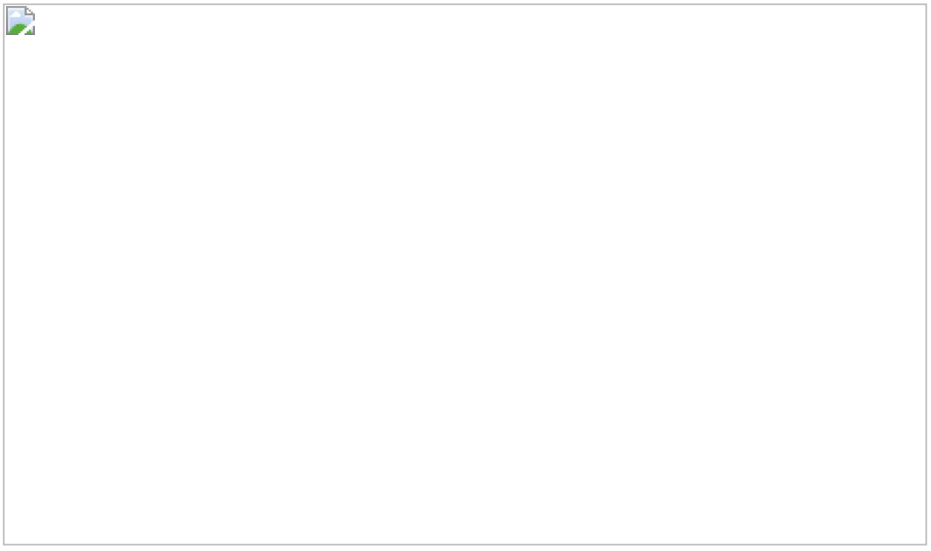
Winterizing Your Boat

On August 11, 2014, record rainfall hit Detroit, Michigan, dropping 4.25 inches of rain at Detroit Metro Airport and stranding motorists on flooded highways throughout the Motor City region.



Mud-covered cars stranded in flood waters on I-75 in Michigan.
Photo credit: Tim Thompson, The Oakland Press

One day later, on August 12, 2014, more record rainfall hits Islip, Long Island when a whopping 9 inches of rain fell in just 2 hours, and more than thirteen inches of rain had fallen when the storm was finally over.



Neighborhood flooding on Long Island (Holbrook, NY)
Photo credit: Delia Frank, News 12

The list goes on and on, and will apparently get a lot longer. The National Climate Assessment report issued in 2014 by the U.S. Global Change Research Program indicates that these heavy downpours are a glimpse of what is in store for us, as increased precipitation will soon be the "new normal" in the Northeast.

This dire prediction is supported by research being conducted at the Northeast Regional Climate Center (NRCC) at Cornell University which is finding that extreme

It's time to think about putting your boat away for the winter. Here are a few clean boating tips:

- Clean your boat on a lawn or gravel driveway away from the water. Your marina or boatyard may have a designated upland cleaning area. Use a drop cloth to collect bottom scrapings and antifouling paint chips.
- Wash your boat with "non-toxic" and "phosphate-free" cleaners. Avoid cleaners with bleach, ammonia, lye or petroleum distillates.
- Recycle used motor oil, but do not mix it with other substances. Use absorbent materials to collect drips and clean up small spills.
- Store lead acid batteries in an area protected from the elements and raised from the ground on pieces of wood.
- Use a shoreside or mobile pumpout facility to flush your holding tank.
- Use non-toxic antifreeze to winterize your system. Propylene glycol antifreeze (usually pink) is less toxic than ethylene glycol (usually green).
- Inspect and clean bilges prior to extended vessel storage. Clean all water, oil, or foreign materials from the bilge using absorbent material.
- Consider using a reusable or recyclable boat cover.

Please refer to the DEEP's Clean Boater Program for more information about clean boating practices.

View past issues of *Sound Outlook*

rainfall is getting even more extreme, with rainfall totals once associated with 100-year, "once-in-a-lifetime" storms now occurring more frequently.

