Case Study

Virginia: Tidewater Area

Water Resource Strategies and Information Needs in Response to Extreme Weather/Climate Events

Tidewater Area

Water Trends

Tidewater Virginia is subject to storm surges, tidal flooding, hurricanes, and nor'easters. Since 1970, there have been ten significant storms, the majority since 2003. Significant storms are predicted to become more frequent.

The lower Tidewater area is second in the continental US for risk of hurricanes, storms, and sea level rise (SLR). Risks are high because of area population growth and national security assets. Relative SLR is accelerated by land subsidence due to compaction of underlying soil formations, and groundwater withdrawal. The Sewell's Point gage at the Norfolk Naval Station has recorded a sea level rise of 14.5 inches since the late 1920s. Scientists predict a local relative SLR of 1.5-feet in the next 40 years and three feet by 2100.

The region is subject to saltwater intrusions into fresh water. SLR threatens the coastal ecosystem, with potential loss of 50% – 70% of wetlands. With 85% of Virginia's shoreline privately owned, this has economic implications for residents, commerce, military installations, and utility services.

Governing Structures

The Hampton Roads Sanitation District (HRSD) is the only sanitation district in Virginia. HRSD owns the treatment plants; the cities own the collection systems and are responsible for stormwater management. Virginia has 21 planning districts, but local governments make all land use decisions. While every locality has a comprehensive land management plan, some allow development in flood-prone areas.

Naval Facilities (NAVFAC) Engineering Command Mid-Atlantic is responsible for design, construction, and maintenance of Navy facilities but gets its water and wastewater services from the municipal systems, as do the other military installations in the Tidewater area.

The Story in Brief

"Tidewater" is the eastern Virginia coastal plain where the James, Rappahannock, and York Rivers join the Chesapeake Bay. Within the lower Tidewater there are four cities (Hampton, Newport News, Norfolk, and Virginia Beach), rural and small communities, military installations including the world's largest naval station (the Norfolk Naval Base), and a large state-owned cargo port. Three metropolitan drinking water utilities and one sanitation district serve 1.7 million people. The region has many wildlife refuges and recreational beaches, alongside areas of dense development. All of this sits at an average 33 feet above sea level, posing challenges to the area's water and wastewater utilities and to the delicate balance between fresh and salt water in the estuarine environment, especially in light of heightened storm threats.

Hurricanes, Nor'easters, and Sea Level Rise (SLR)

Impacts

In 2003, Hurricane Isabel, a slow-moving storm, stalled over the York River during high tide causing storm surges to reach record highs. Isabel killed 36 people in Virginia and caused more than $1.8 billion in damage, cutting off electricity for 1.8 million customers. Again in 2009, Nor'easter Ida caused some of the worst damage ever experienced in the area. Ida lasted six tidal cycles with winds pushing water above the 4.5-foot flood stage and creating surges over 6.7 feet.

Given this history, in August 2011, before Hurricane Irene's predicted arrival at Hampton Roads, Virginia's governor declared a state of emergency. The US Navy sent dozens of ships to sea, universities closed, ferries were stopped, both mandatory and voluntary evacuations were ordered, and water/wastewater utilities activated their emergency response plans. The storm stalled over the area. By high tide, storm surges over 7.5 feet at Sewell's Point were recorded.

"Local governments are faced with the realities of sea level rise and coastal storm impacts and they are in need of solutions and assistance to deal with these challenges."

Dr. Carl Hershner, Director of the Center for Coastal Resources Management, VIMS

On August 25 and 28, 2012, two "short-fuse" nor'easters hit the same 30-square-mile area with high rainfall (2-3 inches/hour) over a short period (2-4 hours), each exceeding a "hundred-year" event.

The most widespread impacts from these events were flooding and power failures. Uprooted trees triggered water line breaks requiring expensive repairs. Isabel caused 250 of 400 small wastewater pump stations to lose power. Ida caused 60% of Virginia Beach's outfalls to fill with silt and caused a partial dam failure on the Chickahominy River. At the Norfolk Naval Base, the storms caused base and roadway flooding, over-topped piers, disrupted utilities, eroded the shore line, caused pier and bulkhead scour, destabilized the ground, and increased loads on structures.

