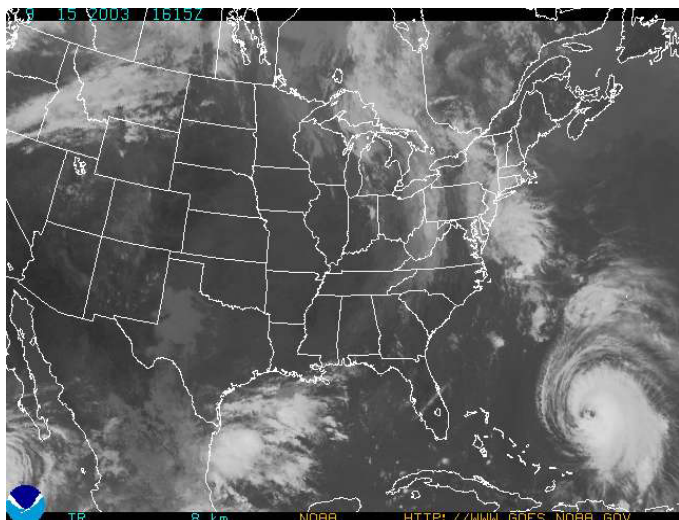


Virginia Water Central

Virginia Water Resources Research Center Blacksburg, Virginia November 2003 (No. 28)



Hurricane Isabel approaching the East Coast on September 15, 2003. Items on Isabel begin on page 8. Photo from National Weather Service, [iwin.nws.noaa.gov/iwin/images/ecir.html](http://www.noaa.gov/iwin/images/ecir.html), 9/15/03.

This issue's **Feature Article** describes the management of Virginia's marine fisheries.



"Three-mile coastal waters, 200-mile offshore waters, migration routes—who's watchin' the fish?"

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Science Behind the News presents several items on devastating Hurricane Isabel, including a National Weather Service meteorologist's assessment of Isabel and her lessons for forecasters, plus some basic facts on the 2003 season's other Atlantic storms.



"Winds, waves, storm surges, deluges, flooding, power failure—Isabel was one BIG storm and story."



VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

FEATURE ARTICLE

Managing Virginia's Marine Fisheries

Ed. note: The following is an excerpt from a June 2003 publication of the same title by Virginia Sea Grant Communications, Virginia Institute of Marine Science, Gloucester Point, Va. This excerpt includes some rewording and deletions for space, along with a few additions (shown in brackets). *Water Central* thanks Sally Mills and Va. Sea Grant for permission to reprint this information. For more information or to request the complete publication, contact Va. Sea Grant at (804) 684-7167.

In the United States, marine waters and associated flora and fauna are considered common property resources and, as such, fall under the purview of federal and state governments to be managed for the benefit of all citizens. While coastal states are responsible for managing marine fishes in waters extending three miles from land, the **National Marine Fisheries Service** (NMFS) assumes primary management of marine fishes from 3—200 miles offshore. NMFS is an arm of NOAA (the National Oceanic & Atmospheric Administration), and the legislation that directs how this federal agency manages the nation's fisheries is the **Magnuson-Stevens Fishery Conservation and Management Act**, also known as the "Magnuson Act." [Please see Table 1, at the end of this article, for a list of the agencies that manage Virginia's common marine fish and shellfish.]

The Magnuson Act established a set of consistency standards across the United States for managing the nation's marine fishes. The process of meeting these standards is undertaken through a shared management structure of eight regional councils, who report to the Secretary of Commerce and advise the NMFS about fishery conditions. The councils produce **Fishery Management Plans** (FMPs), which are the guiding force behind public stewardship of the nation's most popular—and therefore most stressed—marine fishes. Fishery management plans represent the



culmination of exhaustive research and input solicited from scientists, fishery managers, members of the seafood industry, and a host of interested citizens. Fishery management plans, therefore, are key to understanding the basis upon which regulations are made.

In 1996, Congress amended the Magnuson Act by passing the **Sustainable Fisheries Act** (SFA). New language found in the SFA calls for increased attention to the reduction of **bycatch** [harvest of species other than that for which fishing gear is set] and the protection of fisheries habitat. With these changes, the fisheries management paradigm shifted from a "species-by-species" approach to that of a more holistic, multi-species approach that recognizes the needs and services of all marine life sharing a common habitat.

At the same time, Atlantic coastal states came under control of the **Atlantic States Marine Fisheries Commission** (ASMFC) for migratory species moving through state waters. The decisions of the ASMFC now govern how Virginia manages many of its most cherished fishes, including Striped Bass, Summer Flounder, and Grey Trout.

Fishery management plans are, by all accounts, complex. They describe the nature and problems of a fishery and recommend actions needed to conserve it. At the federal level, FMPs are approved by the Secretary of Commerce, and the regulations that implement attendant management measures become federal law. Enforcement falls to the NMFS, the U.S. Coast Guard, and state enforcement agencies.

Fishery Management Plans

While it is beyond the scope of this article to address the detailed dimensions of a fishery management plan, it is important to understand the key pieces upon which one is built. A fishery management plan typically includes the following components:

- An overview of fishery parameters, such long-term potential catch, economic importance, and mortality rates;
- A biological profile of the species;
- Habitat-specific requirements of the species and predator-prey relationships;
- A production profile of the fishery, including landings trends and gear use and efficiency;
- An economic profile of the fishery, including the value of landings and ripple effects upon packers, distributors, and the local economy;
- A statement on the status of the resource—called the “**stock assessment**,” this is the main scientific basis for management regulations. It includes the best information available on current abundance, mortality, and exploitation, and uses that information to establish thresholds [that are designed] to ensure sustainability of the resource;
- Identified data and research needs;
- Existing regulations and management efforts; and
- Specific strategies proposed for action to put the fishery back on track. These might include limiting access, mandating gear changes, imposing more-conservative size restrictions, establishing a marine protected area for the species, and (most dramatically) placing a moratorium on harvesting.

While fishery management plans provide a road map for states to follow, those issued at the federal level stop short of dictating how

Virginia, or any other coastal state, should get there. Instead, it is up to state resource managers to deliberate on those goals and respond with a plan of action that takes into account—and attempts to balance—the needs of various constituents with an interest in marine fisheries, while imposing regulations that sustain the overall health of the stocks.

Fishery management is a dynamic process, of course. As time passes, fish stocks change and it is often necessary to amend or update a management plan. The amendment process is arduous and may take a year or longer to complete. Virtually all Virginia marine fishes for which federal FMPs have been written are now being updated.

In Virginia waters (from the point of tidal influence to three miles offshore), the agency charged with managing marine fisheries is the **Virginia Marine Resources Commission** (VMRC), as directed by the *Virginia Code*. Revenue to do this is provided by the state’s general fund and commercial and recreational fishing fees.

A Birds-eye Look at the VMRC

The VMRC promulgates fisheries regulations through a nine-member board assisted by the director. Board members are appointed by the governor. The agency’s stated mission is to “balance the needs of a growing population for development, commerce, and recreation, with the goals of resource conservation and protection in the marine environment”—no small task indeed.

Access to commercial and recreational fishes is controlled through the issuance of licenses, and the use of approved harvesting gear (both commercial and recreational) is controlled by special permits. A suite of management tools is used, based on information received from marine scientists and fishery managers who regularly sample fish, track landings, and assess other industry-generated information. Analyses of fishing effort and overall stock conditions, as well as formulas designed to calculate threshold limits for maintaining sustainable stocks, are performed.

Restrictions on seasons, size, days at sea, and gear are imposed as needed to achieve

management objectives. Depending on the particular fishery and point in time, such objectives might aim to relax or tighten up access to the resource.

Advisors in the VMRC Process

As the VMRC's mission has expanded to meet a growing coastal population placing various demands on the marine environment, the agency has enlisted the help of **advisory committees** consisting of scientists, commercial and recreational industry representatives, conservationists, and fishery managers. Committee members are appointed by the agency's director and are chosen for their technical expertise and constituent representation. They report to the board and make action recommendations.

These advisory committees are the gears that make everything work. Commission staff, scientists, and industry members share their perspectives based on what they are seeing on the water and landed at Virginia docks. This information sets the stage for refining management tactics. In general, decisions factor in the biological health of the resource and socio-economic considerations of the fishing community. Spirited debate often takes place among members, who at times represent opposing views on resource conservation and exploitation.

Realistically, committee participation involves a significant time commitment and learning curve. Pouring over data and trends and interpreting the results in order to make a management decision does not happen overnight. Like the writing of FMPs, it is often slow and arduous. Industry folks have a reputation for wanting action more quickly, while scientists and resource managers often call for more comprehensive data and information to make valid assessments. While Virginia does not write state-specific management plans, the rigorous evaluations performed during advisory committee meetings, along with existing multi-state agreements or federal FMPs, are together viewed as serving the same purpose.

What comes out of these meetings—eventually—is tremendous compromise by all involved. It is through this “give and take”

that fishery regulations are shaped. Such regulations must be believable by the seafood industry, while incorporating the most current knowledge and advice of experts from many fields.

According to Jack Travelstead, who heads up the VMRC's Fisheries Management Division, “Advisory committees help design the regulations that will be supported by industry. This is key to the process. You must have ‘buy-in’ from those who are being regulated.” Because there is never enough money for 100-percent enforcement, such buy-in, education, and outreach to those affected become ever more important.

Unfortunately, few members of the public engage in the fisheries-management process in Virginia. While doing so requires taking a long view and following issues over time, investing such time and energy makes it more likely that a citizen can successfully convey their point of view.

Recommended actions coming out of advisory committee meetings are distributed to the VMRC board, and a public hearing date is set. During the hearing, additional public participation is encouraged and comments are taken. After completing the public participation process, board members vote on the recommendations. Any new regulations become part of the *Virginia Code*.