The "old" rainfall standards are contained Technical Paper Number 40 (TP-40), an atlas of rainfall frequency published in 1961 by the U.S. Department of Commerce Weather Bureau for the U.S. Department of Agriculture.

However, the NRCC is finding that the frequency of rainfall events that drop 2 inches of rain has increased, and storms that were considered in TP-40 as a 100-year event have become more frequent, now likely to occur almost twice as often! According to TP-40, a 24-hour-long, 100-year rainfall would drop 7 inches of rain in the northeast. But NRCC research has determined that 24-hour rainfall events dropping 7 inches of rainfall are occurring on a 50-year return period, not the 100-year TP-40 standard. So when it comes to rainfall, it looks like the old 100 is the new 50. And the new 100 in Connecticut will be a doozy, as the NRCC research predicts 9 inches of rain falling in a 24-hour period (not in 2 hours as Long Island experienced in August)!

Return Period	Duration	TP 40/Northeast	NRCC/Connecticut
1 year	24 hours	2.5 inches	2.8 inches
2 years	24 hours	3 inches	3.4 inches
10 years	24 hours	5 inches	5 inches
50 years	24 hours	6 inches	**7.5 inches**
100 years	24 hours	**7 inches**	9 inches

The idea of "return periods" and storm intensity can be confusing. Think of it like preparing for a family reunion.

Uncle Joe and Aunt Linda show up just about every year and they'll eat just about anything you put in front of them, so you don't have to do too much to prepare. In rainfall/storm terms, Uncle Joe and Aunt Linda are like our one- and two-year storms: they are the frequent, smaller storms that we experience all the time. The "recurrence interval" of a one-year storm is every year, so statistically speaking it has a 100% chance to occur every year; the two-year storm, with a probability of 1 in 2 that it will occur in any given year, has a 50% chance to occur. Since these storms are frequent, familiar, and relatively small, we are well-prepared to handle them.

Cousin Sue and her daughter Carolyn don't come to every reunion since they live out-of-state, but they make an effort to attend whenever they can. Our 10-year storms are like Sue and Carolyn: their recurrence interval is 10 years, so their probability is 1 in 10, or a 10% chance to occur every year. They have certain demands (they're lactose intolerant) but you've designed your party infrastructure to accommodate them if necessary.

Aunt Sally and Cousin Kelly rarely make a reunion appearance, and they are so intense and demanding (they're gluten-free vegans who are allergic to dog fur) that it's a relief that they don't show up that often. Our 100-year storms and rainfalls are like Aunt Sally and Cousin Kelly: they have a recurrence interval of 100 years, and the probability of them occurring in any given year is 1 in 100, which is only a 1% chance. These are the less frequent but more intense rainfalls and storms that we often equate with hurricanes. These storms pack a punch, but they are predicted to occur so infrequently that it's overkill to plan for them every year. Which means we're ill-prepared to handle their special demands when they do arrive.

Look Out For These Other Upcoming Events!

Long Island Sound Study (LISS) Committee Meetings

Please be sure to check the Calendar of Events on DEEP's website

November: Harbor seals arrive in LIS from northern New England; winter flounder move into shallower water

December: Bald eagles return to Connecticut for the winter. For eagle viewing at Shepaug Dam Bald Eagle Observation Area, Southbury, CT, call 1-800-368-8954 after Dec. 7 to register.

What is the The Climate Adaptation Academy?

The Climate Adaptation Academy (CAA) is a program of the National Oceanic and Atmospheric Administration (NOAA), CT Sea Grant at the University of Connecticut (UConn) Avery Point, and UConn's Center for Land Use Education and Research (CLEAR) to work with municipalities and relevant professionals on current climate change related issues and climate change adaptation.

Through feedback from municipalities and other constituents, CAA is prioritizing the needs of municipal officials and other professionals related to climate adaptation, and is organizing workshops around these priorities.

