



ONE RIVER, TWO WORLDS STATE OF THE NATION'S RIVER 2011

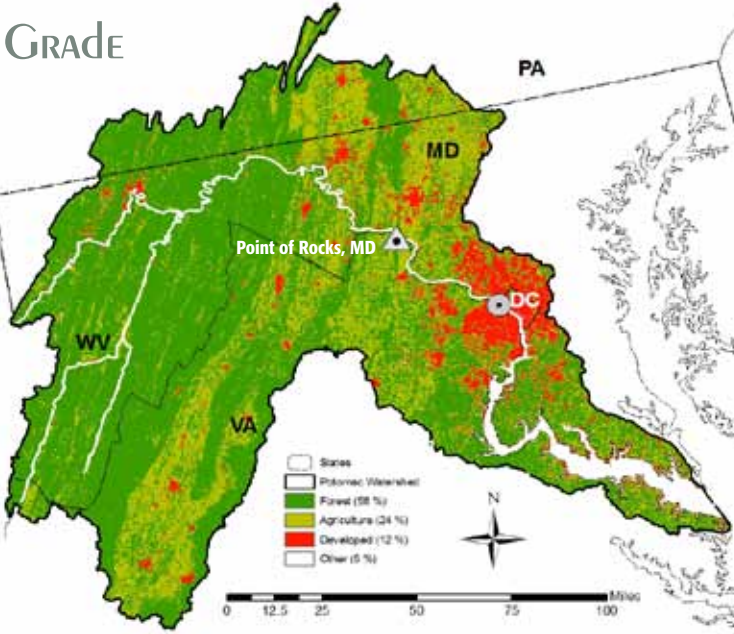
UPSTREAM & DOWN, STRUGGLING TO MAKE THE GRADE

Stand atop the Wilson Bridge looking north to Washington, D.C., and the Potomac River stretches beneath you in a broad, lazy ribbon, with busy roads and tall buildings lining its gently sloping banks. But travel upstream 75 miles to another bridge at Harper's Ferry, West Virginia, and the scene is one of mountains standing above a narrow channel speckled with beautiful rushing rapids and banks mostly blanketed by forests. The two snapshots highlight the Potomac watershed's dual nature: A river born in a rural, forested landscape that ultimately flows through an increasingly urbanized cityscape.

These "two worlds" pose different challenges to the Nation's River. Upstream, forestry and farming practices play a big role in influencing the river's health; downstream, sprawling building projects and vast sewage treatment plants loom large. Different worlds, with much in common. After all, the Potomac flows through our lives, from providing the water we drink every day to offering recreation.

Despite its importance, however, the Potomac is struggling. In 2007, the Potomac Conservancy graded the river's condition a lowly D+. Now, we again take on the challenge of evaluating what's better, what's worse – and how we can move forward to create the healthy, swimmable, fishable and vibrant river we all want and need. Unfortunately, despite progress in some areas, the report card isn't looking much better:

This year, we downgraded to a D, as a result of continuing concerns about poor land use practices in the face of a growing population, ongoing struggles to control pollution, and a suite of new concerns, ranging from emerging contaminants to invasive species. Below, we assess some of these issues.



Jurisdiction	Population in Basin by Jurisdiction			Population Density, sq. mi.
	2000	2010	% Change	
Maryland	2,030,455	2,252,017	10%	586
Pennsylvania	178,511	202,285	11%	128
Virginia	2,343,357	2,854,030	18%	490
Washington, D.C.	572,059	601,723	5%	8735
West Virginia	212,483	261,043	19%	75

Same River, Different Challenges. Rural (green) landscapes in the western part of the Potomac watershed – roughly west of the Interstate 81 corridor – pose different challenges to the river than more populated urban landscapes (red) downstream. Source: Lookingbill, T. et al. (2009) *Altered Ecological Flows Blur Boundaries in Urbanizing Watersheds. Ecology and Society* 14(2): 10.