Other Managing Authorities in Virginia

In addition to the VMRC, other regulatory bodies share authority over Virginia's marine fisheries management. Marine fish moving through inland waters are jointly managed by the **Virginia Department of Game and Inland Fisheries**. Fish in the main stem of the Potomac River are managed in concert with the **Potomac River Fisheries Commission**. Similarly, many species of finfish are co-managed through the auspices of the **Chesapeake Bay Program** (CBP), a multi-jurisdictional body that has worked for more than 20 years under cooperative agreements intended to improve the health of the Chesapeake Bay ecosystem. Fish such as Summer Flounder, American Eel, American

Croaker, and Spot are examples of species for which CBP provides management guidance.

Shellfish Management

Management of Virginia's marine shellfish stocks mimics that of finfish; for Chesapeake Bay species, emphasis is placed on coordination with Bay partner states. Management of the Blue Crab, for example, is conducted through the Chesapeake Bay Program. In 1996, Virginia and Maryland established a Bi-State Blue Crab Advisory Committee was established to assess the status of the fishery and the effectiveness of existing regulations. After two years of study, they recommended—among other actions—a reduction in fishing effort Bay-wide. [The Bi-State Advisory Committee was discontinued in July 2003 due to reduced funding from Virginia.] That recommendation, now a formal part of the multi-state FMP, was translated into several new regulations for Virginia's crabbers. The regulations included a 15-percent reduction in fishing effort and a sanctuary that is off-limits to harvesters during spawning season.

Other shellfish, such as oysters, are also managed under Bay-wide management plans. What many of these plans have in common are goals and objectives that factor in the historical distribution and harvests of the resource, while paying attention to its unique behavioral or life history attributes that call for a more customized, state-specific management approach.

Shellfish Aquaculture

With the challenges imposed by disease and loss of habitat, Virginia is producing more and more of its marine shellfish stocks through **aquaculture** and **gardening** efforts. Aquaculture is booming in both hard clams and oysters; yet in terms of management, it remains the “black box” of Virginia's seafood story. The Virginia Department of Agriculture and Consumer Services, assigned the lead role in following aquaculture activity in the state, conducts periodic surveys on production in order to make impact assessments for the state economy. The latest report of statewide

information was published in 1995. More general information can be gleaned from the U.S. Census of Agriculture, which was last updated in 1998.

While the VMRC has responsibility for managing all subaqueous [underwater] bottomlands in the state, it does not track aquaculture production of clams and soft crabs or of oysters by the estimated 2,000 oyster “gardeners” in the state. Currently the exact contributions of this growing sector of the seafood economy in Virginia remain unknown, in part because aquaculture is still judged to be a very thin slice of the overall “pie” in food production.

Estimates are regularly made about aquaculture and its economic impacts, but a better idea of where and how much activity is currently underway appears to be needed. Issues have recently surfaced regarding incoming clam seed from other states (and with it, disease), forcing the VMRC to institute a tracking system on all importations. Little is known about non-indigenous species' impacts on local ecosystems, their ability to introduce new diseases, and their ability to out-compete native species for survival. The VMRC is considering the introduction of an aquaculture permit, proposing that the funds generated could be targeted to disease research and other management concerns.

Also requiring increased management attention are the conflicts arising between opposing user groups of the shallow water environment. This is especially apparent on Virginia's Eastern Shore, where 90 percent of clam aquaculture takes place and where clam farming in Chesapeake Bay-side creeks and ocean embayments is increasingly in direct opposition with shoreline development and recreational activity.

Multi-species Management

[As noted above, since 1996 the trend in fisheries management is toward **multi-species management**, that is, management strategies based on the habits and habitats of many species interacting within a fishery.] With the advent of multi-species management, more and more of the

information acquired about marine ecosystems must be expressed at a theoretical level, through **modeling** [using mathematics and computer programs to represent or simulate complex processes or systems]. The Virginia Institute of Marine Science (VIMS) is currently involved in developing such models, one of which aims to help managers who are working at the scale of the Chesapeake Bay. Scientists at VIMS are busy creating a sampling platform from which to survey the mosaic of creatures that co-exist across the water column and estuary bottom; these data will form the underpinnings of the model's design.

The benefit of such models is that they can incorporate the effects of technical progress (such as gear design) and biological interactions on population abundance. As such, the information acquired [from the models] and used to write multi-species fishery management plans will offer more realistic scenarios of what occurs in the water. Managers are quick to point out, however, that such models will augment, not take the place of, traditional single-species management plans.

Multi-species management requires greater emphasis on identifying essential fish habitat and reducing wasteful fishing practices, including bycatch. Similarly, concern continues to be raised over endangered animals living in our oceans, and laws and management strategies targeting their protection are on the rise. Two large impacts are likely to result: 1) more damaging harvest gears will be prohibited, with implications for Virginia's dredging gear; and 2) certain areas may become restricted from all fishing activity—for example, underwater grass beds that support the needs of juvenile fishes.

As more information about biological interactions is acquired and fed into ecosystem models, fishery management plans will require more frequent updates and refinements. This will no doubt translate into longer development time to write more complex plans governing the use and enjoyment of Virginia's marine fisheries.



Managing marine fisheries is a difficult task, and it is about to become even more challenging. For that reason, it is more important than ever that Virginians take an active role and make their voices heard in the ongoing dialogue.

Resources for More Information

Chesapeake Bay: Introduction to an Ecosystem. Chesapeake Bay Program, Annapolis, Md. 2000. Available online at www.chesapeakebay.net/pubs/ecosystem.pdf.

"Fish or Cut Bait: How to Participate in the Fisheries Management System." Mid-Atlantic Fisheries Management Council *et al.*, rev. 1999 [brochure].

Fisheries of the United States, 2001. National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics and Economics Division, Silver Spring, Md. 2002.

Guide to Virginia's Laws, Regulations, and Requirements for Marine Shellfish Aquaculture Activities. Virginia Marine Resources Commission, Newport News, Va. 1998.

Laws of Virginia Relating to the Marine Resources of the Commonwealth, 2002 Cumulative Supplement. Virginia Marine Resources Commission, Newport News, Va.

Status of Stock Assessment Knowledge Used to Manage Important Virginia Finfish Species. Virginia Marine Resources Commission, Newport News, Va.; and Virginia Institute of Marine Science, Gloucester Point, Va. 1996.

Understanding Fisheries Management: A Manual for Understanding the Federal Fisheries Management Process, Including Analysis of the 1996 Sustainable Fisheries Act; 2nd Edition. Auburn University Marine Extension and Research Center, Mobile, Ala.; and Mississippi-Alabama Sea Grant Legal Program, University, Miss. Available online at www.olemiss.edu/orgs/SGLC/fisheries.html.

Virginia Saltwater Angler's Guide. Virginia Marine Resources Commission, Newport News, Va.

Agency Resources

Virginia Marine Resources Commission: (757) 247-2200; www.mrc.state.va.us.

Virginia Sea Grant, Marine Advisory Program: (804) 684-7170; www.vims.edu/adv/.

National Marine Fisheries Service: www.nmfs.noaa.gov.

Table 1. Common Marine Finfish and Shellfish of Virginia and the Agencies That Manage Them.

Species	Management Authority
FINFISH	
Amberjack	VMRC, SAFMC
American Eel	VMRC, ASMFC
American Shad	VMRC, ASMFC
American Croaker	VMRC, ASMFC
Atlantic Mackerel	MAFMC
Black Drum	VMRC, CBP
Black Sea Bass	VMRC, MAFMC, ASMFC
Bluefish	VMRC, MAFMC, ASMFC
Butterfish	VMRC, MAFMC
Cobia	VMRC, SAFMC
Dolphin	NMFS
Grey Trout (Weakfish)	ASMFC
Mackerel, King	SAFMC
Mackerel, Spanish	VMRC, ASMFC, SAFMC
Menhaden	ASMFC, Va. Legislature
Monkfish	MAFMC
Northern Puffer	VMRC
Perch (White)	VMRC
Red Drum (Puppy Drum)	VMRC, ASMFC
River Herring (Blueback/Alewife)	VMRC, ASMFC
Scup (Porgy)	VMRC, MAFMC, ASMFC
Sharks (39 species, coastal)	VMRC, ASMFC, NMFS
Sheepshead	VMRC

Species	Management Authority
FINFISH, cont.	
Spadefish	SAFMC
Speckled Trout	VMRC, ASMFC
Spot	VMRC, ASMFC
Squid	MAFMC
Spiny Dogfish (Horndog)	VMRC, MAFMC, ASMFC
Striped Bass (Rockfish)	VMRC, ASMFC, CBP
Sturgeon	VMRC, ASMFC
Summer Flounder (Fluke)	VMRC, MAFMC, ASMFC
Tautog	VMRC, ASMFC
Tilefish	MAFMC
Triggerfish	SAFMC
Wahoo	SAFMC
SHELLFISH	
Blue Crab	VMRC, CBP
Clam, Hard (Quahog)	VMRC, MAFMC
Horseshoe Crab	VMRC, ASMFC, CBP
Oyster	VMRC, CBP
OFFSHORE	
Billfish (Sailfish/Swordfish/Marlin)	VMRC, MAFMC, NMFS, ICCAT
Clam, Surf	VMRC, MAFMC
Conch (Channel Whelk)	VMRC
Conch (Knobbed Whelk)	VMRC
Sea Scallop	MAFMC, NEFMC
Tuna (Bluefin/Yellowfin/others)	NMFS, ICCAT

ASMFC = Atlantic States Marine Fisheries Commission. This agency manages all migratory fish passing through Virginia coastal waters; overall, it manages 22 species of marine fish in all the Atlantic Coast states.

CBP = Chesapeake Bay Program.

ICCAT = International Commission for the Conservation of Atlantic Tunas.

MAFMC = Mid-Atlantic Fishery Management Council. This branch of the NMFS manages fish that primarily inhabit waters greater than three miles from shore.

NEFMC = New England Fishery Management Council.

NMFS = National Marine Fisheries Service. This agency directly manages highly migratory fish, such as Swordfish.