Topics that may be included in future workshops are climate change predictions for Connecticut, coastal/shoreline changes, flooding/stormwater impacts, green infrastructure, living shorelines, impacts to transportation related to climate change, and adaptation resources.

For more information about the Climate Adaptation Academy and upcoming workshops, please contact Bruce Hyde at

860.345.5229 or Juliana Barrett at 860.405.9106

And the recent spate of record rainfalls shows how poorly prepared we are to deal with all of that water. Our existing infrastructure (i.e., culverts, storm drains, sewage treatment plants, etc.) was designed to meet the "old" normal rainfall, so it's no wonder that all of that "new" rainfall water is backing up onto streets and into basements.

It gets worse: according to the NRCC, we're going to be seeing a lot more of Aunt Sally and Cousin Kelly at our reunions from now on. Even though the more intense Sally/Kelly storms have a recurrence interval of 100 years, there is still a 1% chance that these storms can hit in any given year. Even back-to-back years (remember Irene in 2011 and Sandy in 2012?). It's already dangerous to assume that once you've experienced a 100-year rainfall or storm, you won't see another of that magnitude in your lifetime. Factor-in the effects of climate change, and the assumption is even more dangerous as the likelihood of experiencing more frequent, more intense storms increases.

The impacts of increased precipitation and flooding (both inland and coastal) on Connecticut communities was the focus of a University of Connecticut Climate Adaptation Academy (CAA, please see sidebar) workshop held on October 10, 2014. Over 70 attendees representing municipalities and companies across Connecticut learned about precipitation forecasts and what they mean for existing infrastructure. Workshop sessions included a Connecticut Department of Transportation case study looking at impacts of increased precipitation on roadways and culverts on a watershed in northwestern Connecticut, information and resources from the Unites States Geological Survey on flood frequency analysis and real-time stream gauging networks, and floodplain management and policies. Attendees had many questions and comments to share, particularly on the National Flood Insurance Program and its impacts on communities.

It is clear that Flooding Part II will be a topic for the CAA in 2015. In the mean time, state and municipal planners and public works officials are already incorporating Green Infrastructure and other Low Impact Development techniques like green roofs and rain gardens to reduce stormwater runoff volumes. Now we should consider adopting updated rainfall data so that new and retrofitted infrastructure design will accommodate more frequent extreme rainfall events. So we can be better prepared if 50 becomes the new 10.

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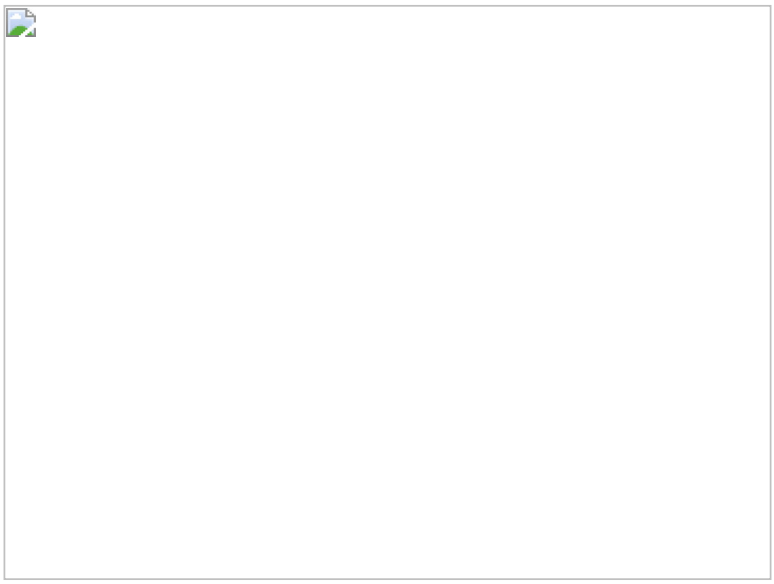
SPOTLIGHTED COASTAL ACCESS:
Waterford Beach Park--A Beach for All Seasons

Welcome to fall on the Connecticut shoreline. The crowds are gone, air and water temperatures are still warm enough to stroll along the beach at the water's edge, and late migratory birds may still be seen feeding or resting in nearshore coastal waters and saltmarshes. Seize the day and experience the beauty of New England's most celebrated season by visiting Waterford Beach Park, one of eastern Connecticut's best-kept natural secrets.