Water and wastewater facilities built on shorelines are particularly vulnerable. Coastal erosion is affecting infrastructure. SLR is causing salinity of inland water sources, and utilities are recording salt water at their intakes. Newport News raised its reservoir water level one foot to keep freshwater upstream and brackish tidal water downstream. SLR inhibits drainage, raising risks from disease vectors like mosquitoes.

Water Utility and Community Response

The severity and frequency of recent storms have motivated localities to collaborate for both acute emergencies and long-term planning by conducting what-if and worst-case scenario analyses and tabletop exercises to consider asset and operational vulnerability. Utility managers share information and seek common funding sources and methods.

To prepare for acute events, local utilities have adopted "action tables" for each wastewater facility on how to respond based on various storm tide levels. After-action reports help managers refine emergency operations, review water levels and flows, and evaluate operational performance. Utilities and other agencies identify critical redundancy needs, such as deploying portable backup pumps and generators prior to events. Widespread dependence on cell phones, which themselves are dependent on electricity, has prompted use of system backups for operations, and utilities are working to align plans with private-sector telecom providers to ensure reliability. Innovative mechanisms have

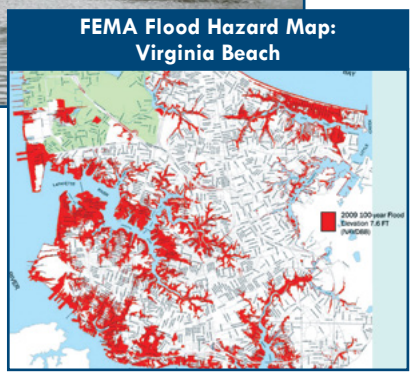
A series of workshops focusing on extreme events and water resources, co-sponsored by the National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (US EPA), Water Environment Research Foundation (WERF), Water Research Foundation (WaterRF), Concurrent Technologies Corporation (CTC), and NOBLIS.

NOAA EPA WERF WaterRF CTC Noblis

been adopted to disseminate information to the public, including the Norfolk Flooding Website (an emergency alert system), Facebook, and Twitter.

To increase long-term resilience, Norfolk is redesigning its 60-year-old drainage system. Inserts in manhole covers help reduce infiltration into sewer lines. Water systems are monitored for saltwater intrusion, and an aggressive effort is underway to identify and remove trees that can take down power lines or pull up and damage water lines. To prevent damage from repetitive flooding, managers are raising control panels, installing watertight doors and hatches, and moving portable equipment to higher ground during storms. Dam managers are improving overflow structures to relieve pressure, and they have an active inspection program to prevent damage from trees and rodents.

The Naval base's strategic importance and position, sixteen feet above sea level, has prompted it to incorporate SLR into its Master Plan, Region Shore Infrastructure Plans (RSIP), and Global Shore Infrastructure Plan (GSIP). Measures being evaluated include building new unloading decks with utility lines and shutoff valves safely above potential water levels, adapting existing infrastructure with flood walls around dry docks and installing tide gates, raising pier elevations, and siting facilities out of impacted areas. The Navy is engaging in shoreline protection projects, including adopting low impact development to reduce runoff. It has expanded its damage assessment teams and emergency operations center and is working with the local community on areas of mutual concern. However, challenges abound. For example, the Navy can elevate buildings and land, but must consider load-bearing capacity of underlying infrastructure, base access, and utilities on and off base.