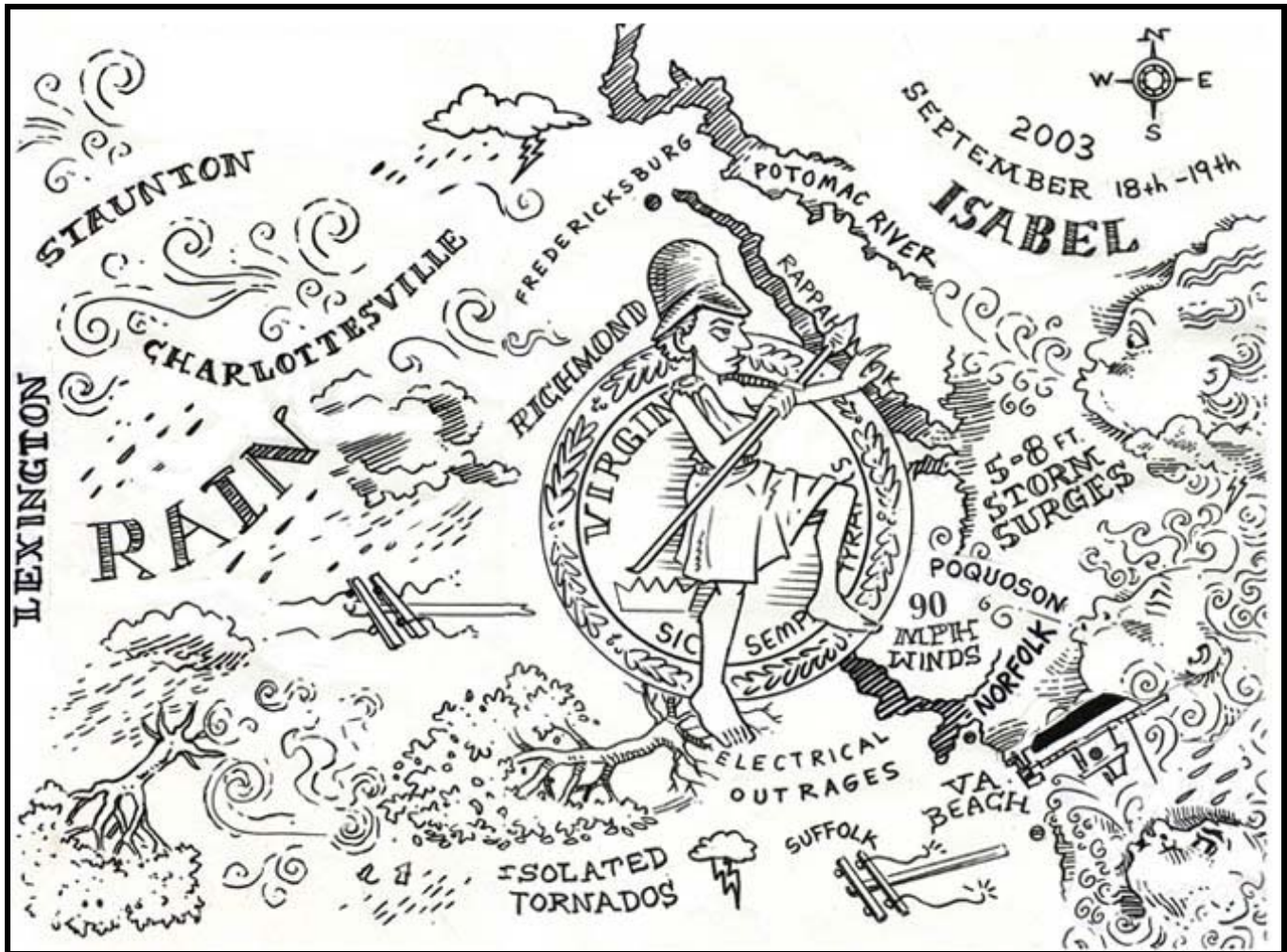
SAFMC = South Atlantic Fishery Management Council

VMRC = Virginia Marine Resources Commission.

SCIENCE BEHIND THE NEWS

Comprehending Hurricane Isabel

In the following nine pages, *Water Central* reviews Virginia's "worst storm in a generation" (in the words of Governor Mark Warner). Part 1 uses various sources to review Isabel's impact. Part 2 presents several view of the science of the storm. Part 3 summarizes the 2003 Atlantic tropical storm season. A list of sources for more information follows Part 3.



Part 1. Isabel's Impacts

Statewide Situation Reports

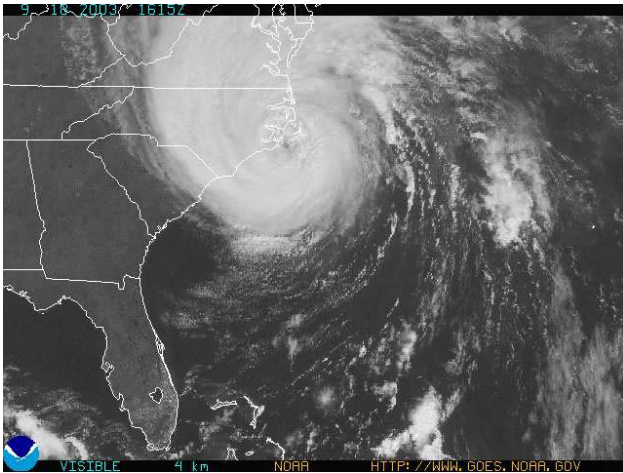
An excellent source of information on the hurricane's impacts and public and private responses in Virginia is the situation reports provided by Virginia Department of Emergency Management (VDEM) (daily September 16—October 9, every other day October 10—October 25, and weekly since October 28). The reports are available online at www.vdem.state.va.us/newsroom/index.cfm#isabelsitreps (as of November 4). Following are storm

details from situation reports on the day after the storm struck, one week later, and one month later (all issued at 2 p.m. on the day indicated), plus some of the most recently available information.

Friday, September 19:

"Hurricane Isabel has moved out of Virginia leaving behind widespread flooding, power outages, damage to homes and businesses, and significant disruption of infrastructure. Interstate

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Visible satellite photo at 12:15 EDT, 9/18/03. Image found at National Hurricane Center Website, www.nhc.noaa.gov/satellite.shtml, 9/18/03.

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highways are mostly passable. Numerous primary and secondary roads remain blocked or debris strewn. Widespread power outages affect 1.9 million customers throughout the Commonwealth. Media reports indicate as many as nine storm related fatalities.”

Additional details:

- “128 shelters open with 13,867 occupants;
- Failure of sewage and water pump stations due to power outages in many coastal jurisdictions;
- Thousands are without wireless and landline telephone service;
- Midtown Tunnel between Norfolk and Portsmouth closed until further notice;
- Widespread problems with lack of or contaminated drinking water;
- Curfews will be imposed in many coastal jurisdictions to lessen the likelihood of looting;
- Richmond International Airport is open, but no flights are expected until early afternoon;
- Amtrak canceled...service south of Washington.”

Thursday, September 25:

“Response operations continue, coordinating local government requests for assistance. Recovery assistance programs have begun and damage assessments are ongoing. Debris management programs appear to be functioning well in all jurisdictions. Major power outages are affecting approximately 365,000 customers as of 1300 today; schools without power remain a priority for restoration. More than 729 homes reported destroyed and 8,277 with major damage. State and local road clearance operations continue with 83 secondary roads closed. Confirmed storm-

related fatalities total 26. One joint state/federal Disaster Field Office is open in Henrico County.

Additional details:

- “The American Red Cross is operating 51 fixed and 75 mobile feeding stations; 246,433 meals served;
- Most public and private schools remain closed throughout the impacted area;
- 672,000 pounds of ice projected for delivery today, 100% of total requested;
- 746,000 gallons of water projected for delivery today;
- Increased public concern with potential Equine Encephalitis outbreak due to potential mosquito infestations. Localities advised to contact their local health department to request mitigation assistance. VDH has requested federal aerial mosquito control assistance;
- Hazmat: 55 home heating oil tanks removed, 75 propane tanks removed, 20 home basements pumped of home heating oil, large oil spills awaiting clean-up contractors;
- The Boil Water Advisory remains in effect in Fort Eustis, Fairfax County, Hampton City, and sections of other cities and counties. Water tested and cleared for Chesterfield County, Henrico County, Richmond City, Hopewell, Newport News, and [City of] Franklin.”

Sunday, October 19:

“Hurricane Isabel entered Virginia September 18 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained winds near 100 mph and tropical storm winds for 29 hours. The hurricane produced storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay with rainfall totals between 2 to 11 inches along its track. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of thunderstorms and tornados came through...Virginia on September 23. Governor Mark R. Warner declared a State of Emergency in the Commonwealth on September 15, 2003. Governor Warner requested, and a Major Presidential Disaster Declaration (FEMA-1491-DR-VA) was granted, to Virginia on September 18, 2003 [ultimately 70 counties and 29 cities were included]. FEMA closed the

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Storm damage on Tangier Island, Va. Photo by George Roarty, Va. Dept. Emergency Management.

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incident period effective October 1, 2003. A total of 30 confirmed deaths to date.”

Additional details:

- “All jurisdictions have ended their disaster-related food stamp programs.
- Temporary housing assistance disbursed to date: \$24,395,560.34;
- Travel trailers have been placed in the cities of Poquoson and Hampton and in the counties of James City, Gloucester, King & Queen, Mathews, York and Rockbridge. The inspection process continues for locating trailers where needed;
- More than 1,062 homes reported destroyed and 8,886 with major damage. More than 77 businesses are reported destroyed; more than 1,400 businesses received some type of damage;
- The Natural Resources Conservation Service’s...‘Emergency Watershed Protection (EWP) Program’ [which funds ‘urgent and compelling’ sites needing work such as channel restoration, rebuilding banks, and debris and cobble removal from streams...with a 75/25 cost share (NRCS/Locality)] has completed repairs in Page, Augusta, and Madison counties in the total amount of \$37,993. Additional counties have been identified for future funding in the total amount of \$1,153,190 with additional jurisdictions expected to apply.”

Additional Information: October 28—30

As of October 28, there were a total of 33 confirmed deaths. Between September 23 and October 28, 38 disaster-recovery centers opened statewide; as of October 28, the centers had served 16,123 clients and 14 centers were still open. In a press release on October 30, VDEM estimated the damage costs from the storm at \$1.6 billion and said the ultimate total would probably be more.