Waterford Beach Park is a town-owned 100-acre outdoor recreation area on Long Island Sound. Although it hosts a range of recreational amenities including tennis courts, playscapes and picnic pavilions, the Park's namesake, Waterford Beach, is its main attraction. This narrow ½ mile-long white sand beach is bounded on the east and west by two rocky outcrops and on the north by one the best examples of a primary dune system in Connecticut. Two major breaches in the dune from recent storms were repaired by the Town in early 2013. Since that time, sand is accumulating and the restoration plantings of beach grass are establishing to stabilize the dune. The Town continues to install and maintain snow fence and signage. A soon-to-be completed Town acquisition of 100 yards of sandy beach adjacent to the western rock outcrop will fill an existing gap in the public ownership of the beach. On the sheltered side of the dunes lie Alewife Cove and a small saltmarsh.



Sunset at Waterford Beach
Photo Credit: Brian Flaherty, Town of Waterford

Beaches connected to bedrock ridges at both ends and backed by a freshwater lagoon are classified as "welded barrier beaches." At Waterford Beach, Alewife Cove is a saltwater cove with an open connection to the Sound, so the beach cannot be considered a welded barrier. Nor is it a true a pocket beach because the bedrock pinning the east end of the beach is not connected to the mainland. Like many other Connecticut beaches, Waterford Beach is a hybrid of these two types of beaches, not quite a welded barrier and not quite a pocket beach, but a blending of both that provides an exceptional natural outdoor recreation experience. Sunbathing and some of the best deep-water swimming in Connecticut are the most popular summer season activities at Waterford Beach. From the third Saturday in June to Labor Day, a Park entrance fee is charged and lifeguards are on duty. After Labor Day, thrifty visitors can enjoy a walk along the surf and carefully climb the rock outcrops at each end of the beach. From these vantage points, visitors are rewarded with views of New London's Ocean Beach Park and the Ledge Light lighthouse to the east, and the architecturally significant former Seaside Regional Center to the west.

More active visitors can launch their kayak or paddleboard (while donning a wetsuit!) and paddle Alewife Cove where a variety of waterbirds may still be seen. But proceed with caution: the strong tidal currents in the channel connecting Alewife Cove to the Sound make it difficult to navigate back into the Cove on an outgoing tide. While the Cove's waters remain warm enough, children will enjoy crabbing from the footbridge over the tidal creek connecting Alewife Cove and the Park's saltmarsh. The footbridge can be accessed along the walkway leading from the parking area to the beach.

As the Sound's water temperatures dip to the low 60s (F) in October, saltwater anglers casting from the rock outcrops flanking the beach may still be able to land late-season migrating bluefish or striped bass. Blackfish and scup remain as possible catches along the rocky shoreline later in the fall and winter as water temperatures continue to decline.

Before leaving the area, be sure to visit the grounds of the Eugene O'Neil Memorial Theater and Harkness Memorial State Park, located adjacent to Waterford Beach Park on Great Neck Road (State Route 213).

For more on Waterford Beach Park and approximately 300 other places open to the public on Connecticut's coastal waters, please see the Connecticut Coastal Access Guide.

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Waterford Beach
Image: Google Earth

Purchase of a LIS License Plate Supports the LIS Fund

As of May 31, 2014:

Plates Sold: 154,660
Funds Raised: More than $5.3 million
Number of Projects Funded: 331
(includes Ecosystem Management projects)

The LIS Fund supports projects in the areas of education, public access to the shoreline, habitat restoration, and research.

For information on ordering a Long Island Sound License Plate, call 1-800-CT-SOUND.

