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Missing Protection

Polluting the Mississippi River Basin's Small Streams and Wetlands

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Executive Summary

Our nation's rivers, streams, and small bodies of water have long been protected by the Clean Water Act, but a series of misguided court decisions now put them in danger. Recent interpretations of the law suggest that many waters historically protected from pollution can now be polluted or destroyed without a permitting process to limit the environmental impact of the discharging activity. This loophole is particularly dangerous in relation to the problem of nutrient pollution in the Mississippi River Basin. Pollution from the Mississippi contributes to the annual formation of an enormous "dead zone" in the Gulf of Mexico, an area where the bottom layer of water is so oxygen-depleted that most sea life cannot survive within it. Fortunately, with immediate action to restore protections to America's waterways we can also address the growing trouble in the gulf.

The formation of the dead zone is caused by the die-off of massive algae blooms in the gulf. These blooms arise in large part because of nitrogen and phosphorus pollution delivered by the Mississippi River from a broad watershed. Small water bodies such as wetlands and headwater streams play an important role both as conduits and as sinks for this nutrient pollution. Evidence shows that while much of the nutrients that reach the gulf come from runoff entering headwater streams, these streams and wetlands can also intercept and remove nutrients from the water before they get to major river systems and the gulf. Actions to protect and restore the health of smaller waters throughout the basin can thus help to filter water in the Mississippi and reduce pollution contributing to the dead zone.

Two recent Supreme Court decisions, along with subsequent policy directives (often referred to as "guidance") from the Environmental Protection Agency (EPA) the Army Corps of Engineers (Corps), endanger protections under the Clean Water Act for these functionally important waters. As discussed in detail in this issue paper, the Supreme Court and federal agencies have given rise to enormous conflict about what kinds of water bodies the law can protect. Accordingly, myriad small streams, adjacent wetlands, and "isolated" waters in the Mississippi River Basin and across the nation could lose the Clean Water Act's protection from unregulated pollution.

The ecological significance of the small waters of the Mississippi River Basin justifies their protection. And the health of the nation's great river and the Gulf Coast depends on such protection. The law remains strong enough—if it is enforced—to protect a great deal of these resources. To ensure that the law is enforced to the fullest degree, NRDC recommends the following:

- Congress must pass the Clean Water Restoration Act to clearly protect water bodies that had been subject to the Clean Water Act prior to the Supreme Court's decisions.
- The EPA and the Corps must retract their guidance documents misinterpreting the Supreme Court's decisions.
- New guidance must make clear that tributaries for traditionally navigable waters—including ones with intermittent or ephemeral flow—are protected without case-by-case analysis of their function.
- The agencies' guidance documents must reverse the *de facto* policy of leaving nonnavigable "isolated" waters unprotected.
- The agencies should examine the available evidence of the importance of wetlands throughout the Mississippi River Basin, including their ecological contributions such as reducing the dead zone, and announce that the resources have a "significant nexus" to the Mississippi itself and to the gulf and therefore are presumptively protected by the Clean Water Act. Although it is not legally necessary to do so (if the agencies implement the third recommendation above), the agencies should also draw the same conclusions about the headwater and seasonal streams of the basin.
- States should use available authorities to protect the resources that the federal government fails to safeguard.

CHAPTER 1

Nutrient Pollution and Its Effects in the Mississippi River Basin

Plants and animals need nutrients to survive, but in high concentrations they can be contaminants in water. Nutrients, as discussed in this issue paper, are chemical compounds that contain nitrogen or phosphorus. Nutrient compounds can change their form or be transferred to or from water, soil, biological organisms, and the atmosphere. While nitrogen is found in many chemical forms, including ammonia and nitrates, the only significant source of phosphorous in freshwater is in the form of phosphates.[1]

Nutrient Pollution Is Widespread

Nutrient pollution is pervasive. Nutrients enter ecosystems from a variety of sources, including fertilizer runoff from farms, golf courses, and lawns; manure disposal; discharge from sewage treatment plants and industrial facilities; nitrogen deposition from the atmosphere; and erosion of nutrient-rich soil.[2] Fertilizer, though, is a particular culprit. In the twentieth century, scientists discovered chemical processes that fixate nitrogen from the air into reactive nitrogen compounds, and these compounds were added to plant fertilizers in significant quantities.[3] Unfortunately, much of the nitrogen applied in fertilizers is lost to the environment. "In recent years, the Mississippi River has discharged as much as one million megagrams of dissolved nitrate-nitrogen annually into the Gulf of Mexico."[4] Phosphorus pollution also comes into the gulf in great quantities from the Mississippi/Atchafalaya Basin; the gulf received an average of 154,000 metric tons of total phosphorus between 2001 and 2005.[5]

Because of their wide use and environmental mobility, nutrients contribute significantly to water contamination. According to a U.S. EPA report on the state of the nation's waters, nutrients were the fifth-leading pollutant in rivers and streams, affecting more than 15 percent of impaired stream miles.[6] Nutrients are also an important contributing factor to stream degradation. A statistically sound assessment of wadeable perennial streams—ones that are small and shallow enough to adequately sample by wading and that have water flowing through at least half the reach—revealed that nitrogen and phosphorous are the most widespread stressors in wadeable streams in the lower 48 states (riparian disturbance, streambed sediments, salinity, acidification, in-stream fish habitat, and riparian vegetation were also assessed).The same study found that streams with elevated nutrient pollution commonly had poor biological quality: "the risk of having poor biological condition was two times greater for streams scoring poor for nutrients or streambed sediments than for streams that scored in the good range for the same stressors."[7]

Every two years, states create lists of water bodies that are polluted to the point of being unsuitable for one or more of their designated uses, such as water contact recreation or aquatic habitat, and submit them to the EPA to be included in "303(d) lists." Those lists, called 303(d) lists for the section of the Clean Water Act that mandates their preparation, demonstrate the breadth of nutrient pollution in the United States. According to the EPA, "[v]irtually every State and Territory is impacted by nutrient-related degradation of our waterways. All but one State and two Territories have Clean Water Act Section 303(d) listed impairments for nutrient pollution. States have listed over 10,000 nutrient and nutrient-related impairments. Fifteen States have more than 200 nutrient-related listings each."[8]

Similarly, a recently published report shows that nutrients are widespread in the environment. Between 1991 and 1997, the National Water-Quality Assessment Program of the U.S. Geological Survey assessed nutrient pollution in 51 watershed study areas, nine of which drain to the Mississippi River. [9] On average, there were about 10 sample sites for each study area. Nationwide, the researchers found that elevated nutrient concentrations were common; the observed levels exceeded the EPA's recommended maximum levels (called "criteria") for nitrogen at 72 percent of undeveloped sites and 96 percent of developed sites, and exceeded the phosphorus criteria at 89 percent of undeveloped locations and 97 percent of developed sites. Despite the widespread contamination, "[c]oncentrations of all nutrient constituents at sites downstream from undeveloped areas are significantly less than at all other sites." In particular, the study noted that agricultural areas had particularly elevated nitrate and total nitrogen levels.

FIGURE 1: Nutrient Pollution Loading and Concentrations in Monitored Waterways: Flow-weighted Concentrations of Nitrogen and Phosphorus in Agricultural Watersheds