Some Details on Power Outages

Dominion Virginia Power provided this summary of impacts on its Website, www.dom.com (10/6/03):

“Weather stations clocked sustained tropical storm-force winds from 44 to 69 miles per hour over what the National Weather Service described as ‘an unusually extensive area.’ The huge storm system covered an area the size of Colorado.... In its official report on the hurricane, the National Weather Service said Isabel had brought ‘permanent change to the landscape’ in Virginia from fallen trees and storm surges. Throughout most of Dominion’s service territory, the winds bombarded homes, businesses and [power] distribution facilities with falling trees and limbs. Soil saturated from recent record rainfall made trees with root systems already weakened by drought much more susceptible to winds...”

“The hurricane affected about 96 percent of Dominion’s customers in eastern Virginia, 95 percent in central Virginia and 69 percent in Northern Virginia. At the peak of the storm, 1.8 million of the company’s 2.2 million customers in Virginia and northeastern North Carolina lost power. In much of central and eastern Virginia, the damage was catastrophic. The damage was less severe but still very significant in most of Northern Virginia....

“Throughout [Dominion’s] two-state service area, more than 10,700 power poles were destroyed, and 14,600 pole cross arms were broken. About 13,000 spans of wire had to be re-strung, and 7,900 transformers replaced.... More than 60 percent of [the] primary distribution circuits were affected....”



Power-system damage. Photos from Dominion Virginia Power; used with permission.

Aquatic Ecosystem Impacts

The hurricane affected not only humans and their habitats but aquatic habitats, as well. The Chesapeake Bay Program, at its Website at www.chesapeakebay.net/isabel.htm (accessed 11/4/03), provided the following summary of Isabel’s impacts on the Bay:

“[Basin-wide], precipitation was generally less than predicted. However, locally heavy rains diminished water quality by carrying large amounts of nutrients and sediment into rivers and streams that feed the Bay....

“High storm surge combined with strong winds caused significant shoreline erosion in some areas of the Bay. Wave action carried sediments into the Bay and resuspended fine silt particles from the Bay’s bottom....

“[Submerged aquatic vegetation], or SAV, may have been damaged by wave action over their shallow water habitat. Additionally, [SAV] may have been covered by fine sediments restricting their ability to produce oxygen....

“Freshwater flow into the Bay may have reduced salinity levels and stressed species unable to move to more preferred habitat, such as oysters and clams.

“Periods of locally heavy rains and power outage caused several wastewater treatment facilities to release untreated sewage into tributaries that flow into the Bay. As a result, Maryland and Virginia temporarily closed all shellfish beds to harvesting, as many oysters,

mussels and clams may have absorbed bacteria from the contaminated water.

“Property damage resulting from the 4—12 foot storm surge was extensive in many parts of the region. Homes, bulkheads and piers were damaged through the entire Bay region.

“Tropical Storm Isabel could have been far worse for the Bay. By occurring in September—when the Bay is beginning to slow down and prepare for colder winter months—long-term impacts may not be as great....

“Due to less than predicted precipitation, most river flows did not reach levels that scour sediments from behind large dams....”

A Sobering Quote

“This storm underscored how vital preparedness is. This storm, as bad as it was, was not [the worst that could happen]. It was a wake-up call to what can happen.”
Chesapeake Fire Chief R. Stephen Best,
quoted in “Isabel, one month later,”
Virginian-Pilot, 10/20/03.

The Story in Headlines

One way to comprehend the big, complicated story of Hurricane Isabel is to scan the hurricane-related headlines from major newspapers serving Virginia’s population centers: *The Washington Post*, *The Richmond Times-Dispatch*, and *The Virginian-Pilot* (Norfolk). Following are selected headlines from the many Isabel articles each newspaper ran from September 18 through November 1.

***Washington Post* (list accessed via www.washingtonpost.com, 10/2/03; Isabel-specific archive no longer available on 11/4/03)**

- Deadly Hurricane Leaves Millions Powerless (9/20)
- Generators' Carbon Monoxide Poisons Nearly Two Dozen (9/20)
- Two Very Different Isabels: In Southern Virginia, Damage Varies Widely (9/20)
- Fairfax City Neighbors Make Do—Together: Storm Brings Out Friends, Generators (9/20)
- Annapolis Is Engulfed By Record Flooding: Naval Academy and Marinas Are Hit Hard (9/20)
- Reserves of Ice and Patience Run Dry (9/20)
- Potomac a Highway For Mound of Water: Surge Exceeded Great Storm of 1933 (9/20)
- PEPCO [Potomac Electric Power Company] Wrestles With Recovery Plan (9/20)
- Traditional Phones Gain New Respect: Power Failures Cut Cell Signals (9/20)
- Aftermath: Hundreds of Thousands Face Days Without Power; 1.2 Million in N.Va. Advised to Boil Drinking Water (9/20)
- Power Cords Link Haves, Have-Nots: Community Sharing Turns on Some Lights (9/21)
- Utilities' Practices, Preparation Challenged (9/21)
- Outages Shutter Schools in D.C., Much of Md.: Most Va. Students to Return to Class...but Sporadic Closures Remain (9/22)
- Flood Pain: Old Town Alexandria Merchant Wonders What Disaster Declaration Means for Him (9/22)
- Area's Political Leaders Scramble to Placate Dissatisfied Constituents (9/22)
- Roiling Potomac Draws Astonished Spectators: Storm's Aftermath Swells River's Waters (9/22)
- Dark Days Drag on; Anger Grows (9/22)
- N.Va. Water Restrictions Lifted As Area's Cleanup Progresses (9/22)

Cont. after photos on next page



Flood-deposited sediment along the South River in Rockbridge County, 10/1/03. The river flooded after heavy rains from Isabel (up to 20 inches in one area), damaging homes and roads in Augusta and Rockbridge counties. Photo by Alan Raflo.



On South River Road, near the community of Midvale in Rockbridge County, 10/1/03. Photo by Alan Raflo.

Cont. from previous page

- Morning Commute Surprisingly Smooth: No Major Problems...Despite Downed Traffic Lights (9/22)
- Businesses Struggle To Recover: Most Damage Isn't Covered by Insurance (9/23)
- Areas Say State Help Coming Too Slowly (9/23)
- Most Md., District Schools To Reopen: Emergency Days Exhausted for Some (9/23)
- Extra Expenses Put Squeeze on the Working Poor (9/23)
- Torrent [from a second storm on 9/22—23] Sets Recovery Back: Flooding Snarls Commutes, Strands Some Drivers; Outages Spread (9/24)
- Postmortem May Be Tough: Area Officials Promise to Grill Utilities About Outages (9/25)
- Underground Power Lines No Magic Fix: Flooding, Corrosion, Cost Are Challenges, Firms Say (9/27)
- PEPCO to Check System For Tracking Outages: Full Restoration of Power Declared Too Soon (9/30)
- Fairfax May Build Crisis Water System: County Weighs Cost of Emergency Generators (9/30)
- PEPCO President Apologizes for Extended Outages (9/30)

***Richmond Times-Dispatch* (list accessed via www.timesdispatch.com, 11/4/03)**

- Large area of Henrico without water; Chesterfield asked to limit use (9/19)
- Storm topples thousands of trees; Scarce fuel may slow trimmers' progress (9/20)
- Ocean cuts into Hatteras Island; Towns suffer huge losses and face long recovery (9/20)
- Isabel's Wake: Dry, Dark, Devastating; "This Could Be The Most Expensive Disaster Virginia Has Ever Seen"; Power, water out throughout state (9/20)
- Tree that cooled Lee went down in storm (9/21)
- "I thought I was going to die"; In Hatteras, there were many survival stories (9/21)
- Landmark pier is just a memory (9/21)
- Hundreds of homes destroyed by trees (9/23)
- State's agriculture hit hard (9/24)
- The Jamestown flood; Thousands of items soaked by storm surge (9/28)
- Power grid safe? Isabel pointed out weaknesses in area's water, electric systems (9/28)
- Utility's efforts to be reviewed; Lawmaker plans public hearing (10/4)
- Seniors' facilities not on priority list (10/4)
- Norfolk's [water-system] preparations paid off (10/4)
- Water supply scrutinized; [Richmond's] response plan reviewed (10/4)
- At long last, all lights back on; 5 million to 6 million in Virginia lost power (10/5)
- Warner names Isabel-review panel (10/11)
- Storm leaves officials skeptical; Question state, federal response (10/11)

- Many still struggle to recover from Isabel; With homes damaged, jobs lost... (10/19)
- SCC public meetings on Isabel response will begin next week (10/24)
- Tax double take follows Isabel; County assessors make adjustments to account for damage (10/25)
- \$442 million OK'd [by Congress] for [military, Coast Guard, and NASA] base repairs (11/1)

Virginian-Pilot (list accessed via www.hamptonroads.com, 10/6 and 11/4/03)

- Navy costs for Isabel at least \$105.6 million (9/27)
- Insurance adjusters out in force assessing Isabel damage (9/28)
- Desperate homeowners growing resigned to tree-removal costs (9/27)
- Isabel wasn't close to being "The Big One" (9/28)
- Huge demand swamps Norfolk's disaster food program (9/29)
- Many businesses try to avoid appearance of price gouging (9/30)
- Issuance of disaster food stamps overcomes glitches in Norfolk (9/30)
- Isabel washed Dismal Swamp water into Chesapeake's system (9/30)
- Ferries prove lifeline for waterlocked areas of Outer Banks (9/30)
- 1753 Hampton house may be razed because of storm damage (10/1)
- Centennial of flight celebration on schedule despite Isabel (10/1)
- Charity services, donations, volunteerism post-Isabel (10/2)
- Residents line up for emergency aid (10/2)
- Hurricane-hit nTelos faces some big losses (10/3)
- Seniors struggle with long lines for emergency aid (10/4)
- At its source, [City of] Chesapeake water looks, smells wrong (10/4)
- Neglected floodgates cost [Midtown Tunnel] chief his job (10/5)
- Thanks to hard-hitting Isabel, Dismal Swamp is still closed (10/9)
- Rivers' depleted oxygen levels reduce numbers of game fish (10/11)
- Inmates helping with hurricane cleanup (10/14)
- Pieces of historic N.C. boat found after hurricane (10/16)
- Midtown Tunnel open again (10/16)
- [Hampton Roads area] Schools' price tag after Isabel is at \$2 million (10/27)
- Work on Hatteras inlet reaches toughest part (10/28)

Part 2. Views of the Science of Isabel

A Meteorologist's Reactions

Mike Emlaw is a Warning Coordination Meteorologist with the National Weather Service's Blacksburg, Va., Forecast Office. In mid-October, he responded to four questions that *Water Central* posed about the scientific interest and value of Hurricane Isabel.