Eat Your Seaweed! It's Good for You and for Long Island Sound

Seaweed Farming May Help Reduce Nutrient Pollution

How many times did your mother tell you to "eat your vegetables!" when you were growing up? While she was probably referring to broccoli and green beans, she should add seaweed to that list. After all, vegetables are plants and seaweed is a plant that grows in the ocean. And not only are some seaweed good for you, they are also good for the marine ecosystems of Long Island Sound since they provide an "ecosystem service" to the Sound in several ways.

Thriving healthy seaweed beds provide protective habitat for young fish and crustaceans. While these creatures are in their larval stages of life, they can hide among the seaweed and the shells of mussels and oysters that live on the sea floor. The seaweed also absorbs nutrients (such as nitrogen and phosphorous compounds) which helps to clean the water of nutrients.

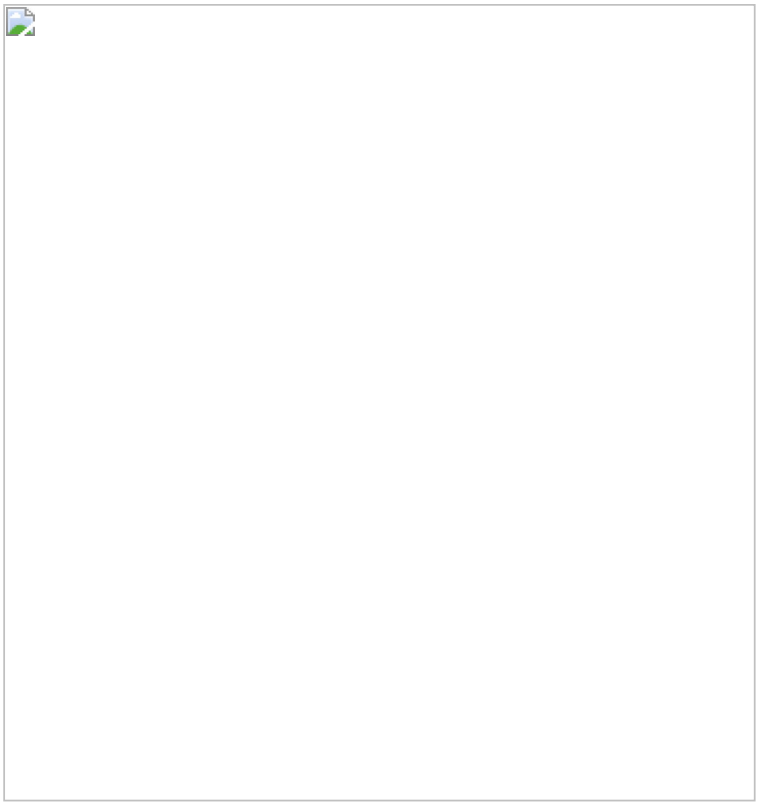
It turns out that these natural "ecosystem services" are very important for the health of Long Island Sound.

About 30 years ago, the Long Island Sound Study estuary program was established to study pollution problems in Long Island Sound. It didn't take long for the study to determine that the biggest problem facing the Sound was low dissolved oxygen--a condition known as "hypoxia"--in the water during the summertime. The primary cause of hypoxia is nutrient pollution in the form of too much nitrogen, phosphorous, and carbon in the Sound. Acting like the fertilizers we put on lawns and gardens to make them grow, these excess nutrients entering Long Island Sound waters cause the excessive growth of algae and plankton which use up oxygen in the water when they decay and settle to the bottom waters of the Sound. The two primary sources of excess nutrients are sewage treatment plant discharges and nonpoint source stormwater runoff.

Over the last 20 years, the states of Connecticut and New York have implemented an aggressive campaign to upgrade sewage treatment plants to remove nitrogen in order to reduce their nutrient load discharges to the Long Island Sound. A second phase of the campaign to reduce nutrients in Long Island Sound is to address the nonpoint sources of nitrogen within the Long Island Sound watershed. On the land, many best management practices to intercept and remove the nutrients from stormwater runoff have taken hold in the last five years. Strategies to use "Green Infrastructure/Low Impact Development" techniques such as rain gardens are removing many nutrients and contaminants from stormwater before it flows into Long Island Sound. These campaigns have been very successful and we are seeing some positive results, but some nutrient contaminants are still capable of making it past all of those management practices into the Sound. So researchers are looking for ways to remove nutrients from Long Island Sound waters themselves.