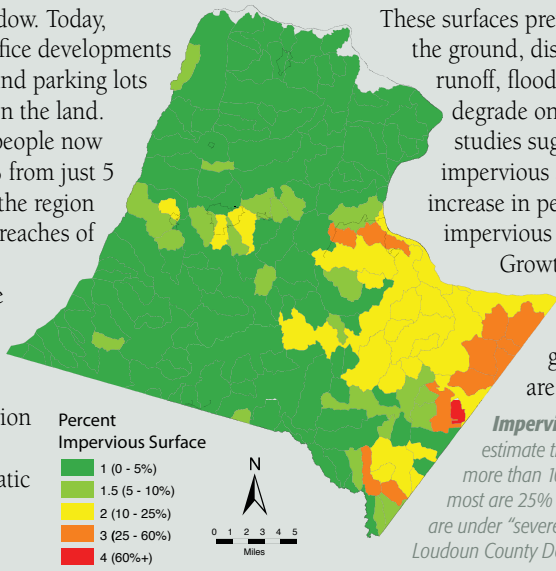
PEOPLE & PAVEMENT: MORE PEOPLE CREATE HARD PROBLEMS

FOCUS
Population growth and increased impervious surfaces

Just 30 years ago, a passenger flying into Dulles International Airport in Loudoun County, Virginia, would have seen mostly fields and woodlands outside the airplane window. Today, however, housing and office developments and miles of new roads and parking lots create a hard black cap on the land.

More than 6 million people now live in the basin – up 5% from just 5 years ago. Another 600,000 people could move to the region in the next decade, mostly in the lower, urbanized reaches of the river.

Along the Potomac, Loudoun County is just one place experiencing this sobering transformation. Between 1980 and 2010, its population increased five-fold, to more than 312,000 people, mostly in the eastern half of the county. During the construction boom, impervious surfaces were expanding by a stunning 6 acres per day, studies found. This dramatic land use change has had serious consequences for stream health.



This population surge will pose a serious threat to the river. One key reason: As population rises in undeveloped areas, so does the amount of land covered with hard surfaces, such as roads, parking lots and rooftops.

These surfaces prevent rainwater and snowmelt from filtering into the ground, disrupting the natural water cycle and speeding runoff, floods and erosion. Indeed, streams begin to degrade once as little as 10% of a watershed is paved. And studies suggest that, in developing areas, population and impervious surfaces grow in lockstep: In our area, each 1% increase in people is often matched by at least a 1% increase in impervious surface – and sometimes much more.

Growth policies and laws need to encourage better site-planning, stormwater management, and sediment controls, denser development and greener building practices. We know more people are coming, and we need to prepare.

Impervious Cover in Loudoun County, Virginia. Today, analysts estimate that more than one-fifth of the county's 161 subwatersheds have more than 10% impervious cover and, in the eastern half of the county, most are 25% covered or more. Nearly three-quarters of the county's streams are under "severe stress" or "stress," according to aquatic life surveys. Source: Loudoun County Department of Building and Development.

1975



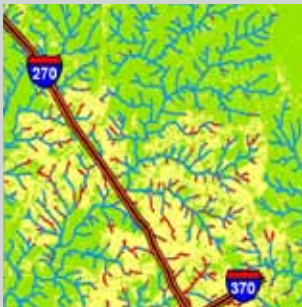
4% Stream Burial

1990



10% Stream Burial

2000



17% Stream Burial



Buried Streams. In Montgomery County, Maryland, rapid development has caused many small headwater streams to become “buried” – paved over or rechanneled into culverts and storm drains. Stream burial can dramatically degrade stream health and water quality. Source: Lookingbill, et al. (2009) *Altered Ecological Flows Blur Boundaries in Urbanizing Watersheds*. *Ecology and Society* 14(2): 10.

LAND USE MATTERS: FORESTS, FARMS AND THE FUTURE

FOCUS
Loss of forest cover and the need for more streamside buffers

In the summer of 2010, it didn't take long for boaters, anglers and swimmers to notice workers felling a thick belt of riverside trees along a popular stretch of the Potomac near Leesburg, Virginia. Within days, the Trump National Golf Course had cleared more than 450 trees from a mile-long stretch of riverbank. The golf course managers broke no laws but violated the spirit of the slim protections that were in place in Loudoun County. The owners made a more open view of the river for their members also increased the potential for bank erosion and destroyed wildlife habitat. The clearcutting sparked an uproar that highlighted the importance of land use to river health, and the need for policies that prevent this unnecessary

destruction of riverside habitat.