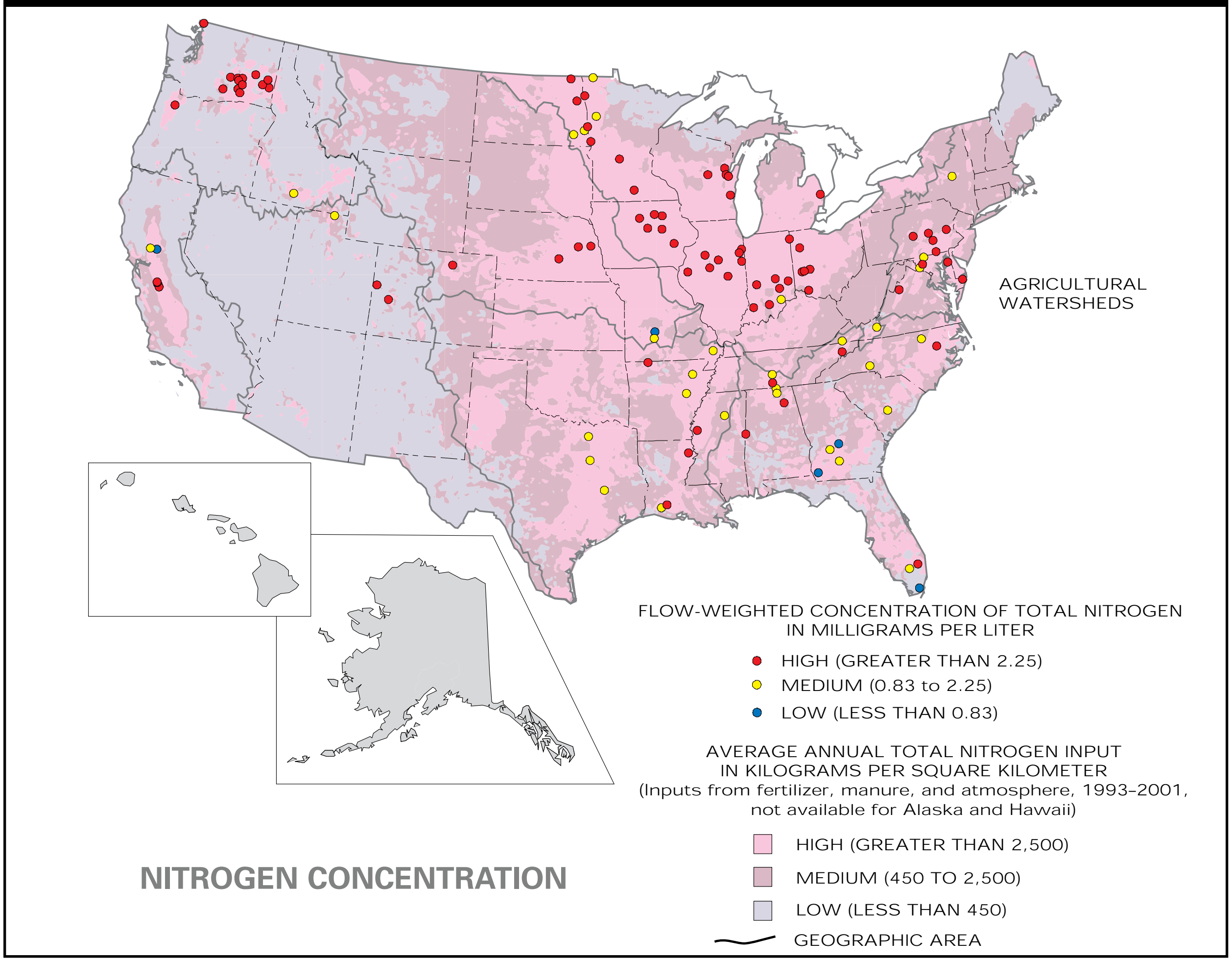
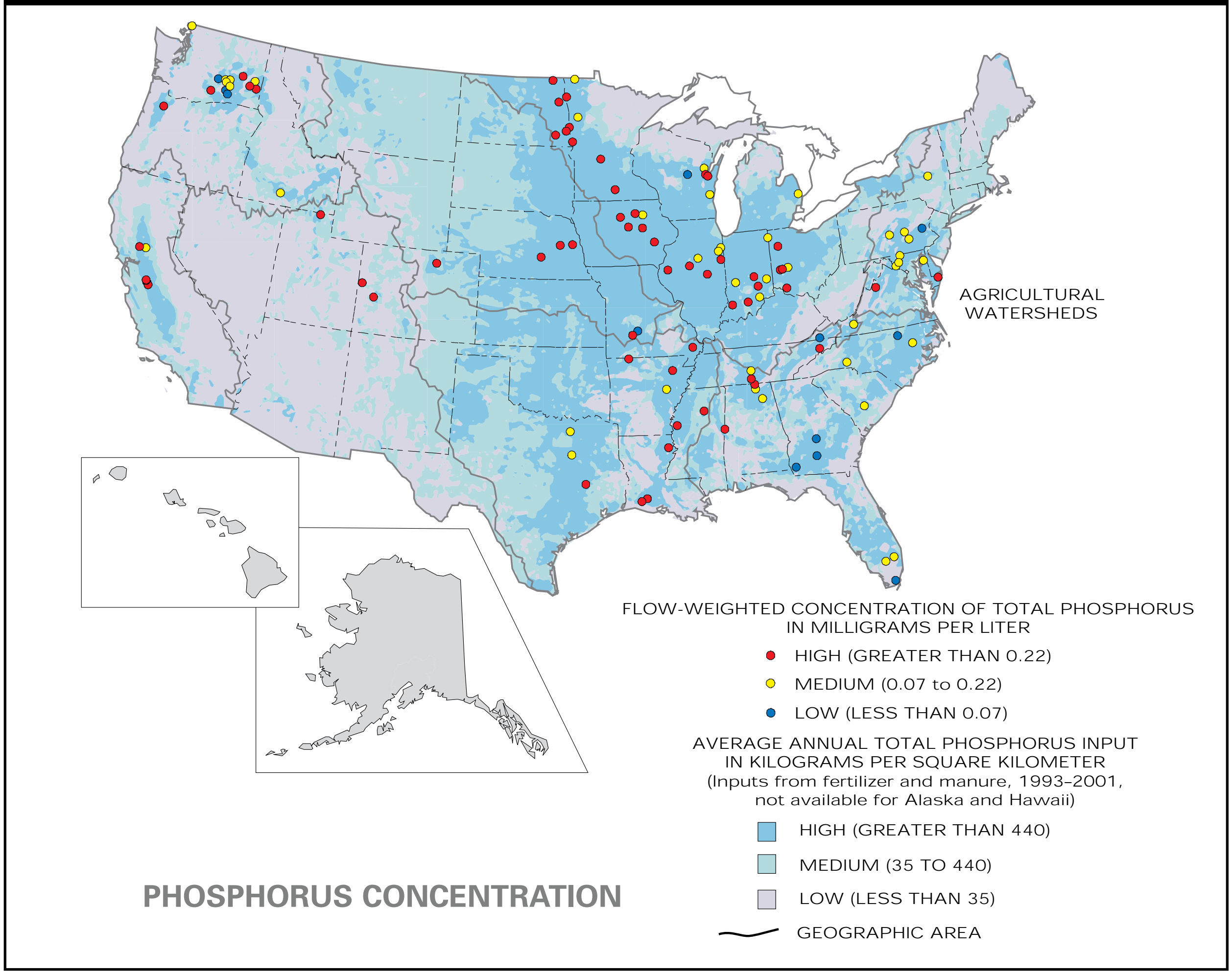


FIGURE 1: (Continued)



SOURCE: Mueller and Spahr, U.S. Geological Survey, 2006.

Nutrient Pollution Contributes to Dead Zone in the Gulf of Mexico

The formation of an oxygen deprived area in the northern Gulf of Mexico is a problem caused in large part by nutrient pollution traveling through the Mississippi River watershed. In some ways, that is just the tip of the iceberg of environmental concerns tied to nutrient contamination, which include nitrate-contaminated drinking water, contribution to disinfection byproduct formation, and harm to aquatic life (see sidebar below).

In aquatic ecosystems, hypoxia refers to a depletion of the concentration of dissolved oxygen in the water column. Excessive nutrients, such as nitrogen, lead to aquatic plants and algae rapidly increasing in abundance. When algae die, the organic material sinks to bottom waters, where microbes decompose it and consume oxygen in the process, leading to a condition called eutrophication. When aquatic systems become eutrophic, hypoxic conditions can result. Moreover, in the northern Gulf of Mexico, the freshwater delivered from river systems to the gulf does not mix well with the salty and denser receiving water; this stratification exacerbates the problem by keeping the oxygen-depleted water on the sea bottom. A schematic of this process appears on page 10.

What other problems are caused by excess nutrients?

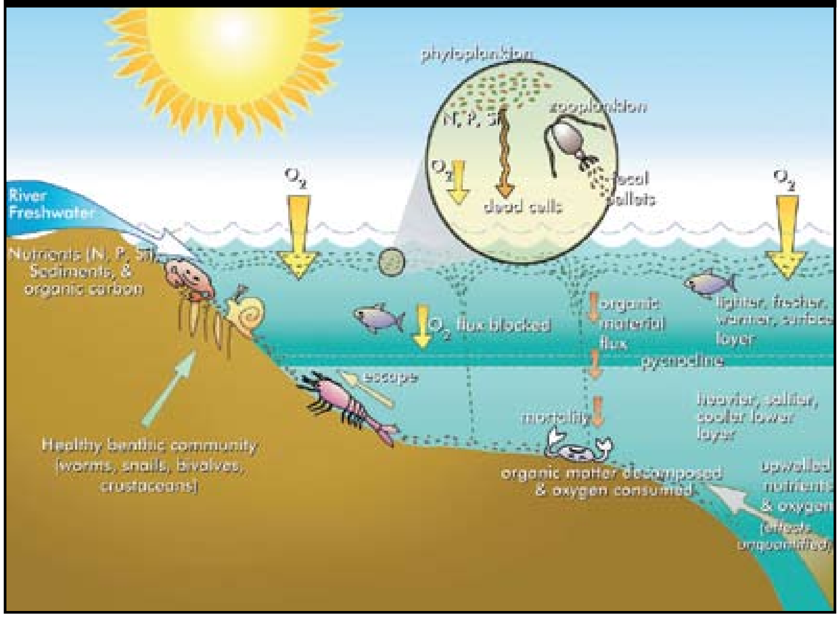
Nitrate-Contaminated Drinking Water: Excessive levels of nitrate in drinking water can cause human health problems. Nitrate in drinking water has been linked to "blue baby" disease (methemoglobinemia), which particularly affects newborns. This is the primary health hazard from drinking water high in nitrates and occurs when bacteria in the digestive system converts nitrate to nitrite. The nitrite reacts with iron in the hemoglobin of red blood cells to form methemoglobin, which lacks the oxygen-carrying ability of hemoglobin. The result is that the blood lacks the ability to carry sufficient oxygen to the cells of the body.[10] To guard against this problem, the EPA established a drinking water standard, intended to protect vulnerable populations, of 10 milligrams per liter of nitrate. Nationwide, a total of 562 drinking water systems serving more than 250,000 people had violations of applicable nitrate requirements in the most recent year for which the EPA has data.[11]

Formation of Trihalomethanes: Nutrients effectively fertilize algae in water bodies. This occurs in local water bodies as well as in faraway gulf waters. When algae are present in raw water used by drinking water supply systems, as the EPA explains, unhealthful compounds may form during disinfection: "Trihalomethanes are carcinogenic compounds that are produced when certain organic compounds are chlorinated and bromated as part of the disinfection process in a drinking water treatment facility."[12] In a single year (fiscal year 2007), the EPA reports that 1,408 drinking water systems serving more than four million people violated requirements for disinfection by-products, of which trihalomethanes are a subset.[13]

Harm to Aquatic Life: Nutrient enrichment in streams directly affects animal communities in these water bodies. For example, research shows that elevated levels of phosphorus correlate with declines in invertebrate community structure.[14] High concentrations of nitrogen in the form of ammonia are known to be toxic to aquatic animals. "Depending on the number of hydrogen atoms in the compound, ammonia in water may be ionic (having an electrical charge) or un-ionized (having no charge). The un-ionized form is more toxic to fish." [15]