Question 1. What was striking or surprising about Isabel? On the other hand, were there things about the storm that were relatively routine?

It was truly amazing that Isabel was a Category 5 storm with sustained winds of over 155 MPH for such a long time. I am not exactly sure of the record duration for a storm to maintain Category 5 status, but if Isabel isn't the record holder, it is very close. Thankfully the storm weakened considerably before it made landfall on the North Carolina coast. Another thing that was striking was the very impressive satellite pictures of Isabel that were available. Not only was Isabel an impressive-looking storm

when it was a Category 5, but the ability to have high-resolution satellite pictures every few minutes was quite impressive.

I am not sure there is ever anything *routine* with respect to a hurricane. [The heavy rainfall] that Isabel produced...occurs with all hurricanes, tropical systems, and remnants of hurricanes and tropical systems. *How much* rain falls at a given location is nearly always determined by the path, speed of movement, and terrain factors, but rainfall rates with these kinds of systems are up to 5 or 6 inches per hour.

Question 2. What went well for the Weather Service in forecasting and tracking Isabel?

I think the forecast track of Isabel was outstanding. More than three days prior to landfall, there was a fairly accurate forecast of where Isabel would track across Virginia. There was high confidence in the forecast track of Isabel because the vast majority of computer models

used to predict the track were very similar and they did not change much as landfall got closer. *Question 3. What would the Weather Service have liked to be able to do better or differently in this hurricane (and future ones), either in forecasting and tracking or in recording data from the hurricane?*

With regard to the track of Isabel, I don't think we can consistently do better, at least not in the near future. In fact, I hope that, because we did so well with the forecast track of Isabel, people don't expect us *always* to predict the track that well; we don't need people *not* taking action because the projected track three days in the future does not have the storm coming over their location. People still have to remember that there is an average error of a few [miles] to several hundred miles for forecasts two-to-three days in the future.

The radar often provides decent estimates of how much rain has fallen. However, we would like to have more real-time rainfall reports, not only during hurricanes, but in all precipitation events.

Question 4. What lessons did the Weather Service's experience with Isabel provide?

Typically, the most significant rainfall associated with hurricanes/tropical systems after making landfall is along and to the right of their path. However, Isabel had a much larger than expected precipitation shield to the *left* of its path as it was making landfall, and this was maintained as it moved through eastern North Carolina and Virginia. Isabel was moving at a decent speed across Virginia, so excessive rainfall amounts were not expected. However, along the Blue Ridge in west-central Virginia, a rainfall report from an automated rain gage indicated that over 20 inches of rain fell. Bucket surveys in the area indicate that the 20-inch+ rainfall measurement was likely accurate. Normally we expect rainfall enhancement from hurricane/tropical systems where the low-level *southeast* winds on the *east* side of the system interact with the Blue Ridge to produce excessive rainfall along and on the east side of the Blue Ridge. In the 20+-inches rainfall case, it appears that the enhancement was from *north* or *northwest* low-level winds on the *west* side of the track of Isabel, because the heavy rainfall occurred on the west side of the Blue Ridge. This event proves the necessity for understanding how "normal" precipitation patterns can be drastically altered as a [large-scale] system interacts with complex terrain features.

How The National Weather Service Described Isabel's Impacts

HURRICANE LOCAL STATEMENT NATIONAL WEATHER SERVICE BALTIMORE MD/WASHINGTON DC 800 AM EDT FRI SEP 19 2003

AT 8 AM EDT...THE CENTER OF TROPICAL STORM ISABEL WAS LOCATED NEAR LATITUDE 40.3 NORTH...LONGITUDE 79.5 WEST OR 25 MILES EAST OF PITTSBURGH PA. MOVEMENT WAS NORTH-NORTHWEST AT 22 MPH. MINIMUM CENTRAL PRESSURE IS 996 MB. MAXIMUM SUSTAINED WINDS ARE NEAR 40 MPH WITH HIGHER GUSTS.

...RAINFALL AND INLAND FLOODING... PRELIMINARY RAINFALL REPORTS INDICATE THAT AMOUNTS OF 6 TO 12 INCHES FELL OVER THE CENTRAL SHENANDOAH VALLEY...2 TO 6 INCHES OCCURRED ACROSS THE EASTERN WEST VIRGINIA PANHANDLE WESTERN MARYLAND AND THE NORTHERN SHENANDOAH VALLEY WITH 2 TO 5 INCHES ACROSS THE PIEDMONT AREA AND THE BALTIMORE WASHINGTON METRO AREAS....

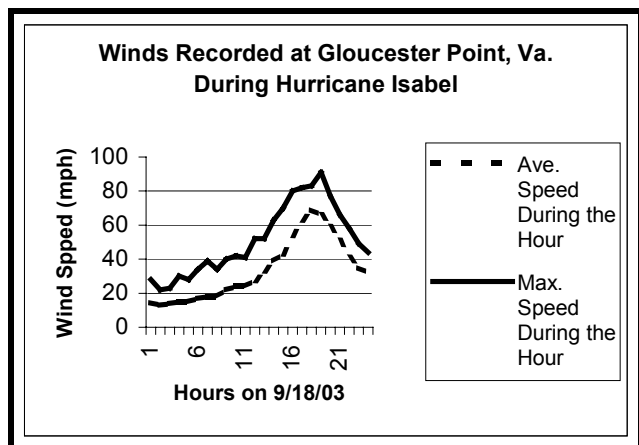
...STORM SURGE...WAVES AND TIDAL FLOODING...SEVERAL LOCATIONS ALONG THE CHESAPEAKE BAY AND THE POTOMAC RIVER AND ITS TRIBUTARIES ARE REPORTING STORM SURGES OF 4 TO 8 FEET THIS MORNING. THE TIDAL POTOMAC AT WASHINGTON DC REACHED 11.3 FEET WHICH IS 0.2 FEET HIGHER THAN THE RECORD SURGE WITH THE AUGUST 1933 STORM. BALTIMORE HARBOR AND ANNAPOLIS WERE REPORTING A SURGE OF 6 TO 7 FEET. WATER LEVELS ON THE TIDAL POTOMAC AND OTHER TIDAL RIVER BASINS ALONG THE WESTERN SHORE OF THE CHESAPEAKE BAY SHOULD BEGIN TO RECEDE WITH THE TIDE...BUT WATER LEVELS WILL CONTINUE TO BE HIGH WITH SOME FLOODING POSSIBLE AT HIGH TIDE FOR THE NEXT FEW CYCLES...

...WIND AND TORNADO INFORMATION... TROPICAL STORM FORCE WIND GUSTS REMAIN ON THE UPPER PORTION OF THE CHESAPEAKE BAY EARLY THIS MORNING. INLAND WIND GUSTS HAVE DIMINISHED TO 20 TO 30 MPH. WINDS PEAKED OVER THE WASHINGTON DC AREA AROUND MIDNIGHT LAST NIGHT WITH GUSTS OF 50 TO 60 MPH....

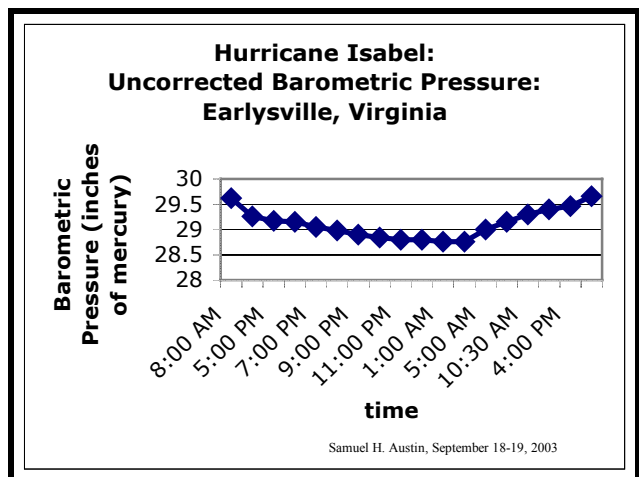
Storm Data from Some People Who Experienced Isabel

In this section, *Water Central* presents measurements made during Isabel's passage by the Virginia Institute of Marine Science (VIMS) and by individuals at three other locations. The data here have not necessarily undergone standard scientific verification to ensure accuracy. *Water Central* thanks the individuals who provided data.

Wind Speeds: recorded by the Virginia Institute of Marine Science in Gloucester County. Data located at www.vims.edu/images/isabel/wind.pdf, 11/5/03; data used with permission of VIMS.



Barometric Pressure: recorded by Sam Austin at Earlysville in Albemarle County.



Other observations by Mr. Austin: "Total darkness; winds howling; 80-foot-tall pines swaying above the roof; anticipating the tree that may soon come down, crashing through the ceiling; driving rain; limbs snapping; no electricity, no water, no telephone."

Rainfall: recorded by Chris and Katie Register at Rice in Prince Edward County.

Time of Observation	Cumulative Rain Amount (inches)
8:00 AM 9/18/03	Rain started
10:30 AM	0.16
1:00 PM	0.70
4:00 PM	1.34
6:00 PM	2.54
8:00 PM	4.39
9:30 PM	5.25
10:10 PM	5.68
7:30 AM 9/19/03	5.98

Stream Bacterial (Fecal Coliform) Levels:

Recorded by Blake Robertson on Sayler's Creek in Prince Edward County.