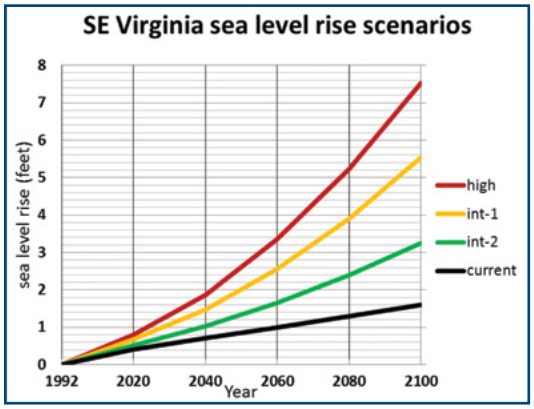


Looking Forward

Utilities are grappling with environmental challenges, aging infrastructure, and a struggling economy along with a changing climate. Critical high-cost investment priorities are causing utilities to reach limits set by US EPA's Affordability Guidelines and are stretching communities' ability to pay.

Nonetheless, there is a growing awareness of the need to manage risk and to take a proactive approach to protecting current assets and preserving ecosystem functions. The Tidewater region is deploying new and more sophisticated technologies. For example, they are undertaking comprehensive LIDAR (light detection and ranging) airborne laser mapping that they will combine with ground topography and elevation mapping to help citizens identify their risks and to improve floodplain management.

(Top) The cost of raising one block of housing above flood level is about $1.2 million in Norfolk, VA. (Middle) FEMA's flood hazard map of Virginia Beach shows how floods threaten areas. (Bottom) Sea level rise scenarios show four estimates based on 2012 National Climate Assessment global scenarios. Even a conservative estimate (green) predicts a 1.5-foot (0.5 m) SLR by 2052.



Water managers expressed a need to raise the public's understanding of the difference between impacts and responses to tropical storms vs. nor'easters so that public and private solutions are effective in both cases. The public also needs access to accurate and timely information for decision making.

Virginia promotes regional collaboration and intergovernmental relationships through active regional planning commissions and citizen boards, such as HRSD and Hampton Roads Planning District Commission. Engaging area utilities, including those in rural areas, has the potential to increase the effectiveness of a coordinated regional approach to building resilience.

The Navy is an important actor and its installations are an integral part of the regional planning process. The Virginia Institute of Marine Science (VIMS) and Virginia Emergency Management Association (VEMA) are important partners in understanding and responding to risk from extreme events. The work of VIMS and the Virginia Department of Environmental Quality in promoting living shorelines to control ecosystem erosion is a vital aspect of adaptive planning.

Although limits exist on what individual water utilities can do given their resources, understanding, and authority, they are increasingly integrating their resources and strengthening their relationships with other water managers, private service providers, and federal and other agencies, thus increasing their resilience and further minimizing risks.

To learn more about how the water sector is responding to extremes, visit:
http://www.cpo.noaa.gov/ClimatePrograms/ClimateSocietalInteractionsCSI/SARPProgram/ExtremeEventsCaseStudies.aspx

Lessons Learned

- What-if and worst-case scenario planning can help prioritize budgets and future response actions.
- Solutions require sensitivity to people's values and concerns.
- Hard asset locations should be assessed and operational "brain centers" moved from at-risk areas.
- Tools for rapid communication are essential for controlling messages and ensuring quick and appropriate emergency responses.
- Local communities need flexibility to implement local solutions.
- Engineering design standards must be based on the reasonableness of expected levels of service, sensitivity of facilities, criticality of assets, and budgets.
- Backup power must be provided for critical systems and communications.
- Real-time data and alerts, which can be shared among fusion centers, and emergency operations centers, must be accessible.

Useful Tools and Resources

- Virginia Interoperability Picture for Emergency Response (VIPER) – a GIS-based platform that links data
- WebEOC – a web-based emergency operations center, run by the Virginia Department of Emergency Management
- Water Agency Response Network (WARN)

Information Needs

- Improved forecasts for short-term and less-intense storms, especially at a local level
- Socioeconomic impact studies
- More sophisticated models that include different elevations and levels of inundation and that incorporate SLR, precipitation, bathymetry, storm surges, high tides, hurricanes, and nor'easters
- Public education on risks and differences between flooding and storm surges
- Information and incentives to help land- and home-buyers make educated decisions about their investments
- Guidance to water and wastewater facilities on how to incorporate new information on SLR estimates in their planning approaches and on understanding what HAS happened versus what COULD happen
- Grants to help smaller communities plan