Excessive levels of algae also cause problems for aquatic life. In addition to hypoxia, algae can generate toxic by-products that can sicken swimmers and cause die-offs of aquatic life ranging from shellfish to marine mammals.[16] According to one report, a "preliminary and highly conservative nationwide estimate of the average annual costs of [harmful algal blooms] is approximately $50 million."[17]

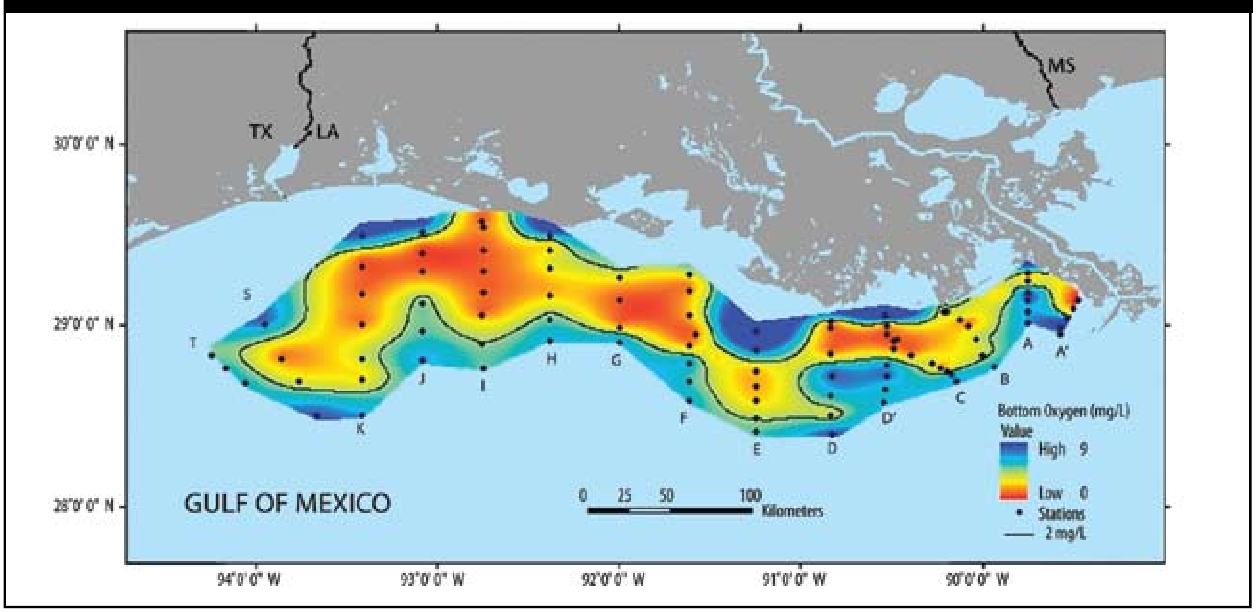
FIGURE 2: Overview of Hypoxia Development[18]



CREDIT: NATIONAL SCIENCE AND TECHNOLOGY COUNCIL, COMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES, INTEGRATED ASSESSMENTS OF HYPOXIA IN THE NORTHERN GULF OF MEXICO (MAY 2000)

This phenomenon plays out on a grand scale along the Louisiana-Texas coast. Nutrients contribute to the creation of a large zone of seasonally low dissolved-oxygen concentrations in the Gulf of Mexico. Aquatic life flees this zone when it can and dies when it cannot. The dead zone varies in size from year to year, but the average size from 1985 to 2007 was 13,500 square kilometers. [19] In 2007, the dead zone was the third-largest dead zone on record since systematic measurements began, reaching 20,500 square kilometers (see Figure 3), an area roughly the size of New Jersey.

FIGURE 3: Zone of Hypoxia in the Gulf of Mexico in July 2007



Data source: N. Rabalais, LUMCON. Map by A. Sapp

2008 Dead Zone Is Second-Largest on Record

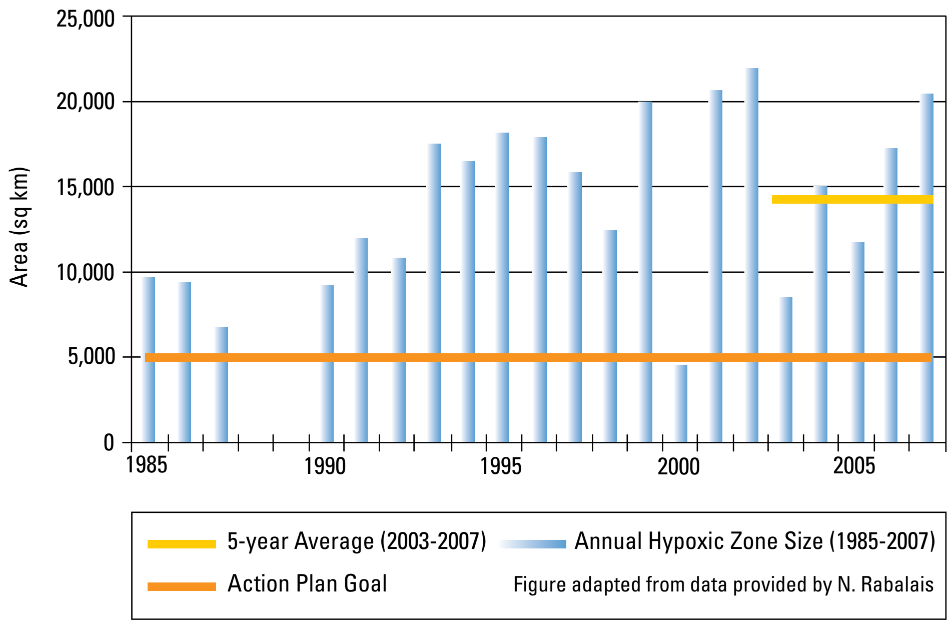
As we finished work on this issue paper, researchers from the Louisiana Universities Marine Consortium completed their mapping of the dead zone for 2008. Reaching 20,720 square kilometers, the hypoxic zone was the second-largest ever recorded.[20] Although far from good news, their finding was a bit of a relief given estimates that the amount of nitrogen entering the gulf reached its highest level in nearly 40 years and brought with it the potential for the largest dead zone ever.[21] The researchers suggested that Hurricane Dolly churned up the water in the Gulf enough to avoid breaking the record.[22]

Obviously, a state-size region of oxygen-starved water raises serious concerns for important fishing resources. For instance, shrimpers today find it more difficult to reach the same level of catch that prior generations were able to accomplish. It is not clear that hypoxia harms the overall condition of the gulf's fishery; while the National Research Council notes that there have not been "catastrophic losses of fisheries resources in the northern Gulf of Mexico," the Council further reports:

> Numerous studies document the effects of hypoxia on coastal fishes and shrimp. Shrimp, as well as the dominant fish, the Atlantic croaker, are absent from the large areas affected by hypoxia. There is a negative relationship between the catch of brown shrimp—the largest economic fishery in the northern Gulf of Mexico—and the relative size of the midsummer hypoxic zone. The catch per unit effort of brown shrimp has also declined during the recent interval in which hypoxia was known to expand. The presence of a large hypoxic water mass when juvenile brown shrimp are migrating from coastal marshes to offshore waters inhibits their growth to a larger size and thus the poundage of captured shrimp. The unavailability of suitable habitat for shrimp and croaker forces them into the warmest waters inshore and also cooler waters offshore of the hypoxic zone with potential effects on growth, trophic interactions, and reproductive capacity.[23]

Concerns about the dead zone led to the formation of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force in 1997. Following the development of an integrated scientific assessment of hypoxia in the northern Gulf of Mexico, the Task Force released an action plan in 2001 that set a goal of reducing the average size of the zone of hypoxia to 5,000 square kilometers by 2015.[24] Unfortunately, a number of the actions in the plan were not carried out, preventing significant progress toward the goal.[25] Indeed, although roughly half of the timeline laid out in the action plan has elapsed, the size of the dead zone in 2007 was more than four times the plan's target, and nearly the same as it was in 2001 when the goal was set. Similarly, the five-year average from 2003 to 2007(14,644 km^2) remained significantly above the goal and was roughly equivalent to the average from 1996 to 2000 (14,128 km^2).[26]

FIGURE 4: Size of Gulf Hypoxic Dead Zone, 1985 to 2007



Source: Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Gulf Hypoxia Action Plan 2008.

Nutrient Pollution Is A Major Cause of Dead Zone

A number of factors contribute to the size of the dead zone (see sidebar below), but nutrient pollution substantially drives the problem, and new science underscores the need to target both nitrogen and phosphorus loadings. Until relatively recently, scientists thought that nitrogen was primarily responsible for hypoxia in marine waters and that freshwater systems responded more to phosphorous levels.[27] However, the evidence now suggests that both nitrogen and phosphorus affect the size of the dead zone. It appears that phosphates entering the gulf via the Mississippi and Atchafalaya rivers are important to near-shore eutrophication, particularly during the peak time of algae growth (February to May). [28]

What other factors influence the size of the dead zone?