That's where seaweed "ecosystem services" come into play. Growing seaweed in Long Island Sound can serve several purposes: removing excess nutrients from Sound waters (also known as "bioextraction"), creating jobs, and producing a harvestable product that can be used in a variety of ways, from human and animal food to alternative energy biofuels. The Long Island Sound Study supports and promotes the use of these bioextraction methods as a complement to the other strategies that Connecticut and New York have implemented for reducing nutrient loads to Long Island Sound.

Recently, a group of scientists, environmental groups, and aquaculture entrepreneurs ("ocean-farmers") have partnered to start pilot projects in Long Island Sound to grow seaweed. The Project Team includes researchers Charlie Yarish and Jang Kim from the University of Connecticut, environmental groups in the Bronx, New York, the Bridgeport Regional Aquaculture Science and Technology Education Center (BRASTEC), and commercial oysterman Bren Smith. Working off the coast of Branford, Connecticut, the team is providing seed stock and growing areas for native seaweeds (a summer crop known as



UConn Researchers Harvest Seaweed in Long Island Sound
Photo Credit: Long Island Sound Study

Gracilaria and a winter crop known as *Saccharina*). Some of the seaweed seed stock has been planted by BRASTEC in the waters off Fairfield, Connecticut and by Water Blues/Green Solutions in the Bronx River. Connecticut-grown seaweed has quickly gained a reputation in the region as a superior food product, and the nitrogen removal data looks promising.

So, the next time you buy sushi, give Long Island Sound a "kelping" hand and take a bite out of pollution: ask for locally grown seaweed. You'll make your mother happy too.

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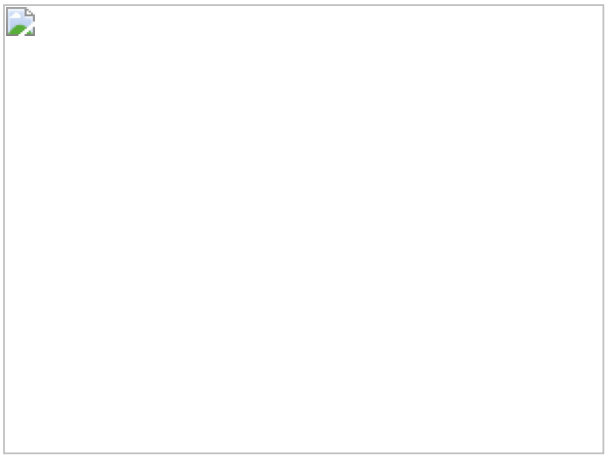
Wetlands Rival Bulkheads for Erosion Control

In assessing the property damage caused by Tropical Storm Irene in August 2011 and "Super Storm" Sandy in October 2012, Office of Long Island Sound Programs staff observed that "hard" structures like seawalls and bulkheads did not live up to their top billing as erosion control superstars. It was evident to staff that areas protected by natural techniques like sand dunes and tidal wetlands sustained much less damage than areas buffered by hard structures.

Now there is scientific evidence that OLISP Staff's post-storm observations are more than mere anecdotal speculation!