Date	Time	CFUs/100 ml ¹
9/17/03	14:45	200
9/18/03	8:45	100
9/18/03	13:00	1600
9/18/03	13:45	6100
9/18/03	17:30	24900
9/18/03	19:30	21300
9/19/03	9:30	1700
9/19/03	12:30	1500
9/20/03	10:30	1100

Other observations by Mr. Robertson: A rain gauge located several miles west of the sample sites recorded 5.98 inches.... At 17:30 the level of both sites was just above bankfull (~2 feet). When the next sample was taken the water level increased to over 6 feet. Contamination was highest before the water level reached this depth.... Conditions became treacherous while sampling in Hurricane Isabel. Gusts of wind were knocking branches down and they were falling like daggers into the stream. A nearby falling tree convinced me to pack up my gear and go home."

¹ The unit is the number of bacterial "colony forming units" per 100 milliliters of sample water. The Virginia standard (regulation 9 VAC 25-260-160, effective August 2003) for waters used for swimming or other primary-contact recreation states that water samples are not to exceed "a geometric mean of 200 CFU/100 ml for two or more samples over a calendar month nor shall more than 10 percent of the total samples taken during any calendar month exceed 400 CFU/100 ml."

Part 3. 2003 Atlantic Ocean Tropical Storms

No.	Name	Dates	Max. 1-min. Wind (mph)	Min. Sea-level Pressure (millibars)	Landfall Location
1	Ana	Apr. 21-24	45	996	No landfall
2	Two	Jun. 10-11	35	1008	No landfall
3	Bill	Jun. 29-Jul. 1	60	997	Louisiana
4	Claudette	Jul. 8-17	90	979	Mexico, then Texas
5	Danny	Jul. 16-20	75	1000	No landfall
6	Six	Jul. 19-21	35	1008	No landfall
7	Seven	Jul. 25-27	355	1016	Georgia
8	Erika	Aug. 14-17	70	987	Mexico
9	Nine	Aug. 21-22	35	1008	No landfall
10	Fabian	Aug. 27-Sep. 8	145	939	Bermuda
11	Grace	Aug. 30-31	40	1007	Texas
12	Henri	Sep. 3-8	60	997	Florida
13	Isabel	Sep. 6-19	160	920	North Carolina
14	Fourteen	Sep. 8-10	35	1007	No landfall
15	Juan	Sep. 25-29	105	970	Nova Scotia
16	Kate	Sep. 27-Oct. 7	125	952	No landfall
17	Larry	Oct. 1-6	60	993	Mexico
18	Mindy	Oct. 10-14	45	1002	No landfall
19	Nicholas*	Oct. 13-	60	997	No landfall

*Information incomplete. Latest update by source was 10/20/03.

Source: National Oceanic and Atmospheric Administration (NOAA)/National Hurricane Center and Tropical Prediction Center, 11691 SW 17th Street, Miami, FL 33165-2149. Information found at www.nhc.noaa.gov/2003atlan_summary.shtml, 11/5/03.

For More on Isabel and Other Hurricanes

(All Website addresses listed were current as of 11/6/03.)

- The National Weather Service's Wakefield, Va. Forecast Office has a Hurricane Isabel Report—post-storm description, photo gallery, and graphs—at its Website, www.erh.noaa.gov/akq/.
- The Virginia State Climatology Office, in Charlottesville, has several “Hurricane Season Links” at its Website, www.climate.virginia.edu. At the site you can also find “Isabel and Virginia’s Current Problem,” which compares Isabel’s winds and impacts on power lines to other hurricanes that have hit Virginia; the article also has a description of a hurricane *in 1667*. The phone number is (434) 924-0548.
- In October 2003, *The Virginian-Pilot* in Norfolk published two excellent, detailed reviews of the storm: “Isabel, one month later,” 10/20/03, and “Isabel’s wrath along the Eastern Seaboard,” 10/18/03. The articles were available online at www.hamptonroads.com/weather/storms/.
- The Virginia Institute of Marine Science’s (VIMS) Website at www.vims.edu/isabel_images.html offers photographs and video images of the Isabel’s effects along with data on pressure, wind, waves, rain, etc.
- The Chesapeake Bay Program’s Isabel information is online at www.chesapeakebay.net/isabel.htm.
- The U.S. Geological Survey’s “Hurricane and Coastal Storm” Website, at www.usgs.gov/hurricanes/stormsites.html, offers links to many resources on past storms as well as sites for tracking ongoing storms and other current water-related events.
- The National Hurricane Center/Tropical Prediction Center’s Website has an archive of past hurricane seasons (Atlantic and Pacific), with narratives and graphs for each tropical storm. The site is located at www.nhc.noaa.gov/pastall.shtml.
- Publications about hurricane safety are available at the National Weather Services Website, www.nws.noaa.gov/om/brochures.shtml

—Article compiled by Alan Raflo

VIRGINIA WATER STATUS REPORT

This section of *Water Central* presents recent and historical data on Virginia's precipitation, stream flow, and groundwater levels (one topic per issue, rotating among the three topics).

Groundwater Levels at Selected Virginia Wells, Summer 2003

Observation wells show that a wet spring and summer in 2003 raised the low groundwater levels seen during the 1999—2002 drought up to unusually high levels.

The U.S. Geological Survey (USGS) and the Virginia Department of Environmental Quality monitor groundwater levels in 279 observation wells in Virginia. Water levels in these wells are measured monthly or continuously via monitoring equipment. For all the observation wells, the USGS publishes the measurements annually (the latest in the series is *Water Resources Data-Virginia-Water Year 2002, Volume 2*). More recent data for selected wells, including the data in the following table, are available online at the USGS/Virginia District Offices' Website at

va.water.usgs.gov/DROUGHT_99/gw_lv_2002.html (accessed 11/6/03). That site contains

hydrographs for certain wells, along with the well location and other information. Hydrographs show current monthly well levels (in feet below the surface), plotted in relation to the maximum (deepest), minimum (shallowest), and average values recorded in that month over the period of record (which varies for different wells). *Current data are provisional (i.e., subject to revision).*

Please note that the values shown for the period of record do not include the most recent reading. So in some cases (e.g., Arlington), the most recent reading was shallower than the minimum for the period of record.

Well (Local #)	Most Recent Level*	Average Level for Month over Period of Record	Maximum (deepest) Level on Record for Month	Minimum (shallowest) Level on Record for Month	Period of Record
Arlington (54V 3)	40 (Jul. '03)	43	44	41	Since Jan. 1958
Buckingham (41H 3)	22 (Aug. '03)	24	36	16	Since Mar. 1970
Clarke (46W 175)	26 (Sep. '03)	39	45	27	Since Jul. 1987
Col. Heights (51G 1)	12 (Sep. '03)	16	18	11	Since Oct. 1939
Fairfax (52V 2)	13 (Sep. '03)	16	23	12	Since Oct. 1976
Loudoun (50W 4C)	36 (Sep. '03)	41	47	32	Since Oct. 1977
Montgomery (27F 2 SOW 019)	1 (Jul. '03)	5	7	3	Since Apr. 1969, plus Jul. 1953
Pr. William (49V 1)	8 (Sep. '03)	10	13	8	Since Nov. 1968
Rockingham (41Q 1)	60 (Sep. '03)	74	98	66	Since Aug. 1970
Suffolk (58B 13)	7 (Sep. '03)	10	12	6	Since Mar. 1975
Westmoreland (55P 9)	0 (Sep. '03)	8	11	0	Since Jul. 1977

*Units for all levels are feet below land surface; values here rounded to nearest foot.

IN AND OUT OF THE NEWS

Newsworthy Items You May Have Missed

The following summaries are based on information in the source(s) indicated in parentheses, usually at the end of each item. Selection of this issue's items ended November 6, 2003. Unless otherwise noted, all localities mentioned are in Virginia and all dates are in the year 2003.

In Virginia...

•An update on oysters:

••At a national conference in Annapolis in September, oyster researchers reported that Virginia and Maryland's **2002 oyster harvest** was "miserable" compared to the harvests in Louisiana and on the Pacific Coast. Maryland's 2002 harvest, for example, was about two million pounds, while Louisiana harvested 500 million pounds and the Pacific Coast harvested 92.5 million pounds. (*Baltimore Sun*, 9/9/03)

••In its August 2003 report, *Study on Non-Native Oysters in the Chesapeake Bay*, the National Research Council found that **no federal regulatory approval** would be needed for **introduction of the non-native Asian (or Suminoe) Oyster** (*Crassostrea araiakensis*), which is the subject of current interest in Virginia and Maryland as a replacement for the Bay's depleted native oyster (*Crassostrea virginica*). The U.S. Army Corps of Engineers regulates waterways structures (including non-native oyster aquaculture facilities) under the federal Rivers and Harbors Act, and the Corps regulates placement of oyster shells—to enhance oyster habitat—under the Clean Water Act. But apparently no federal legislation would give the Corps authority over placement of a non-native species. Virginia and Maryland have promised, however, to perform an environmental impact statement (EIS) for any proposal to introduce non-native oysters to the Bay. The EIS process would involve the Corps and other federal agencies and allow for public review. (*Bay Journal*, Oct. 2003)

••Virginia Institute of Marine Science researcher Mark Luckenbach traveled this summer to China and Japan to **study the Asian Oyster in its natural habitats**. He observed that the mollusk's growth habits differ from place to place. For example, in Japan's Ariake Sea the Asian Oyster grows on mud flats, but in China's Bo Hai Sea it grows in large reefs. It's unclear whether this and other differences result from different varieties of the species or from varied environmental conditions. Scientists are looking at the Asian Oyster's behavior in its native areas

to help predict how the species might react in the Bay. (*Bay Journal*, Oct. 2003)

•More on the Chesapeake Bay:

••**Submerged aquatic vegetation (SAV)**, also called "underwater grasses" or "Bay grasses," covered almost 90,000 acres in the Bay and its tidal tributaries in 2002, the largest area since annual surveys began in 1984. Submerged vegetation, which provides food and habitat for many Bay species, is a key indicator of the Bay's environmental health. (*Bay Journal*, Oct. 2003)