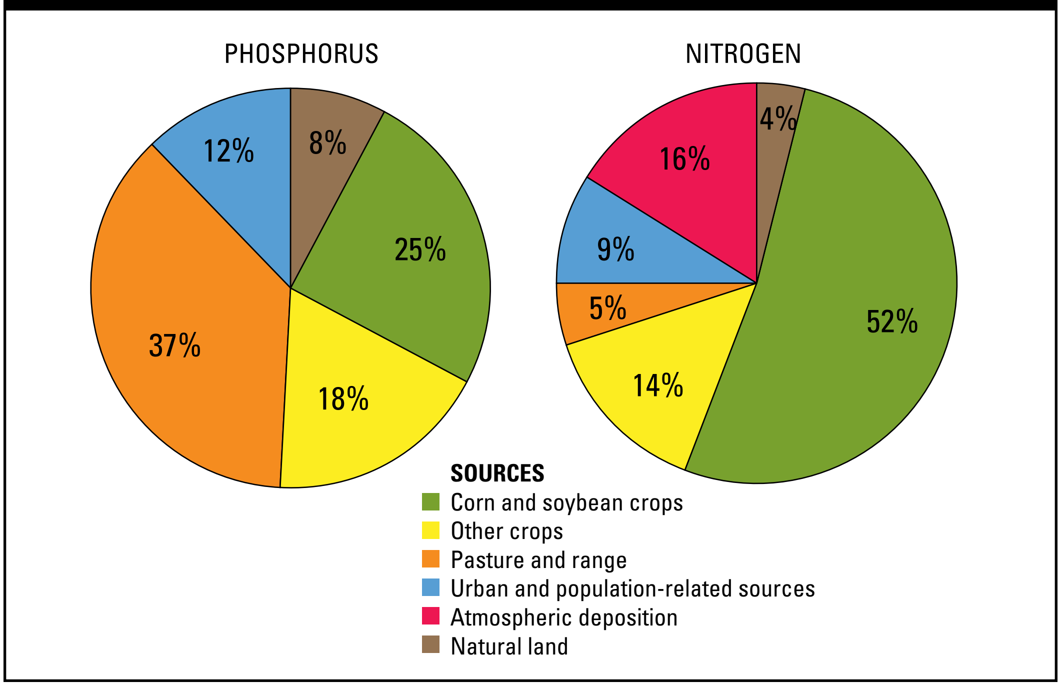
For one, water in the northern gulf is stratified; low-salinity freshwater from the Mississippi and Atchafalaya rivers enters the gulf and acts as a barrier to vertical mixing, causing water low in oxygen to remain on the floor of the gulf. [29] In particular, the diversion of water from the Mississippi River to the Atchafalaya River, which empties into the gulf 200 kilometers west of the mouth of the Mississippi, appears to contribute to the dead zone. The ocean shelf drops steeply at the mouth of the Mississippi River but remains shallow far offshore of the mouth of the Atchafalaya River. Consequently, the freshwater coming from the Atchafalaya does not mix as well with bottom water as the water coming from the Mississippi to the gulf does, preventing the oxygenation of that water.

The time of year that nutrients reach the gulf also influences the size of the hypoxic zone. Nutrients delivered in the spring affect the size of the dead zone more than fluxes at other times of year. The highest productivity of plankton, including algae, occurs in the spring, a time when "the river is disproportionately enriched with all nutrients ... but particularly with nitrate."[30]

Pollution also weakens the gulf's resistance to future hypoxia, according to recent information. Last December an expert panel studying hypoxia for the EPA concluded that the gulf has apparently undergone a "regime shift," making it more sensitive to nutrient pollution than it was in the past. [31] Addressing hypoxia therefore requires more nutrient pollution reduction than was previously expected. Experts previously thought that reducing the dead zone to a five-year average of 5,000 square kilometers would require cutting only nitrogen, and only by approximately 30 percent. However, the latest scientific assessment recommends reducing both nitrogen and phosphorus by at least 45 percent.[32]

But where are all these nutrients coming from, and where will it be important to concentrate pollution reductions? The evidence clearly shows that areas with significant agricultural uses are the largest contributors of nutrient pollution to the gulf. Specifically, a recent analysis using a detailed water-quality model estimated that 52 percent of Mississippi Basin nitrogen comes from lands on which corn or soybeans are grown, while another 14 percent in the Mississippi Basin comes from other crop production, including wheat and alfalfa. For phosphorus, 80 percent of the pollution comes from manure on pastureland and rangeland (37 percent), corn/soybean production (25 percent), and other crops (18 percent).[33] The pie charts that follow show the degree to which different sources contribute to nutrient pollution.[34] On many of these lands the movement of nutrient-laden water away from fields and into river systems is particularly efficient, because they frequently have an extensive network of subsurface tile drains that are designed to rid these fields of excess water.

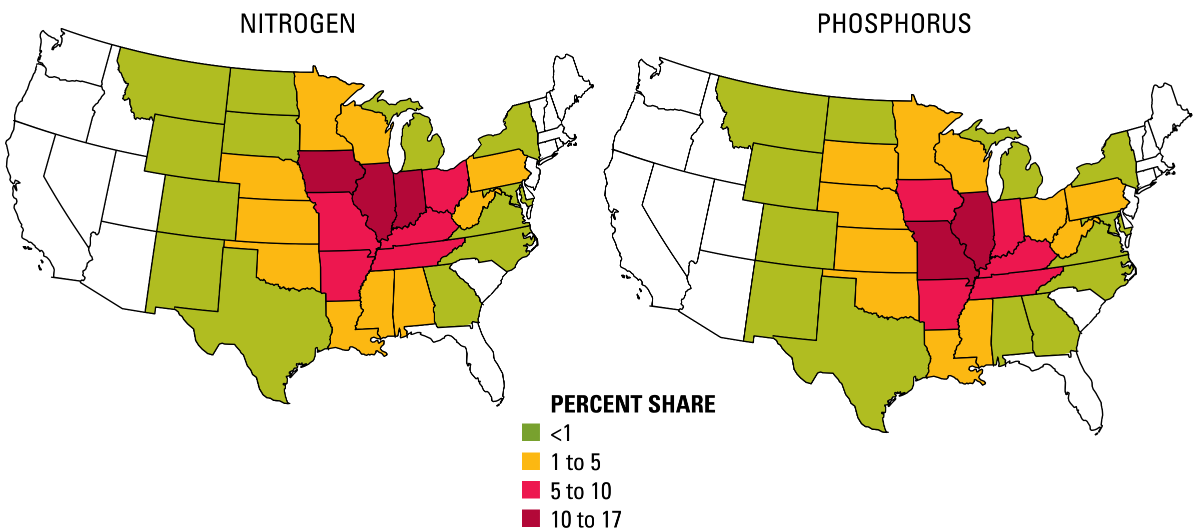
FIGURE 5: Sources of Nutrients Delivered to the Gulf of Mexico



Source: United States Geological Survey

As the maps below indicate, a number of states in the Mississippi Basin are primarily responsible for much of the delivered nutrient pollution. The U.S. Geological Survey, which performed this analysis, explains: "Nine states in the Mississippi River Basin with the largest nutrient deliveries to the Northern Gulf of Mexico contribute more than 75 percent of the nitrogen and phosphorus to the gulf, but make up only one-third of the 31-state Mississippi River drainage area. These states include Illinois, Iowa, Indiana, Missouri, Arkansas, Kentucky, Tennessee, Ohio, and Mississippi."[35]

FIGURE 6: State-by-State Share of Nutrient Contributions



Source: U.S. Department of the Interior, U.S. Geological Survey, Nutrient contributions to the gulf, by state (http://water.usgs.gov/nawqa/sparrow/gulf_findings/by_state.html)

Similarly, the the U.S. Geological Survey found that on average, from 2001 to 2005, the upper Mississippi and Ohio-Tennessee River "subbasins represent about 31 percent of the total land area within the [Mississippi-Atchafalaya River Basin], yet they contribute about 82 percent of the nitrate-nitrogen flux, 69 percent of the total Kjedahl Nitrogen (sum of organic nitrogen, ammonia, and ammonium), and 58 percent of the total phosphorus flux."[36] Indeed, these estimates may understate the importance of these areas to the hypoxia problem; available information indicates that "the upper Mississippi and Ohio-Tennessee River subbasins currently represent nearly all of the spring [nitrogen] flux to the gulf. These subbasins represent the tile-drained, corn-soybean landscape of Iowa, Illinois, Indiana, and Ohio and illustrate that corn-soybean agriculture with tile drainage leaks considerable [nitrogen] under the current management system. The source of riverine [phosphorus] is more diffuse, although these subbasins are also the largest sources of [phosphorus]."[37]

Tile Drainage Can Worsen Polluted Runoff Problems

To improve the agricultural productivity of land, crop producers—particularly in the upper Midwest—commonly use subsurface drainage systems, which are now prevalent across the landscape. According to one recent analysis, for instance, 32.4 percent of the cropland in Iowa has subsurface drainage; in Illinois, Ohio, and Indiana, the percentages are even higher (47.8 percent, 48.3 percent, and 42.2 percent, respectively), and in some individual counties, the percentages are extremely high.[38]

Discharge from a tile drainage system. CREDIT: PHOTOGRAPH BY STEPHEN HARDEN, U.S. GEOLOGICAL SURVEY, 2001[39]

Because subsurface drainage historically was constructed out of clay pipes called tiles, the practice of installing drainage systems is commonly known as tiling, even though modern systems often use plastic tubes. Tiles have openings to allow subsurface water to enter the drain when the water table is above the tile.[40]

Tiles can exacerbate nutrient pollution. Although phosphorus generally runs off agricultural land with subsurface drainage to a lesser degree, nitrate-laden water moves easily through soil to tiles, where it is transported to surface waters.

Biofuels and Their Potential Impact on the Dead Zone

In part to help combat dangerous global warming, policymakers in recent years have become more interested in increasing the degree to which U.S. consumers rely upon renewable fuels for their motor vehicles. However, policies that simply encourage the use of more biofuels such as ethanol from corn could result in an increase in the size of the dead zone, because corn cultivation typically involves larger amounts of fertilizer than other crops. Experts expect rapid growth in grain-based ethanol production in the coming years; this potentially will have major implications for the dead zone, unless there is a significantly greater focus on conservation practices in agriculture in general and the performance of biofuels production specifically.