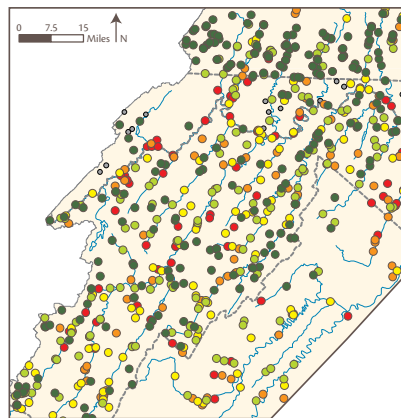
The Potomac is fortunate that the western, upstream part of its basin is still relatively rural, with extensive forests, pastures and farm fields. Although some agricultural and forestry practices degrade water quality, these rural landscapes typically do a better job than more urbanized landscapes in protecting the river, helping to filter out pollutants and slow down runoff and reduce erosion. A patch of forest, for example, will produce 95% less runoff – and soak up many more nutrients – than a similar swatch of pavement. As a result, tributaries along the upstream Potomac typically get better ecological health and water quality scores than similar streams in the Potomac's more urbanized, downstream reach (see maps at bottom of page).

Worryingly, however, the continuing, basin-wide loss of forests – especially in the “riparian” zone directly adjacent to waterways – threatens to undermine these benefits. **Overall, about 50% of the basin is still forested, but downstream reaches continue to lose trees and woodlands to development.** Prince George's County, Maryland, for example, lost about one-half of its forests between 1993 and 2007.

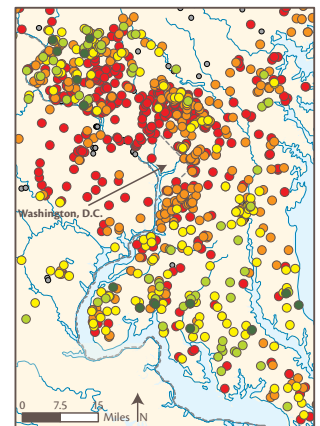
Upstream, researchers worry that a long-term trend of net forest gain (primarily due to the abandonment of agricultural lands over the last 100 years) is beginning to reverse, due to growing development pressure and other factors, including damage from acid rain and introduced pests and diseases. And although some landowners have taken steps to restore some riparian forests, others continue to allow their banks to remain bare – exposing the river to damaging erosion and polluted runoff. Still others – such as the Trump National Golf Course – are intentionally stripping away these defenses.

Forest loss is an expensive problem. Studies estimate that local governments now spend billions of dollars annually to provide services – such as stormwater management – that trees provide for free. To avoid that expense, a first step is to develop policies that ensure no net loss of forest—and encourage reforestation where possible. Along river banks, local governments need to bar the clearing of forests—and to encourage the planting of new ones where needed. Studies show that a forested streamside strip just 50- to 300-feet wide, for instance, can dramatically reduce erosion and runoff problems.

There is a link between stream health and land-based activities Potomac River Watershed Example



HEALTH STATUS	# OF SITES
Total	3,291
Excellent	510
Good	546
Fair	603
Poor	741
Very poor	891



Land Use Matters. Stream health scores tend to be higher (green dots) in upstream parts of the Potomac basin (left), and lower (red dots) in downstream stretches (right). Studies show that encouraging development near existing towns and cities can save money. Source: *EcoCheck Newsletter*, April 2009, http://ian.umces.edu/pdfs/ecocheck_newsletter_209.pdf.

Key to this
Report

Trend



Increasing



No significant
change



Decreasing

Impact/Effect



Positive



Neutral



Negative

EXTREME WEATHER HIGHLIGHTS EVERYDAY WATER QUALITY THREATS



When near-record floodwaters swelled Mid-Atlantic rivers in the spring and fall of 2011, NASA's Terra satellite documented the muddy, polluted water pouring into the Chesapeake Bay from the Potomac and other major tributaries. Unfortunately, the continuing threat to public health and the

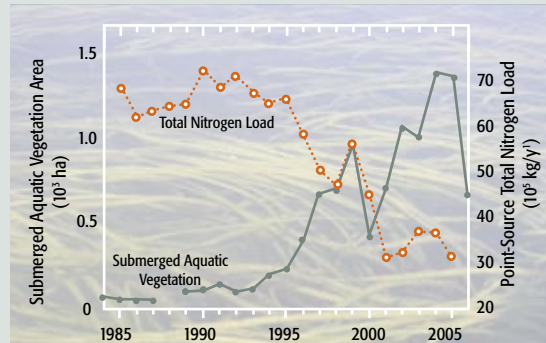
environment that they exposed was much more ordinary. Every day, poor development and agricultural practices, inadequate runoff controls and insufficient sewage treatment allow a wide range of contaminants to flow into the Potomac, threatening both river life and the water we drink.

