Flooding simulation at the Fraunces Tavern ® by Anita Kusick; photo by Peter Reitzfeld

# Closing the Doors on Storm Surges

The storm warnings are up. Torrential rains, flooding, strong winds and high seas are expected to hit the area as the powerful storm reaches the metropolitan area early this evening. The storm gathers strength as it moves north. The forecasters are calling this a 100-year storm. The NY metro area braces for impact.

In the middle of rush hour, the giant storm slams ashore with 110 mph winds and a storm surge 12 feet above mean high tide. Large scale flooding occurs as low-lying neighborhoods are inundated. Massive flooding along the FDR Drive stalls vehicles. Stranded motorists are trapped by rising water and buffeted by high winds and driving rain. Sea water floods the Brooklyn-Battery Tunnel.

Continued on page 6



*Spring '05* A Publication of New York Sea Grant *Vol.34/No.1*

Sea Grant New York

NOAA

OCEANS

continued from page 1

# Closing the Doors on Storm Surges

### Storm Surge

**According to the Federal Emergency Management Administration (FEMA), storm surge is simply water that is pushed toward the shore by the force of winds that are part of a storm. This advancing surge combines with the normal tides to create a storm tide which can increase the mean water level 15 feet or more in some areas. This rise in water level can cause severe flooding in coastal areas, particularly when the surge coincides with the normal high tides.**

Subway lines in lower Manhattan, Brooklyn and Queens are flooded by sea water, stopping service and trapping passengers. Shorts and electrical fires halt the entire subway system. Basements of buildings are flooded and electrical systems shorted out. Downed utility lines leave 250,000 customers without power, and repair crews are hampered by flooded streets. As the storm lashes the area, a year's worth of coastal erosion occurs in one day.

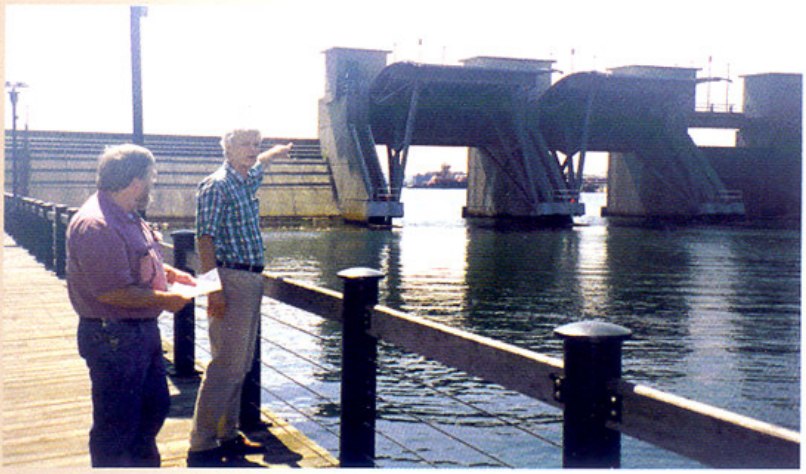
When it's all over, a shaken and battered New York and northern New Jersey assess the damages. Thousands are left homeless, recovery will take months and the damages are expected to be in the billions.

This scenario may seem like frightening fiction out of Hollywood. However, according to scientists, the scenario of a massive storm hitting the New York metro area is very possible. It is not a question of if, but a question of when. Led by **Dr. Malcolm Bowman**, New York Sea Grant researchers at Stony Brook University's Marine Sciences Research Center have studied the possibility of protecting the metropolitan New York City area from powerful storms through the use of storm surge barriers. Such barriers erected at three "choke points" would effectively seal off the area from incoming storm surge (see map page 7). The question Bowman and his Stony Brook Storm Surge Research group addressed was this: Would such barriers work and protect the area from devastating surges of powerful storms?

Our region is always at risk for large, damaging storms such as hurricanes and nor'easters that can produce unusually large storm surges resulting in severe flooding. Add to that the impact of global warming and sea level rise which would increase the frequency and severity of damaging storms. Says Bowman, "The damage done by a 100 year storm now will equal the damage done by a 25 or 50 year storm later in the century if sea level rise accelerates."