Corn prices have increased dramatically, driven by energy prices, growing international demand, and increasing demand for ethanol. Not surprisingly, as prices have gone up, so has the number of acres in corn production: "Corn acreage in the United States rose to nearly 93 million acres in 2007 (a 17 percent increase), a level not seen since 1944."[41] According to the Renewable Fuels Association, the trade group for the ethanol industry, "ethanol soared to 6.5 billion gallons in 2007, a 32 percent increase from the 4.9 billion gallons produced in 2006." Looking forward, the Association estimates that the industry's production capacity will rise from 7.8 billion gallons in 2007 to 13 billion gallons once the biorefineries currently being constructed or expanded come online.[42] The vast majority of this new ethanol production is likely to come from corn.

New legislation will also drive increased corn ethanol production. The Energy Independence and Security Act of 2007 will greatly expand biofuels production; it sets a target of at least 36 billion gallons of biofuels per year by 2022. [43] Although the law states that a minimum of 21 billion gallons must be "advanced" (derived from plants' cellulosic material rather than corn grain, for instance), it still leaves room for at least 15 billion gallons of corn-based ethanol that year. This law does include important minimum global warming pollution standards and land use safeguards, but it does not explicitly require better fertilizer management or overall water quality or quantity performance improvements.

Last October the National Research Council issued a report titled "Water Implications of Biofuels Production in the United States."[44] This review makes it clear that, without additional safeguards, increased biofuels production can be expected to increase water pollution from agriculture and intensify many regional and local water shortages. It reaffirms that "[e]xpansion of ethanol production ... will drive increased corn production until marketable future alternatives are developed."[45] The report even addressed the particular concern of the dead zone:

> All else being equal, the conversion of other crops or non-crop plants to corn will likely lead to much higher application rates of nitrogen. Given the correlation of nitrogen application rates to stream concentrations of total nitrogen, and of the latter to the increase in hypoxia in the nation's water bodies, the potential for additional corn-based ethanol production to increase the extent of these hypoxic regions is considerable. [46]

A recent scientific review reached a similar conclusion. To roughly estimate the scale of increased nutrient loading associated with ethanol production, the EPA Science Advisory Board used predicted corn acreage increases in the next several years and estimated that the cultivation of the corn could lead to the increased runoff of 238 million pounds of nitrogen per year in the Mississippi River Basin.[47]

These outcomes are not inevitable. Addressing water pollution and consumption should be integrated into policies and programs that promote biofuels production, such as tax credits and other incentives. In particular, management practices that help reduce nutrient pollution should be part of a suite of minimum standards applicable to energy crop producers. (For NRDC's road map to responsible biofuels production, see *Getting Biofuels Right: Eight Steps for Reaping Real Environmental Benefits From Biofuels*, available online at www.nrdc.org/air/transportation/biofuels/right.pdf.) More generally, as pressure builds on farmers and foresters to increase output and cut costs, farm bill programs to promote soil, water, and wildlife conservation need to grow dramatically larger and more effective.

CHAPTER 2

Headwaters and Wetlands: Their Function and Prevalence in the Mississippi River Basin

Small streams and wetlands are important because these nonnavigable water bodies help to purify water. The small water bodies profiled here include streams in the upper reaches of watersheds and streams that do not flow year-round, which scientists refer to as "intermittent" or "ephemeral" streams. (For ease of reference, one can describe these as headwater and seasonal streams.) Many wetlands, including those adjacent to headwater and seasonal streams and those that are isolated from other waters, are also included as they are similarly nonnavigable by boat and critical to water quality.

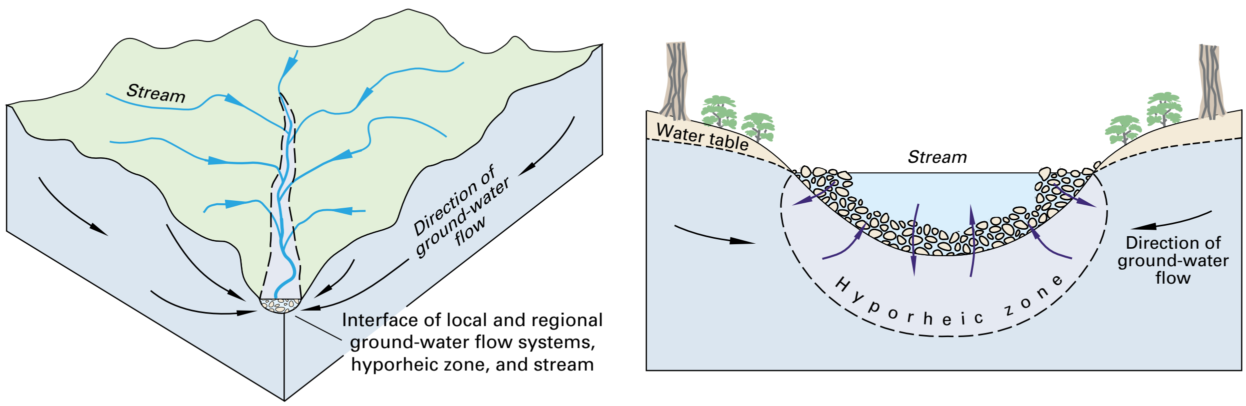
Headwater Streams Contribute To Improved Water Quality

In the area under and next to a streambed, known as the hyporheic zone, water interacts with saturated sediments and the microbial organisms that live there (see Figure 7 on page 18). In headwater streams, increased contact occurs because of the slower movement of water and because such streams are often shallow.[48] This process can remove nutrients. In particular, microorganisms living in the hyporheic zone consume inorganic nitrogen and phosphorous and convert them into forms that are less likely to result in downstream algal growth. As a recent scientific survey of the ecological functions of small streams explains, headwater streams are important nutrient sinks:

- "[N]itrate removed by headwater streams accounts for half of total nitrate removal in entire river basins."
- "The nutrients that are not removed in headwater streams travel far downstream because uptake processes are less efficient in larger systems."
- "A mathematical model based on research in 14 headwater streams throughout the U.S. shows that 64 percent of inorganic nitrogen entering a small stream is retained or transformed within 1,000 yards."[49]

This phenomenon occurs in the headwater and seasonal streams of the Mississippi River Basin, too. Modeling of nitrogen and phosphorus delivered from watersheds within the basin to the gulf shows that the higher the percentage of water delivered, the lower the nutrient removal.[50] In general, the model results indicate that a larger percentage of nitrogen is delivered to downstream waters by larger river systems. That is, once nutrients enter larger rivers, there is typically very little pollution removal.

FIGURE 7: Illustration of the Hyporheic Zone



Streambeds and banks are unique environments where groundwater draining from the subsurface of landscapes interacts with surface water draining from the surface of landscapes.

Source: Thomas C. Winter et al., U.S. Geological Survey Circular 1139, Ground Water and Surface Water: A Single Resource (1998)

Aquatic features need not be permanently flowing, or permanently connected to other waters, to be important for nutrient removal. Intermittent and ephemeral streams, which flow in response to precipitation, are also important because the same precipitation that causes nutrient runoff also causes the streams to flow and enables the in-stream nutrient removal processes to occur.

CASE STUDIES: Small Stream Nutrient Removal In Midwest River Systems

- **Examination of nitrogen flows through an intact headwater stream near the source of the Mississippi River**[51]

  Scientists from the University of California at Davis and the U.S. Geological Survey followed the flow of dissolved inorganic nitrogen (DIN) through a section of the headwaters of the Shingobee River in north-central Minnesota, about 40 kilometers from the source of the Mississippi River. The study helps explain the natural abilities of an intact headwater stream to capture dissolved nitrogen prior to its connection with the larger river system.

  DIN includes three forms of nitrogen: ammonia, nitrite, and nitrate. When environmental conditions are right, certain bacteria can convert ammonia to nitrite and then to nitrate. Dissolved nitrate can be taken up from the water by aquatic plants and eventually returned as ammonia when the plants decay. It can also be converted to nitrogen gas by other kinds of bacteria and released harmlessly to the air. The long, shallow beds of headwater streams are more favorable for the growth of both kinds of bacteria; such streams also enhance bacteria's contact with DIN, more so than the deep open waters farther downstream.

  This study looked at the transport of DIN through "four hydrologically distinct but physically connected zones: (1) hillslope groundwater (ridge to bankside riparian), (2) alluvial riparian groundwater, (3) hyporheic groundwater discharged through bed sediment (hyporheic), and (4) stream surface water." Each zone played a different role in the retention of dissolved nitrogen. For example, nitrate concentrations were reduced about 97 percent through zone 1. In zones 2 and 3, summertime nutrient removal rates were greater since higher temperatures favored greater biological activity. The longer and shallower the stream, the more effective the retention of DIN during the summer months, and the better the stream functions to ultimately convert pollution to nitrogen gas. The researchers wrote: "Headwaters with intact hydrologic connectivity, especially through riparian and hyporheic zones, constitute a critical nexus in mitigating downstream DIN loading to navigable waterways."

The same level of removal, however, would not be expected if massive nitrate loadings from row crop agriculture were to overwhelm this natural system. Moreover, the loss of a headwater stream's hydrologic integrity through channelization or other modifications could both increase loading and accelerate flows through the system, thereby decreasing nitrogen retention and further increasing loading to downstream waters.