River scientists have long understood that runoff and Potomac pollution go hand in hand. In rural upstream areas, runoff from agricultural lands carries unwanted sediment, manure and other fertilizers, and farm chemicals into the river. In urbanized downstream stretches, wet weather sweeps contaminants off paved surfaces and inundates sewer systems, causing raw sewage to spill into the river. The river's bacterial contamination levels, for example, spiked to unsafe levels after the late summer floods caused by Hurricane Irene and Tropical Storm Lee. The late summer deluge overwhelmed wastewater treatment plants, and more than 30 million gallons of diluted wastewater poured into local streams. Even after typical, everyday storms, however, it routinely becomes unsafe to boat or swim in the Potomac.

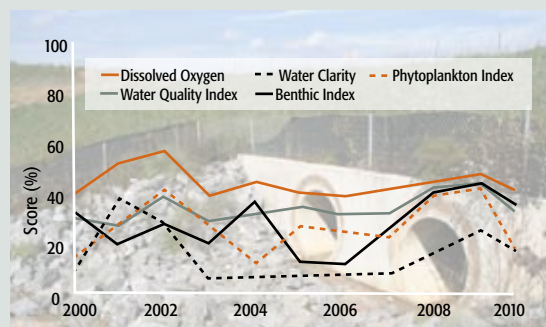
The good news is that, over the long term, some water quality trends in the Potomac have improved. In part, that's thanks to upgrades at major sewage treatment plants, such as the Blue Plains plant that serves the D.C. area. The upgrades have reduced nitrogen pollution and made the water clearer—helping beds of submerged aquatic vegetation dramatically expand in the Potomac below Great Falls (see top graph). This vegetation provides critical habitat and breeding grounds for bass, waterfowl and wading birds and many other species.

Those gains, however, are being undermined by continuing stress from things like poor land use and antiquated sewage systems. Downstream reaches of the Potomac, for example, continue to be flooded with raw sewage after some heavy storms due to combined sewage overflows (CSOs) – piping systems that are supposed to separate sewage and runoff, but can't handle heavy flows. The District of Columbia alone has 53 CSOs, many of which need upgrades. And as more people hook up to sewage systems, experts say nutrient levels from sewage treatment plants will begin to rise – posing a fresh challenge.

As a result of such continuing assaults, overall health indicators for the Potomac have essentially leveled off or declined since our last report, according to annual data compiled by Chesapeake EcoCheck, a government/university partnership (see bottom graph). Indeed, in 2010 the Potomac had the second largest decline in EcoCheck scores, falling from a marginal 45% in 2009 to a poorer 34% in 2010. Four of six major indicators – which includes things like levels of dissolved oxygen and phytoplankton numbers in the river – dropped. That trend suggests that, despite substantive efforts, water quality in the Potomac has not improved in the last decade.



Green Gain. As nitrogen pollution in the lower Potomac decreased between 1984 and 2006, mostly due to sewage treatment improvements, beds of submerged aquatic vegetation began to recover, with some setbacks. Source: RJ Orth et al. (2010) *Estuaries and Coasts* 33: 1144-63. Photo Credit: Nancy Rybicki, U.S. Geological Survey



Leveling Off. Many measures of water quality in the Potomac have changed little over the last decade. Source: Chesapeake EcoCheck, 2011, www.eco-check.org.

AS AGRICULTURE INTENSIFIES, WASTE PILES UP



Humans aren't the only animal with a growing population in the Potomac basin. More than 75 million chickens are now raised along the river each year – mostly in large, computer-controlled facilities that can hold 25,000 birds at a time. Although such intensive poultry operations can be efficient and profitable for farmers, managing the nutrient- and chemical-laden waste they produce poses a serious challenge. Ten thousand 6-week old broiler chickens, for instance, can produce 3,500 pounds of manure a day – and poultry houses often produce far more litter than can be safely spread on nearby fields as fertilizer. Along with nitrogen and phosphorus – two nutrients that can degrade water quality and spur algal blooms – studies show the waste can also hold antibiotic residues, estrogen-like

chemicals, pesticide residues and trace metals.