Tidal wetlands can be an effective
"living shoreline" erosion control technique.
Photo credit: CT DEEP OLISP

Researchers at the University of North Carolina at Chapel Hill published a September 2014 report in the scientific journal *Ocean and Coastal Management* that compared the effectiveness of several different shoreline protection techniques during Hurricane Irene, which was a Category 1 storm when it hit North Carolina (maximum sustained winds ranging between 74 and 95 miles per hour according to the Saffir-Simpson Hurricane Wind Scale). The researchers looked at the damage caused to each technique from the storm at three locations throughout coastal North Carolina, and measured shoreline erosion of marsh surface elevations in one region before and after the storm. They found that in the central Outer Banks, which experienced the strongest sustained winds across the longest stretch of open water, Hurricane Irene damaged 76% of the bulkheads in their study, while there was no significant damage to the surface elevations of the marshes. And while there was some damage to marsh vegetation caused by the storm, vegetation density recovered to pre-hurricane levels within one year--no doubt a less-expensive fix than rebuilding a bulkhead.

This study bolsters Connecticut's efforts to encourage the use of "living shorelines" like wetlands as an effective erosion control technique (please see the June 2012 issue of *Sound Outlook* for more information on living shorelines). If wetlands can help erosion-prone areas withstand a Category 1 hurricane along the Outer Banks of North Carolina, they should do very well in Long Island Sound!

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Climate Change Update: Connecticut's Coast Gets "SLAMMed"

Computer Model Examines Potential Effects of Sea-Level-Rise on Connecticut's Coast

In Connecticut, coastal processes like hurricanes and tropical storms can change the character, location, and extent of critical coastal resources, suddenly and dramatically altering large areas of the coast. But common and subtle processes not associated with storms, like monthly new- and full-moon high tides or changes in seasonal wind direction can also, over longer periods, transform the character of coastal systems such as tidal wetlands and beaches.

We know how essential tidal wetlands are as a part of Long Island Sound's larger ecosystem, and University of North Carolina researchers have confirmed how important they can be for erosion control purposes. But as resistant as these resources are in a Category 1 hurricane, they will simply drown if sea levels rise faster than the wetlands can accumulate sediment and build-up their surface elevations.

A 2006 U.S. Fish and Wildlife Service study of tidal wetlands along the Connecticut portion of western Long Island Sound indicates that some of our state's wetlands are already transitioning to intertidal mudflats and open water. These findings, coupled with the importance of tidal wetlands to the health of the Sound's larger estuarine system and the generally accepted expectation within the scientific community that sea level rise (SLR) rates are increasing, led DEEP's Office of Long Island Sound Programs (OLISP) to team with the New England Interstate Water Pollution Control Commission, EPA's Long Island Sound Study, and New York's Department of Environmental Conservation to investigate the possible consequences of predicted increases in SLR rates on the Sound's marshes and beaches.

The investigation, being developed for CT DEEP and its partners by Warren Pinnacle Consulting, uses a computer model called Sea-level-rise Affecting Marsh Migration (SLAMM) that assigns probabilities to the potential responses of Connecticut's coastal marshes and adjacent upland areas under four different SLR scenarios. These scenarios were run at 7 time-steps between 2010 and 2100 using high-resolution elevation data, the National Wetlands Inventory, flood hazard areas designated by the Federal Emergency Management Agency (FEMA), DEEP Dam information, NOAA tidal data from three Connecticut tide stations, as well as marsh surface elevation change rates provided by cooperating academic researchers.

A preliminary run of SLAMM for the lower Connecticut River estuary area is shown in the figures below. Figure 2 shows the conversion of Great Island marsh with a 3 foot (1 meter) rise in sea level. Figure 4 shows a rapid-polar-ice-melt-scenario with a 5 [illegible] foot rise in sea level, which could result in a significant conversion of Great Island marsh from tidal wetlands to open water by 2100.

The results of the SLAMM investigation will be used to help the state and coastal municipalities identify and prioritize potential SLR adaptation strategies, including coastal land acquisition, marsh restoration, infrastructure development, and other land and facility management actions. Additional coastal areas throughout Long Island Sound will be "SLAMMed" through the end of 2014 to model potential land cover change. As this data is released, it will be shared with coastal municipalities, and summaries of key findings will be reported in future issues of *Sound Outlook*.

Visit the DEEP website at **www.ct.gov/deep**.

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Please contact Kevin O'Brien at 860.424.3432 for more info about the SLAMM model.

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