- **East-Central Illinois: The impact of stream alterations on the nitrate removal capacity of headwaters in a heavily agricultural area**[52]

  Headwater streams in five areas of east-central Illinois have been dramatically altered during the region's transition from natural prairie and wetlands to intensive agricultural production. Several studies of these streams and comparable but undisturbed streams reveal the important role that natural streams play. The streams in question had been subjected to stream incision (downward erosion), straightening (channelization), widening, and substitution of the naturally diverse riparian vegetation with grass. About 67 percent of all second-order streams in the Embarras Basin have been channelized; the proportion is even higher for the Kaskaskia River. The impacts of these alterations are compounded by extensive tile drainage in the respective watersheds.

  In 2001 scientists from the University of Illinois–Urbana and the University of Notre Dame conducted a nitrate removal study on five headwater sites within three of the major river basins in east-central Illinois: the Sangamon, Embarras, and Kaskaskia river basins. In these headwater streams, the researchers found that nitrate levels routinely exceeded 10 mg per liter and could approach 20 mg per liter after a heavy rain with removal rates of less than 5 percent.

  In contrast, a team of researchers from Kansas State University, Utah Valley State College, the University of Notre Dame, and the Ecosystems Center at Woods Hole found that undisturbed small streams in natural prairie settings in Kansas, similar to pre-European settlement conditions in east-central Illinois, removed 23 percent of nitrogen.

  Considering this evidence, one study's authors concluded that "headwater streams in east-central Illinois are less retentive of [nitrogen] now than they were before European settlement and conversion of the native prairie and wetlands to agriculture."

A synthesis of several studies' findings concerning nitrogen removal in river systems confirms the importance of smaller streams. For example, increased nitrogen removal generally corresponds to shallower stream depths.[53] Besides processing nutrients so that they are retained or less likely to cause harm downstream, undisturbed headwaters help maintain steady water supplies, reduce flooding, trap excess sediment, sustain downstream ecosystems, and maintain biological diversity.

Wetlands Serve As Natural Water Filters

As the National Research Council states, "Wetland ecosystems, once ubiquitous in the Mississippi River Basin, serve important functions in regulating runoff and in reducing runoff of pollutants."[54] In particular, wetlands are recognized nutrient sinks, because the wetland plants use the nutrients as they grow, reducing the available nutrients for later use by algae.

Wetlands adjacent to other water bodies can intercept nutrients and keep the nearby waters cleaner. For instance, a study of a Pennsylvania marsh found that the wetland significantly reduced nutrient levels in waters passing through.[55] The EPA observes that "[r]ecently published studies on pollutant removal rates for natural and restored wetlands indicate that, depending on the type of wetland, the season, and other factors, wetlands can retain significant percentages of nitrates, ammonium, phosphorus, and sediment loads."[56] Because of this purifying capacity, wetlands are often referred to as the kidneys of the aquatic environment.[57] Similarly, studies have shown that wetlands associated with the smallest streams are the most effective at reducing nutrients. One study showed that the wetlands of the streams at the top of the watershed did the vast majority of the work, removing 90 percent of the total amount of phosphorous removed by wetlands in eight northeastern watersheds.[58]

So-called isolated wetlands also can remove nitrate quickly.[59] Although few, if any, wetlands are truly isolated from the aquatic system, wetlands that appear to be isolated from other water bodies can clean nutrient-laden stormwater. A survey of the role that such wetlands play in water quality found that prairie potholes (common in the Great Plains), slope wetlands, and flats can and do retain nutrients.[60]

CASE STUDIES: Nutrient Removal By Wetland Systems In The Midwest

- **Wetlands nab nitrogen from waters flowing into midwestern reservoir**[61]
  Lake Bloomington serves as the drinking water source for about 70,000 inhabitants of the city of Bloomington in central Illinois's McLean County. Every year from 1986 through 2003, Lake Bloomington's waters exceeded the maximum contaminant levels for nitrate—not surprising, given that 86 percent of the lake's watershed is used for corn and soybean agriculture.

  In 1997 scientists reconstructed natural wetlands near Lake Bloomington similar to those once existing in the greater midwestern United States. The project recreated nature's own purification systems for reducing nitrate contamination in the waters running off nearby agricultural lands by 31 to 42 percent. The report suggests that multi-million dollar investments in drinking water treatment plants in local watersheds could be mitigated if preserving or restoring wetlands alleviate contamination problems.

- **Constructed wetlands lower nitrogen and phosphorus content of polluted water**[62]
  In 1998, researchers at the Ohio State University created a wetland, roughly three acres in size and draining an agricultural area approximately 14 times bigger, adjacent to a tributary stream flowing to the South Fork of the Great Miami River. The Great Miami River flows into a lake, which then flows to the Ohio River and on to the Mississippi.

  The researchers have monitored the water quality of the incoming and outgoing water flows over time and have found that the wetland's ability to remove nutrients increased with age. In 1999 the wetland reduced nitrate-nitrite levels by an average of 30 percent and diminished total phosphorus pollution by an average of 37 percent. In a subsequent analysis reported in 2005, the wetland "reduced levels of phosphorus by nearly 60 percent and nitrates by 40 percent." One of the researchers stated that the wetland might be expected to eventually stop removing phosphorus—which does not degrade over time—but should continue to remove nitrogen.

The Geographic Extent of the Small Water Bodies of the Mississippi River Basin

Parts of some 31 states are included in the broad area—approximately 41 percent—of the continental United States drained by the Mississippi River Basin.[63] Of these, 10 states touch the "main stem" of the Mississippi: Minnesota, Wisconsin, Illinois, Iowa, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. We will focus on those central states below.

A good deal of information is available about the kinds of nonnavigable water bodies that exist in each state. For instance, in response to public requests and Freedom of Information Act demands, the EPA has provided data about the kinds of streams located in each state most likely to be nonnavigable: headwater streams (referred to as "start reaches"—streams into which the agency's database indicates there are no other tributaries flowing) and seasonal streams. As shown in Table 1, the extent of such streams in each of the main stem Mississippi states is significant.

Given their prevalence, these nonnavigable streams are important components of the states' water resources, and discharges into them are currently limited by Clean Water Act permits. Table 2 indicates the number of people in each state served by drinking water suppliers drawing some of their water from source water protection areas (SWPAs) containing at least one headwater or seasonal stream. Table 3 shows the number of pollution sources with individual permits under the Act's National Pollutant Discharge Elimination System program currently authorized to discharge into such waters. The main stem Mississippi states have more than 14 million people who depend at least to some degree on nonnavigable streams for their drinking water, and have roughly 5,000 sources whose pollution into such water bodies currently is subject to a Clean Water Act permit.

It does not take much imagination to conceive what might happen if a significant portion of these waters lost the Act's legal protections, and pollution-limiting permits were annulled. Perhaps concerns such as these were what led state officials in every single main stem state to join a brief to the Supreme Court in the most recent case interpreting the Clean Water Act's scope, which argued for broad protections for nonnavigable tributaries and their adjacent wetlands.[67]

Table 1. Percentage of State Stream Miles That Are Nonnavigable[64]

STATE	Percent Start Reach	Percent Intermittent/ Ephemeral
Minnesota	45	51
Wisconsin	53	45
Illinois	56	55
Iowa	59	62
Missouri	58	66
Kentucky	55	29
Tennessee	60	18
Arkansas	52	63
Mississippi	55	58
Louisiana	38	36

Table 2. Nonnavigable Streams as Drinking Water Sources[65]

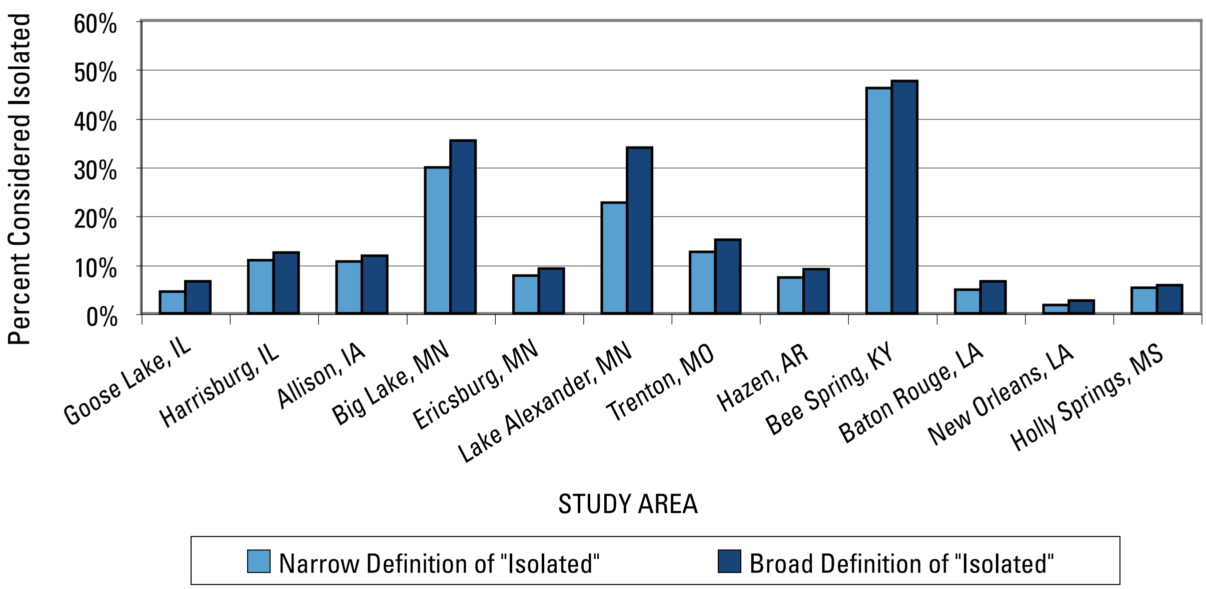
STATE	Population Served by SWPAs Containing Nonnavigable Stream(s)
Minnesota	959,301
Wisconsin	199,457
Illinois	1,623,780
Iowa	620,639
Missouri	2,549,622
Kentucky	3,097,903
Tennessee	2,963,333
Arkansas	911,466
Mississippi	289,740
Louisiana	1,071,156
TOTAL	**14,286,397**