In the wake of the devastation caused by the December 2004 Indian Ocean tsunami, many started to wonder if New York is vulnerable to such destructive waves. Though chances are small that an earthquake-generated tsunami like the one in the Indian Ocean would strike New York, storm surge is an ever-present threat. The question remains: Is there anything that can be done to protect the New York metropolitan area from a major storm surge? Fortunately the answer is yes. First of all, accurate weather forecasting provides early warning that allows time for evacuating vulnerable areas and saving lives. However, the region's population density would make evacuation slow and difficult, limiting its usefulness. Also, valuable infrastructure would still be vulnerable and costly to repair or replace. According to NYSG research, the building of storm surge barriers could protect valuable real estate and infrastructure and reduce the need for a costly and dangerous evacuation.

To determine the potential effectiveness of hypothetical barriers built at The Narrows, the upper East River (near the Whitestone Bridge), and at the mouth of the Arthur Kill (Perth Amboy, NJ), the research team developed a modeling system that adapted and combined two well-established numerical models that are used to help predict regional weather and coastal ocean currents. The system, called the Stony Brook Storm Surge system (SBSS) integrates the Advanced Circulation Model for Coastal Ocean Hydrodynamics (ADCIRC) and the MM5, a regional weather forecasting model.



**Co-investigators Roger Flood (l.) and Robert Wilson (r.) view the three Tainter gates at the Fox Point Hurricane Barrier in Providence, RI. Others working with the research group are Douglas Hill, Brian Colle, Frank Buonaiuto and several students. Photo by Douglas Hill**

**This retractable storm surge barrier spans 3,000 meters across the Eastern Scheldt in the Netherlands.**
**ANP–Foto**

**Cover photo: The Fraunces Tavern ® was built in 1719 on marshy ground in lower Manhattan and was frequented by George Washington. At only a few feet above sea level, the area near the Battery is at risk for flooding should a huge storm surge accompany a 100-year storm.**

***Fraunces Tavern ® is a registered trademark of Sons of the Revolution in the State of New York Inc.***

The SBSS uses calculations from both models to simulate the impacts of surges from major storms. It can also show how effectively barriers would protect the metropolitan area from storm surge flooding. This system provides the research team with a valuable tool that can be updated as new data become available and then used for future modeling.

The research group validated the model by running it using conditions from previous real storms to simulate water levels and then compared their results with actual observations of the storms. The results showed the model to be accurate. The simulations (called hindcasts) of the September 1999 Hurricane Floyd (downgraded to a tropical storm by the time it reached NY) and the Christmas 2002 nor'easter showed that model predictions were almost identical to observed values.

With the model validated, the researchers next used the model system to predict what effect the closed storm surge barriers would have during a storm. They created a scenario in which a storm generated wind speeds almost double that of Tropical Storm Floyd. They dubbed this synthetic storm "Super Floyd." Such a storm would lead to a peak water level of four feet above mean high tide at the Battery in lower Manhattan, somewhat higher than the three feet peak caused by Floyd.

With such anticipated high water levels, how well would the barriers work? If they had been closed at low tide before the approaching storm, the model predicted that the barriers would have been very effective at the three planned locations. With the barriers closed, water levels on the inside remained at normal levels during the period of the storm.

The results of this project show that storm surge barriers would be effective in protecting some low lying parts of the NY metro area from storm surge flooding. According to researcher Robert Wilson, "Analysis of results continues, including the possible amplification of storm surges outside (seaward) of the barriers."

Of course, actually building such barriers would need to take into consideration a host of other factors including cost and environmental issues. Such barriers have been built in New England, Holland and England and have been effective in providing protection against storm surge flooding. In these cases they were built following flooding disasters with loss of life. With careful planning and foresight, such a disaster could be avoided in New York. This project provides the first step.

**— Lane Smith**


**This metropolitan area map indicates in white the hypothetical locations of storm surge barriers used for modeling.**
**Base map courtesy of Laura Bartovics**