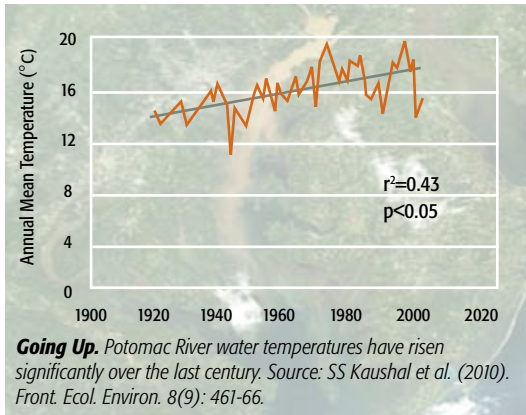
The waste-handling challenge is particularly acute along the Potomac's upstream tributaries in West Virginia and Virginia, where hundreds of 500-foot-long chicken houses dot the landscape, and along the tidal Potomac in Maryland near the Chesapeake Bay. And it's not just chickens: Other concentrated animal feeding operations (CAFOs) in the basin include intensive beef cattle and hog lots and turkey houses. There are between 235 and 280 large CAFOs in the Potomac headwaters region, by some estimates, and many other smaller operations.

Although many CAFOs now handle their waste better than they did 20 years ago, concerns remain. Due to vague policies, many are not regulated. In many areas, too much manure is still being spread on too few fields, and a lack of adequate streamside buffers means too many nutrients and chemicals leak into streams. Researchers have also found worrying correlations between CAFO density and the occurrence of intersex fish – which have both male and female characteristics – in nearby waterways. It's clear that we also need to continue to improve how we handle the basin's robust flocks and herds. Supporting efforts to help CAFO owners properly locate facilities – and use best practices for storing, composting, and using manure—is a critical and ongoing task.

Nitrogen load in the Potomac, kg/km ² /yr ⁻¹	
Net atmospheric N deposition	769
N fertilizer use	1024
N fixation in forestlands	271
N fixation in agricultural lands	1173
Net N import in food and feed	1452
Total N inputs	4689

Nutrient Flows. The Potomac is a leading carrier of nitrogen to the Chesapeake Bay, contributing nearly one-third of the total from the Bay's four major feeder rivers, according to some estimates. Animal feed and food is a leading source of imported nitrogen. Source: Boyer, E. et al., 2002. *Biogeochemistry*, 57: 137-169.

Will Invaders, Climate Shifts Remake the Potomac Basin?



At first glance, the tiny, iridescent green insect known as the emerald ash borer doesn't seem like much of a threat. But scientists say the beetle has the potential to reshuffle Potomac basin forests. Since the Asian native was first discovered in 2002, it has spread to 14 states and killed tens of millions of ash trees, an important species in forests.

Other invasive species – from weedy plants to predatory snakehead fish and tree-munching Asian longhorn beetles – have also gained a foot- or fin-hold. And climate shifts may be making their presence felt. A recent study, for instance, concluded that the Potomac experienced rapid warming between 1922 and 2006, with water temperatures increasing by roughly 5 degrees Fahrenheit. Some of that increase was probably due to land use changes and “heat islands” created by urban development, but a warming climate may also have played a role.

How the already-stressed Potomac ecosystem will respond to these changes isn't clear. But taking steps to improve the river's health could provide the resilience it needs to adapt to what could be a very different future.

EMERGING CONTAMINANTS POSE NEW CHALLENGE

Since the Conservancy's first report was issued in 2007, researchers have learned much more about the presence of endocrine-disrupting chemicals (EDCs) and other emerging contaminants in the Potomac. Scientists have documented the presence of hundreds of compounds, including dozens of pesticides, pharmaceuticals and even the residues of illegal drugs. These chemicals can originate from everyday products like shampoo, perfumes, prescription drugs and birth control pills, and from farm chemicals and animal manure. Research has shown that even low levels of some of these compounds can disrupt the body's endocrine system, which produces the hormones that regulate everything from reproduction and growth to metabolism and mood.