••The Chesapeake Bay is not alone in experiencing **periodic low-oxygen conditions** that threaten aquatic organisms (please see the August 2003 *Water Central*, p. 12, for a previous item on low oxygen in the Chesapeake). A recent survey by the National Oceanic and Atmospheric Administration found that low oxygen levels periodically occur in 42 out of 138 bays nationwide (plus in the northern Gulf of Mexico). Nutrient inputs to bays are a primary factor leading to oxygen depletions, but some bays (including the Chesapeake) are more susceptible to excessive nutrients because of such factors as a bay's depth and size in relation to its watershed. (*Bay Journal*, Oct. 2003)

•Two recent opinions—one from the U.S. EPA and the other from a federal appeals court—clarified **Virginia's regulatory authority over nitrogen and wetlands**, respectively:

••Virginia has the **authority to regulate nitrogen in wastewater discharge permits** in the Bay watershed, according to a September letter from U.S. EPA Assistant Administrator G. Tracy Mehan to Virginia Del. Albert Pollard (D-99th). Del. Pollard had requested the EPA opinion after Virginia officials claimed in August that the state could not regulate nitrogen before setting nitrogen standards for state waters. The EPA letter stated that nitrogen regulation is allowable if the state finds that a nitrogen discharge would hinder the designated uses of a waterbody. (Washington Post, 10/7/03; and *Inside EPA's Water Policy Report*, 10/20/30)

••On September 10 the Fourth U.S. Circuit Court of Appeals, in the case of *Treacy v.*

Newdunn Associates, ruled that Virginia **may regulate wetlands more broadly** (or more strictly) under the Virginia National Wetland Resources Act of 2000 than is allowed to federal authorities under the Clean Water Act. In a lawsuit in federal district court in 2002, Newdunn Associates had claimed that Virginia, because it relies on federal definitions of wetlands, could not require permits for wetland-impacting activity in areas not subject to federal jurisdiction under the Clean Water Act. But the appeals court disagreed and overturned the district court ruling. (*Inside EPA's Water Policy Report*, 9/22/03)

•In October, four ships from the **James River Reserve Fleet** were towed to England to be dismantled. But a federal judge's order on October 2 halted the transport of nine other ships because of concerns that the U.S. Maritime Administration had not adequately assessed the environmental risk of the operation. Subsequently the Maritime Administration agreed to allow more environmental assessment, and the case will be reexamined in April. Winter weather precludes any further transport this year in any case. The Reserve Fleet was created in 1925 to hold older ships that might be needed in a future national crisis. Over 70 of the 90-some ships now in the fleet are obsolete, however, and pose a danger of leaking oil or other toxins. (Associated Press, as printed in *The Roanoke Times*, 10/21/03. Please see the October 2002 *Water Central*, p. 20, for a previous item.)

•On October 7, the **U.S. Supreme Court heard oral arguments in the case of *Virginia v. Maryland***, concerning Virginia's use of the Potomac River. The transcript of the oral arguments, with interesting exchanges about the history of the states' rights to the Potomac River and about riparian (streamside) rights in general, are available at www.surpemecourtus.gov (click on "Oral Arguments," then "Argument Transcripts"). Transcripts are also available, for a fee, from Alderson Reporting Company, at (202) 289-2260. (Please see the June 2003 *Water Central*, p. 16, for a previous item.)

•In October, the Federal Energy Regulatory Commission (FERC) extended until January 10, 2004, the **comment period** on American Electric Power's (AEP) **shoreline management plan for Smith Mountain Lake**. The lake, a hydroelectric-generating impoundment in Bedford, Franklin, and Pittsylvania counties, covers about 21,000 acres and has about 500 miles of shoreline. AEP submitted the draft plan to FERC on August 29 and on September 1 began

enforcing its provisions, which regulate shoreline construction, vegetation, and materials. (*Roanoke Times*, 10/10/03. Please see the August 2003 *Water Central*, p. 12, for a previous item.)

Meanwhile, on October 29 state officials issued a **fish-consumption advisory for Flathead Catfish in the Roanoke River and Smith Mountain Lake**, due to PCB (polychlorinated biphenyl) contamination. The advisory recommends that no one eat more than one eight-ounce meal of Flatheads per month, and that pregnant women, nursing mothers, and children eat no Flatheads. The actual warning area covers 9.5 miles of the Roanoke River just downstream of the town of Vinton (adjacent to Roanoke) but also includes a caution about all of Smith Mountain Lake. (*Roanoke Times*, 10/30/03)

•In October, the **U.S. EPA cited the Virginia Department of Corrections** for violating waste-storage and oil-spill-prevention regulations at the furniture shop of the Greensville Correctional Center in Jarratt (Greensville County). The furniture shop is near the Nottoway River. The department faces fines of more than \$75,000 for the violations. (Associated Press, as reported in *The Roanoke Times*, 11/4/03)

...and Outside of Virginia

•On September 9 a federal district court judge issued an **injunction halting Maryland's plans to shoot 525 Mute Swans (*Cygnus olor*)** in the Chesapeake Bay area. In August, Maryland and seven other eastern states had received a permit from the U.S. Fish and Wildlife Service to reduce the birds' population by about 3,000 over 10 years. The Fund for Animals, an organization in Silver Spring, Md., and two citizens then sued to block the shootings. The parties were to meet September 17 to set a trial date. (*Baltimore Sun*, www.sunspot.net, 9/9/03. Please see the August 2003 *Water Central*, p. 13, for a previous item.)

•A study in the September 18, 2003, issue of the scientific journal *Nature* reported that **Sockeye Salmon (*Oncorhynchus nerka*)** transmit significant levels of **industrial contaminants from the Pacific Ocean to interior lakes in Alaska**. After spending most of their lives in the ocean, the fish travel in great numbers to inland rivers and lakes to spawn. The study found that, while each fish may transport only small amounts of contaminants, large spawning congregations collectively produce significant increases in lake contamination. (*New York Times*, 9/23/03)

•**Delays confront the U.S. EPA's expected "watershed rule,"** which would regulate how states and the federal government address impaired waters and associated Total Maximum Daily Loads (TMDLs). The White House Office of Management and Budget (OMB) asked EPA to delay the rule until after the confirmation of Mike Leavitt as the new EPA administrator (Mr. Leavitt was confirmed October 28 and sworn in November 6). In addition, interagency reviews of how to address nonpoint source pollution, dams, and other issues have slowed the rule's development. (*Inside EPA's Water Policy Report*, 10/20/03. Please see the August 2002 *Water Central*, p. 7, for a detailed previous item.)

•On October 6, **New Hampshire sued 22 chemical and oil companies for continuing to blend MTBE** (methyl tertiary butyl ether) into gasoline. The suit claims that the companies have known for years that MTBE can contaminate groundwater supplies and that continued use of it creates a public nuisance and violates state environmental laws. Similar litigation is ongoing in California. But, as of October 16, the energy bill progressing through the U.S. House of Representatives contained language that would provide liability protection for MTBE producers if MTBE is detected in groundwater used as a public-water source (suits claiming negligence and certain other grounds would still be allowed). The House bill would make the protection retroactive to October 1, 2003. (*Inside EPA Water Policy Report*, 10/20/03. Please see the April 2000 *Water Central*, p. 11, for an introduction to MTBE.)

•On July 11, the U.S. EPA issued a guidance stating that **pesticide applications over and into water bodies** do *not* constitute point-source pollution, thereby requiring discharge permits under the Clean Water Act (CWA), *as long as* applicators follow the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The EPA action comes in the context of at least two recent federal appeals court rulings on pesticide applications. In 2001, the 9th Circuit Appeals Court (in *Headwaters, Inc. v. Talent Irrigation District*) held that CWA permits were required for herbicide applications over irrigation canals; and in 2002, the same court (in *League of Wilderness Defenders v. Forsgren*) held the U.S. Forest Service needed CWA permits to spray insecticides over forest lands and waters. Various interest groups have lined up on either side of the question; don't be surprised if more litigation follows. (*Inside EPA's Water Policy Report*, 10/20/03. Please see the March 2003 *Water Central*, p. 26, for a previous item.)

A Final Word

•"[T]he Potomac River is an interstate river. The Congress recognized that in 1976 when it required the waters to be allocated. A drop of water that begins in the Shenandoah is not a Virginia drop of water anymore than it's a Maryland drop of water when it's in the main stem of the Potomac."—Stuart A. Raphael, oral argument for the State of Maryland to the U.S. Supreme Court in *Virginia v. Maryland*, 10/7/03.

—By Alan Raflo

TEACHING WATER

Especially for Virginia's K-12 teachers

This Issue and the Virginia Standards of Learning

Below are suggested Virginia Standards of Learning (SOLs) supported by this issue's Feature and Science sections. The SOLs listed below are from Virginia's 2003 Science SOLs and 2001 Social Studies SOLs. **Abbreviations:** BIO = biology; ES=earth science; GOVT = Va. and U.S. government; LS=life science; VS = Va. studies; WG = world geography.

Feature Article—Managing Marine Fisheries

Science: 6.9, LS.12, ES.7, ES.11, BIO.9.

Social Studies: VS.10, WB.7, GOVT.5, GOVT.9, GOVT.16.

Science Article—Hurricane Isabel

Science: 4.6, 6.6, LS.11, ES.13, BIO.9.

Social Studies: WG.2, WG.12.

N O T I C E S

State Meetings and Hearings

The Virginia Department of Environmental Quality (DEQ) posts notices of regulatory action, public hearings and meetings, and other events on-line at www.deq.state.va.us/info/ (click on "Public Calendar" or "Public Notices"). The DEQ Coastal Program posts events and other notices on-line at www.deq.state.va.us/coastal/calendar.html. Following the water-related public meetings listed 11/8/03; we include past events in case readers wish to enquire about what occurred at a given meeting. To reach the listed contact people by e-mail, go to the Public Calendar Website, find the event, and click on the name; by phone, call the DEQ's Central Office in Richmond at (800) 592-5482.