Table 3. Permitted Sources Discharging to Nonnavigable Streams[66]

STATE	Number of Individual Permits on Start Reaches (Percentage of Total)	Number of Individual Permits on Intermittent/ Ephemeral Streams (Percentage of Total)
Minnesota	183 (30%)	169 (28%)
Wisconsin	212 (31%)	191 (28%)
Illinois	823 (43%)	746 (39%)
Iowa	513 (42%)	484 (39%)
Missouri	1,470 (55%)	1,603 (60%)
Kentucky	910 (50%)	412 (23%)
Tennessee	136 (12%)	74 (6%)
Arkansas	345 (43%)	389 (48%)
Mississippi	401 (55%)	409 (56%)
Louisiana	393 (34%)	255 (22%)
TOTAL	**5,386**	**4,732**

So-called isolated wetlands are also common in the states that border the Mississippi River. In 2002 the U.S. Fish and Wildlife Service used Geographic Information System analysis to estimate the extent of "isolated" wetlands in various regions across the country. [68] The graph below summarizes the results for sites within the Mississippi main stem states and indicates the percentage of wetland area determined to be "isolated" under different assumptions about what factors make a water body "isolated." As is evident from the table, "isolated" waters are not rare in Mississippi River states. (Nationally, "isolated" wetlands are also common; approximately 20 percent of wetlands in the continental U.S. are "isolated.") Moreover, as the next section discusses, many wetlands have already been lost in the basin, making it even more important to protect the remaining resources.

FIGURE 8: Extent of "Isolated" Wetlands at Sites Within Main Stem States



States Object to Loss of Clean Water Act Protections for Headwaters and Wetlands

In 2003, in response to a Supreme Court decision interpreting the scope of the Clean Water Act concerning intra-state, nonnavigable, "isolated" waters discussed in Chapter 3, the EPA and the Army Corps initiated a regulatory proceeding to consider revising their rules to restrict which kinds of water bodies are protected by the Act. The agencies received roughly 133,000 comments on the action, some 99 percent of which urged the EPA and the Corps not to change the rules.[69] Importantly, "[a]n EPA official stated that 41 of the 43 states that submitted comments were concerned about any major reduction in Clean Water Act jurisdiction."[70] A number of these comments discussed the extent and importance of headwater and seasonal streams, wetlands, and "isolated" waters in the main stem states of the Mississippi and are summarized here.

Minnesota: The Minnesota Department of Natural Resources first noted that the concept of "isolated" waters was a problematic one, saying, "With more than 10,000 lakes, unpredictable weather patterns including flooding and drought, and complex hydrogeologic features, it is very difficult for us to consider and even more difficult to prove that any of our surface waters are truly isolated."[71] The agency also argued that the state water resources, including ones that appear to be isolated, were closely linked with interstate commerce and should be protected. And the agency estimated that, depending on how one defines the term, between 12 and 23 percent of the state's wetlands could be considered "isolated."[72] The agency concluded by saying, "Excluding a substantial subset of the nation's waters from CWA jurisdiction will make it nearly impossible to achieve the overall goals of the Act."[73]

Wisconsin: The state Department of Natural Resources expressed concern that a restriction on Clean Water Act protections could "potentially affect vast portions of Wisconsin's remaining waters and wetlands, some of them our most valuable and most endangered. Prairie potholes, wet meadows, many forested wetlands, ephemeral ponds, bogs, and fringing wetlands along small, nonnavigable ponds, are among the major categories of wetlands that would be at risk."[74] In particular, the agency estimated that limiting the law's coverage of so-called isolated waters would mean that approximately 1.1 million acres of Wisconsin wetlands would lose federal Clean Water Act protections.[75] And the agency noted that the region's wetlands served important functions in reducing nutrient pollution: "A 1989 study has shown 70 percent removal rates of nitrogen from water entering prairie basin wetlands."[76]

Illinois: The state Department of Natural Resources was greatly concerned about restricting Clean Water Act protections for nonnavigable waters because "[t]hese tributaries, wetlands, and nonnavigable streams are vital to the health of Illinois' watersheds, and [it] requires the partnership of state and federal protection to prevent pollution, and to support the state's efforts to achieve the no net loss of Illinois wetlands or their functional values...."[77] The EPA regional office that covers Illinois reported that the "Illinois Natural History Survey estimated that 150,118 acres of wetland[s] are at risk if 'isolated' wetlands are no longer regulated."[78]

Iowa: The Iowa Department of Natural Resources reported that 11 to 72 percent of the state's prairie pothole wetlands could be considered "isolated," depending on the assumptions used to label a water "isolated."[79] The Department specifically noted that these resources were crucial to controlling nutrient pollution: "A large portion of these prairie pothole wetlands are located in the Des Moines River watershed. [EPA] studies suggest that this watershed is one of the largest contributors to hypoxia in the Gulf of Mexico. Nitrates from farming activities enter … drainage ditches and subsurface tiles, and are quickly transported to the Des Moines River. These converted wetlands that now exist on the landscape are no longer a nitrate sink, but instead now act as a source of nitrates for the Des Moines River watershed. We are very concerned that if prairie potholes are no longer regulated, this scenario will be repeated throughout the prairie pothole region."[80] Fens, a type of wetland where groundwater flows to the surface, would likewise be imperiled. Of 2,333 historic fens in northeastern Iowa, only 160 remain.[81]

Missouri: The state Department of Conservation undertook a preliminary geographic analysis and "determined that approximately 660,000 acres (35 percent) of the 1,868,550 acres of wetlands in Missouri could be adversely affected by a restriction on the kinds of wetlands protected by the law. Major affected wetland types include wet meadows, river fringing wetlands along small nonnavigable rivers and streams, lake fringing wetlands for smaller nonnavigable lakes, many forested wetlands, old meander channels, oxbows, sloughs, fens, seeps and springs."[82]

Kentucky: The state Department for Environmental Protection's Division of Water reported that "[o]f Kentucky's 89,000 total stream miles, we estimate that 49,000 miles are intermittent headwater streams"[83] and urged the EPA and the Corps not to radically rewrite their rules. The Department stressed that "Kentucky has no comparable state law that could replace the loss of CWA jurisdiction."[84]

Tennessee: According to the Tennessee Wildlife Resources Agency, the state has some 787,000 acres of wetlands, the majority of which are not adjacent to navigable-in-fact waters.[85]

Arkansas: The Arkansas Game and Fish Commission strongly urged the EPA and the Corps to maintain broad protection for aquatic resources. The Commission noted that the state was rich in nonnavigable mountain streams, including many which begin in Karst topography, which move at times through bedrock, and which therefore do not appear to flow continuously.[86] The Commission further observed that "[a]ll adjacent wetland[s] intercept overland flows, and therefore protect the physical and chemical integrity of their streams by recycling nutrients, reducing sedimentation and erosion in streams, reducing flood peaks and draw downs, and providing carbon and other nutrients to aquatic food webs."[87]

Water Resources Throughout the Mississippi River Basin Have Been Polluted or Destroyed

Headwaters

Headwater streams are susceptible to damage from changes to their watersheds. Cultivation, such as agricultural production, compacts the soil so that peak runoff volumes are higher. When disturbance to a headwater stream's watershed causes runoff to frequently exceed the area's absorption capacity, the streams' rough streambed may become smoothed as a result. This smoothing can reduce the hyporheic zone and create faster water flow, so that nutrients are buffered less effectively.[88] Urbanization also leads to higher peak runoff volumes due to the construction of paved and other impervious surfaces.

Available data suggest that this pattern plays out in the Mississippi Basin. Table 4 summarizes findings from the EPA's Wadeable Streams Assessment for four ecoregions that partially drain to the Mississippi River. Assessments such as "good" and "low" in this table represent comparisons with the least-disturbed streams in each ecoregion. The macroinvertebrate index and taxa loss assessments shown in the table are measures of biological health. In-stream fish habitat and good riparian vegetative cover are likewise indicative of stream disturbance and, by extension, water quality. Streams with excess phosphorus and/or nitrogen can be considered chemically stressed. (For each of the categories, a high number is desirable—it is good to have a greater percentage of streams with good macroinvertebrates and low nitrogen and phosphorus, for instance). This table shows that the small streams in each ecoregion commonly have red flags indicating human-caused stress and, potentially, lost aquatic functions.

Table 4. Summary of Findings for Four Ecoregions Draining Partially Into the Mississippi River Basin in the Wadeable Streams Assessment

Ecoregion	Miles of Wadeable Perennial Stream	PERCENT OF STREAM MILES WITH:					
		Good Macroinvertebrate Index	<10% Taxa Loss	Low Phosphorous	Low Nitrogen	Good In-Stream Fish Habitat	Good Riparian Vegetative Cover
Southern Appalachians	178,449	21	30	44	39	62	54
Coastal plains	72,130	36	32	58	72	46	52
Upper Midwest	36,547	28	45	42	48	14	44
Temperate plains	100,879	26	58	74	41	41	53

Source: Data from 2004 sampling conducted by the U.S. EPA.[89]

Not only are streams degraded by human activity; sometimes they are obliterated. Entire lengths or parts of small streams can be destroyed by development and other construction. We do not know, frankly, how much this has occurred over time, as we lack reliable data even about the extent of headwater streams today. This makes it very difficult to describe historical losses. Topographical maps are the best source of information about the current extent of streams, but they have been found in some cases to not include many of these streams or to have incorrect information about them. For instance, two studies found that roughly 20 percent of the streams in an area of Appalachia appeared on USGS topographical maps. In one Georgia watershed, an analysis found that 40 to 60 percent of headwaters were not captured in topographical maps.[90] In the same vein, the EPA's National Hydrography Dataset (NHD), which is a digitized version of USGS maps intended to provide spatial data on surface waters, classified as perennial streams many aquatic resources that were not. When the EPA conducted its Wadeable Streams Assessment, it found that "[o]f the more than 1 million miles of estimated perennial length, almost 400,000 miles (34 percent) were found to be non-perennial or non-target in some other way (e.g., wetlands, reservoirs, irrigation canals)."[91]

Wetlands

Wetlands are a critical resource for removing nutrient pollution, but only a fraction of the wetlands that existed in the United States prior to European colonization remain. According to one assessment, "[o]ver a period of 200 years, the lower 48 states lost an estimated 53 percent of their original wetlands." [92] Based on this analysis, the following table provides a summary of the estimated wetlands acreage for the states along the main stem of the Mississippi.