Many of these contaminants tend to be more common and occur in higher concentrations downstream of wastewater treatment plants. Others, such as the widely-used agricultural pesticides atrazine and metolachlor, tend to increase with spring runoff, reaching levels 3 to 9 times higher than in the fall. Researchers have concluded that effluent from wastewater plants is probably influencing the reproductive health of the river's small- and largemouth bass, but that the presence of intersex fish throughout the basin suggests that other sources – including agricultural runoff – also contribute.

Despite these troubling findings, however, EDCs remain essentially unregulated. Although the EPA has launched studies of many of these chemicals, it has so far been reluctant to suggest safe limits on their presence in drinking, surface or ground water. Meanwhile, thousands of new chemicals enter the market each year – with relatively little testing. In essence, we are conducting a grand chemistry experiment on the Potomac; so far, the results don't seem encouraging.

PUTTING THE POTOMAC ON A DIET

Can local governments WIP the Potomac's pollution problem? That's the question as an effort to develop Watershed Implementation Plans – or WIPs – moves into a higher gear. In essence, a WIP is a roadmap designed to put the Potomac on a new “pollution diet” – reducing the quantities of sediment, nutrients and other contaminants it carries to the Chesapeake Bay. Under a WIP, all sources of pollution, from agriculture to development, are asked to take steps to reduce their contributions, to meet an overall reduction target called a Total Maximum Daily Load (TMDL). In the Potomac's case, the Chesapeake Bay TMDL calls for cutting total nitrogen by 13%, phosphorus by 23% and suspended solids by 21%. WIPs, which are to be finalized in early 2012, will detail the specific, enforceable steps needed to meet those goals by 2025. The federal and state governments have done their part with planning, and now towns and counties must decide what they will do to ensure local rivers and streams are not further degraded by pollution. The decisions they make will have far reaching effects for decades to come.

NEXT STEPS: FLOWING TOWARD THE FUTURE

The last 5 years have seen some progress along the Potomac – but not enough. Here are some things we can do right now to help improve the river:

- **Enact and enforce strong stormwater rules.** New regulations should limit stormwater runoff from new development sites to pre-development levels. States must issue enforceable urban stormwater permits (known as MS4 permits). Permits should include numeric pollution limits that are linked to, and even exceed, federal water quality standards.
- **Put a LID on impervious surfaces.** State and local governments need to revise local codes and ordinances to require or create incentives for low-impact techniques that reduce polluted runoff.
- **Protect existing forest land and replant strategic areas.** There should be no net loss of forests. Zoning rules must protect trees along stream banks. Governments should take steps to encourage the creation of forest management plans for larger forested areas, and provide all landowners with incentives and technical assistance to plant and protect vegetation.

- **Help promote well-managed farms.** There must be strong support for our working landscapes. Federal and state governments need to continue to provide financial incentives and to fund fully the cost share programs designed to help farmers adopt and use best management practices.
- **Make sure WIPs happen.** County and local governments must actively engage in the Watershed Implementation Plan process, and commit to developing practical, efficient and cost-effective ways to improve the river's health.
- **Control emerging contaminants.** If properly enforced, the Toxic Substances Control Act (TSCA) could play a pivotal role in keeping harmful chemicals from entering the Potomac. In particular, Congress must shift the burden that TSCA places on EPA to show that an existing chemical poses an “unreasonable risk” before it can be declared unsafe; instead, the agency should have greater leeway to regulate chemical threats before they enter our water supply.
- **Improve CAFOs.** Potomac states must encourage CAFOs to adopt best management practices, expand regulation, and hold regulated facilities accountable through rigorous inspections. Facilities should have comprehensive nutrient management plans, and use high-quality manure application and storage practices. Violators must be fined at meaningful levels and be responsible for cleanup.

Acknowledgements: We thank Danaher Corporation, the Keith Campbell Foundation for the Environment and the Curtis and Edith Munson Foundation for their support of this report, and David Malakoff for writing and gathering data for this report. Copyright 2011, Potomac Conservancy.



Safeguarding the lands and waters of the Potomac River and its tributaries and connecting people to this national treasure.

8601 Georgia Avenue • Suite 612 • Silver Spring, MD 20910 • 301.608.1188 • www.potomac.org