11/2, Richmond: Advisory committee on proposed confined animal feeding operation general permit regulations. For more information: Scott Haley.

11/12, Richmond: Program funding and permit fee task force (VPDES and Virginia Pollution Abatement permits). DEQ central office, Richmond, 3 p.m. For more information: Melissa Porterfield.

11/13, Blackstone: Public meeting on proposed Total Maximum Daily Load (TMDL) for benthic impairment of unnamed tributary of Hurricane Branch in Nottoway County. For more information: Kelly Wills.

11/13, Virginia Beach: Advisory committee on proposed exceptional-waters designation of Ragged Island Creek in Isle of Wight County. For more information: Jean Gregory.

11/13 and 11/19, Stuart: Public meeting on proposed TMDL for bacteria impairment of South Mayo River in Patrick County. For more information: Jason Hill.

11/17, Charlottesville: Public meeting on proposed TMDL for bacteria impairment of Moore's Creek in Albemarle County. For more information: Robert Brent.

11/18, Richmond: Ground Water Protection Steering Committee. For more information: Mary Ann Massie.

11/20, Richmond: Public meeting on notice of intent to amend solid waste management regulations for permit by rule for waste piles. For more information: Michael Dieter.

11/20, Lawrenceville: Public meeting on proposed TMDL for bacteria and benthic

impairment of Roses Creek in Brunswick County. For more information: Mark Alling.

11/24, Richmond: Public meeting on proposed TMDL for benthic impairment of unnamed tributary of Chickahominy River in Hanover County. For more information: Mark Alling.

12/2, Virginia Beach: Public meeting on proposed TMDL for bacteria impairment of Lynnhaven River, Broad Bay, and Linkhorn Bay in Virginia Beach. For more information: Chester Bigelow.

12/3, Verona: Public meeting on proposed TMDL for multiple impairments in Middle River watershed. For more information: Robert Brent.

12/4, Richmond: State Water Control Board. For more information: Cindy Berndt.

Conferences and Other Gatherings

•**2004 EC04 Conference and Expo.** Feb. 16—20, 2004, Philadelphia, Penn.; sponsored by the International Erosion Control Association. For more information: Kim Kline at kim@ieca.org; Website: www.ieca.org.

•**7th National Mitigation & Conservation Banking Conference.** March 3—5, 2004, New Orleans, La.; sponsored by several private organizations and government agencies. For more information: Carlene Bahler, (703) 837-9763 or cbahler@erols.com; or visit www.mitigationbankingconference.com.

Water Quality Assessment Guidance

The latest revision (11/3/03) of the Virginia Department of Environmental Quality's (DEQ) Water Quality Assessment Guidance Manual is now available online at www.deq.state.va.us/wqa/305b2004.html. The manual describes how DEQ staff are to develop the biennial assessments of water quality—and related list of impaired waters—that the federal Clean Water Act requires (the next reports are due in 2004). For more information: Harry Augustine, (804) 698-4037 or hhaugustin@deq.state.va.us.

Nominating Waters for State Monitoring

The Virginia DEQ has developed a guidance document and nomination form for citizens to nominate state surface waters for inclusion in DEQ's annual Water Quality Monitoring Plan. Nominations for this year must be received by December 31, 2003. The guidance document for

nominations is available online at www.deq.state.va.us/cmonitor/guidance.html. For more information: Joyce Brooks, Telephone: (804) 698-4026, or jfbrooks@deq.state.va.us.

Database for Watershed Funding

The U.S. EPA Office of Water has created an online, searchable database of over 80 sources of federal funding for watershed protection. The Website, at www.epa.gov/watershedfunding, allows users to search by type of assistance, type of organization, and keywords.

Status of U.S. Oceans

America's Living Oceans—Charting a Course for Sea Change (Pew Oceans Commission, June, 2003, 166 pp.) examines the current condition of America's oceans. This report helps set the stage for another nationwide oceans analysis due soon from the U.S. Commission on Ocean Policy. The Pew Commission report is available online at www.pewoceans.org/oceans/oceans_report.asp, or contact the Pew Commission at (703) 516-0624.

Also Out There...

From the many water-related publications that arrive in the Water Center's mail, here are brief descriptions of some recent, detailed articles on various subjects.

Here are two articles that examine the status of American Shad and related fish in the Chesapeake Bay and its tributaries:

1) "Once Nearly Vanished, Shad Rebound in Bay."—Discusses the comeback of American Shad in the Bay. *Bay Journal*, Jul./Aug. 2003; Alliance for the Chesapeake Bay Inc., Baltimore, Md.; (410) 377-6270; available on-line at www.bayjournal.com.

2) "Migratory Fish Restoration Programs Continue to Grow Fish, Awareness."—Reports on the effectiveness of shad and river herring restoration projects. *Potomac Basin Reporter*, May/Jun. 2003; Interstate Commission on the Potomac River Basin, Rockville, Md.; (301) 984-1908; available on-line at www.potomacriver.org.

At the Water Center

To reach the Water Center: (540) 231-5624; water@vt.edu; www.vwrrc.vt.edu.

•**Financial Support for *Water Central*.** The Virginia Manufacturers Association (VMA), based in Richmond, agreed in September 2003 to provide \$5000 per year for two years to support the printing and mailing of *Virginia Water Central*. Starting with this issue, *Water Central*'s back

cover will carry an acknowledgment of this financial support. The Water Center is grateful for this assistance.

•**New Reports Available.** Two reports of research supported in part by the Water Center are newly available on our Website (www.vwrrc.vt.edu; click on "Publications," then "Recent Publications"):

••*Demonstration and Evaluation of Optimal Design Tools for Determination of TMDL Allocations*, by Teresa Culver and Yanbing Jia of the University of Virginia;

••*Quantifying NPS Pollutant Discharges from an Urbanizing Headwater Basin*, by Mark Dougherty and five co-authors from Virginia Tech.

USGS Competitive Grants

The U.S. Geological Survey (USGS) is calling for proposals under its National Competitive Grants Program. Any investigator at an institution of higher learning in the United States is eligible to apply for a grant through a Water Research Institute or Center established under the provisions of the Water Resources Research Act of 1984, as amended. Proposals involving substantial collaboration between the USGS and university scientists are encouraged. Proposals may be for projects of 1 to 3 years in duration and may request up to \$250,000 in federal funds. Successful applicants must match each dollar of the federal grant with one dollar from non-federal sources. Proposals must be filed on the Internet at <https://niwr.org/NIWR/> by 5:00 p.m. EST, **March 1, 2004**, and must be approved for submission to the National Competitive Grants Program not later than 5:00 p.m. EST, **March 12, 2004**, by the Institute or Center through which they were submitted. The Government's obligation under this program is contingent upon the availability of appropriated funds.

Proposals under this Announcement will be accepted only through the Internet site at <https://niwr.org/NIWR/>. Prospective principal investigators must register at that site prior to submitting a proposal. Registrations and proposals will be accepted on the Internet site beginning **December 1, 2003**. Registration does not obligate the registrant to submit a proposal.

THE VIRGINIA STEP PROGRAM in SUMMER 2003

Through the **Service Training for Environmental Progress (STEP)** program, students live in Virginia communities while working on a water-related project identified by the community. Following are summaries of the four STEP projects in Summer 2003; for a copy of any of the full reports, please contact STEP (contact information follows). **If you are a student interested in a STEP internship, or a community group interested in STEP assistance**, you can get more information about STEP at the Water Center's Web-site, www.vwrrc.vt.edu (click on "Education"); or contact Alan Raflo, (540) 231-5463; araflo@vt.edu; 23 Agnew (0444), Blacksburg, VA 24061.

"Water Supply Planning in the New River Valley," by Toby Ieuter.

This project's purpose was to gather background information for the New River Valley Planning District Commission in preparation of a regional water supply plan. Information about localities' water supply systems was obtained, as well as information about water supply planning in general and potential funding for activities related to the regional water supply plan. All information was cataloged in three project notebooks and eighteen summary sheets.



Toby Ieuter

"A Practical Guide to Natural Resource Education, Funding, and Technical Resources for Rockingham County," by Nathan Mitchell.

The objective of this project was to research and compile technical, funding, and educational resources to assist the Virginia Agriculture and Nature Center in its development of its educational and environmental stewardship programs. The project resulted in production of a manual entitled, *A Practical Guide to Natural Resource Stewardship for Rockingham County*, which can help the agricultural community in the Shenandoah Valley area find funding and technical help for water-quality issues.



Nathan Mitchell

"Assisting the Wetland Mitigation and Education Project on the Campus of the University of Virginia's College at Wise," by Chris Perez.

The purpose of this project was to assist the Lonesome Pine Soil and Water Conservation District and the Guest River Group's project to correct an acid mine drainage problem on the campus of the University of Virginia's College at Wise. The STEP intern helped Lonesome Pine compile historical information on the UVA-Wise wetland-project site, wrote a grant proposal to seek funding for an educational trail at the site, and helped organize a community meeting about the wetland project.



Chris Perez

"Mapping the Natural Hazard Risks in the New River Valley," by Zhou Daquan.

The purpose of this project was to supplement the risk-assessment portion of a natural-hazard mitigation plan being developed by the New River Valley Planning District Commission. The study examined flooding, wildfire, and landslide. For these three hazards, hazard-prone areas were compared to property assessments from tax-parcel maps. Based on that, property risks were estimated and mapped.



Zhou Daquan

Virginia Water Central

Published by the Virginia Water Resources Research Center, 23 Agnew Hall (0444), Blacksburg, VA 24061; (540) 231-5624; fax (540) 231-6673; e-mail: water@vt.edu; Tamim Younos, interim director.

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You can find *Water Central* on the Internet at www.vwrrc.vt.edu. If you prefer to read the newsletter there, instead of receiving a paper copy, please send an e-mail requesting this to water@vt.edu, and we will notify you whenever a new issue is posted.

Please notify us at (540) 231-5463 or araflo@vt.edu if your address has changed or if you no longer wish to receive the newsletter.

Thank you!

**Virginia Water Resources Research Center
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