Table 5. Estimated Wetlands Acreage for the States Along the Main Stem of the Mississippi

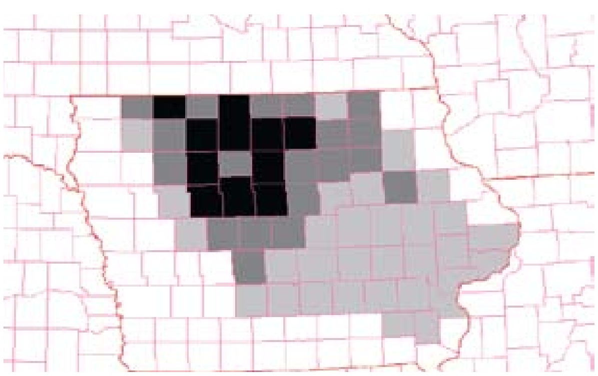
STATE	Estimated Original Wetland Acres	Estimated 1980s Wetland Acres	Estimated Percent Wetlands Lost
Minnesota	15,070,000	8,700,000	42%
Wisconsin	9,800,000	5,331,392	46%
Illinois	8,212,000	1,254,500	85%
Iowa	4,000,000	421,900	89%
Missouri	4,844,000	643,000	87%
Kentucky	1,566,000	300,000	81%
Tennessee	1,937,000	787,000	59%
Arkansas	9,848,600	2,763,600	72%
Mississippi	9,872,000	4,067,000	59%
Louisiana	16,194,500	8,784,200	46%
TOTAL	**81,344,100**	**33,052,592**	**59%**

These estimates suggest that, within the main stem states, an area slightly less than the size of Iowa has been converted from wetlands.[93] And as astonishing as these estimates are, they are quite uncertain. Actual records of the extent of wetlands in colonial times were not kept. Indeed, there is reason to believe that in some states, these estimates may understate the amount of wetlands lost.

We compared an analysis of early surveyor records that sought to identify original wetlands acreage[94] and a Geographic Information System–based estimate of the extent of tile drainage for Iowa.[95] The maps below display

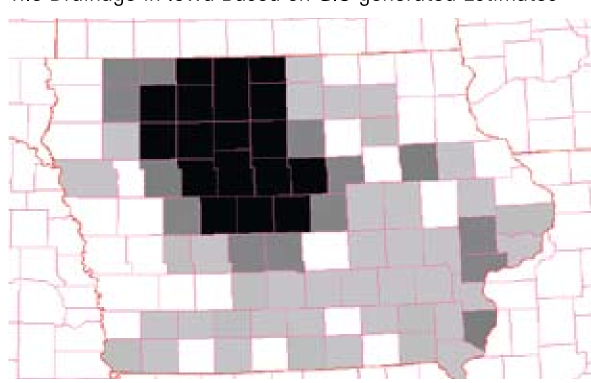
FIGURE 9: Comparing the Location of Precolonization Wetlands with Current Tile Drainage Areas In Iowa

Extent of Precolonization Wetlands in Iowa



Source: Adapted from Hewes, 1951.

Tile Drainage in Iowa Based on GIS-generated Estimates



Source: Adapted from Sugg, 2007.

More than one half	More than one tenth to one quarter
More than one quarter to one half	Less than one tenth

Table 6. Pre-Colonization Wetland Extent Estimates and Tile-Drained Land Estimates			
STATE	**Wetlands Lost From Precolonial Era to 1980s, in Acres (Dahl 1990)**	**GIS-Based Estimate of Tile-Drained Land, in Acres (adapted from Sugg, 2007)**	**Difference Between Prior Estimate of Wetlands Lost and Estimates Based on Tile Drainage**
Iowa	3,578,100	8,811,940	5,233,840
Illinois	6,957,500	11,560,523	4,603,023
Ohio	4,517,200	5,736,342	1,219,142
Indiana	4,849,367	5,667,260	817,893

the data from these two sources, and despite the fact that they are separated by more than half a century and generated using wholly different techniques, the images look quite similar. This suggests that estimates of tile-drained land based on satellite data may provide a reasonable proxy for wetland losses in this Corn Belt state. Prior efforts to estimate wetlands acreage acknowledge the close relationship between tiling and wetlands loss; as one commonly cited report estimating the prior extent of U.S. wetlands observed, relying on agricultural drainage as an indicator of wetlands lost "is not unreasonable given that the vast majority of wetland losses have been due to agricultural conversion."[96] Indeed, because agricultural tile drainage is only one means of destroying a wetland—that is, it does not reflect wetlands lost to urban expansion or transportation development—using tile drainage alone may underestimate wetlands losses.

If this relationship between current tile-drained land and past wetlands acreage holds true, then in four Mississippi Basin states (two along the Mississippi main stem)—Iowa, Illinois, Ohio, and Indiana—the tiling estimates suggest that the previously accepted value for original wetlands is low. That leads us to conclude that in these states even more wetlands may have been lost since colonization than previously believed.

The extent of tile drainage and related wetlands loss is intimately related to the dead zone problem. A very recent examination of gulf hypoxia by a panel of the EPA's Science Advisory Board (SAB) concluded that "the upper Mississippi and Ohio-Tennessee River subbasins currently represent nearly all of the spring [nitrogen] flux to the gulf. These subbasins represent the tile-drained, corn-soybean landscape of Iowa, Illinois, Indiana, and Ohio and illustrate that corn-soybean agriculture with tile drainage leaks considerable [nitrogen] under the current management system."[97] Separately, the SAB underscored the relationship between wetlands and nutrient pollution in the basin, noting that targeted wetlands restoration "is a particularly promising approach for heavily tile-drained areas like the Corn Belt."[98] The report noted that wetlands can be particularly effective at removing nitrogen when concentrations are high and highlighted estimates that nitrogen loading to the gulf could be cut by approximately 20 percent if two million acres of wetlands were restored in the basin.

In light of the important environmental function of headwaters and wetlands, and in light of their historic destruction and degradation, it is vital to preserve as much as possible the existing resources and the natural function of the features that remain. One of the key legal tools to protect aquatic resources from pollution and filling is the federal Clean Water Act, which generally bans unpermitted discharges into water bodies and contains safeguards designed to limit the impact of discharges that are allowed. In the next section, we discuss the role of the law in protecting water bodies and examine the attacks that have raised questions about the extent to which the law may be used to protect many headwaters and wetlands.

CHAPTER 3

The Clean Water Act: Its History and Legal Scope

By 1972, incredible problems beset the nation's waters; rivers caught fire, Lake Erie was declared "dead," and other events called out for immediate action.[99,100] "Record numbers of fish kills were reported in 1969. Over 41 million fish were killed, more than 1966 through 1968 combined, including the largest recorded fish kill ever—26 million killed in Lake Thonotosassa, Florida, due to discharges from four food-processing plants."[101]

The Clean Water Act Brought Protections for America's Waterways

In the face of these problems, Congress amended the Federal Water Pollution Control Act to significantly overhaul the way the country controlled water pollution. That legislation, now known popularly as the Clean Water Act, sought to replace existing law with a much tougher and more comprehensive solution. As part of this restructuring, Congress sought to apply the law's new protections to a broad range of water bodies. The drafters addressed this by stipulating that numerous pollution control programs in the law would apply to "navigable waters," a term borrowed from predecessor statutes, but then defining that term very broadly to mean "the waters of the United States, including the territorial seas."[102]

Within two years of the new law, the Environmental Protection Agency and the Army Corps of Engineers issued regulations that sought to identify the water bodies that the law would protect. The agencies initially went in different directions: The Corps' rules limited safeguards to waters that were actually navigable or could be made so,[103] but the EPA's regulations sought to protect waters much more broadly, without requiring particular water bodies to be navigable in order to be covered by the law.[104] The Corps' restrictive approach was quickly eviscerated in court; the judge reviewing the limited rules held that "Congress by defining the term 'navigable waters' in Section 502(7) of the Federal Water Pollution Control Act Amendments of 1972 to mean 'the waters of the United States, including the territorial seas,' asserted federal jurisdiction over the nation's waters to the maximum extent permissible under the Commerce Clause of the Constitution. Accordingly, as used in the Water Act, the term is not limited to the traditional tests of navigability."[105]

In the years that followed, both the EPA and the Corps adhered to an approach that reflected Congress's desire to fully protect the nation's waterways. And, though the agencies' rules were very inclusive, the courts did not, except in rare cases, take issue with the expansive view of the law. The Supreme Court, for instance, observed that "[t]he Act applies to all point sources and virtually all bodies of water"[106] and that "Congress chose to define the waters covered by the Act broadly."[107] The fact that Congress had chosen to use the term "navigable waters" in the statute did not trouble the justices; as the Court stated unanimously in *U.S. v. Riverside Bayview Homes*, a case upholding the regulation of nonnavigable wetlands adjacent to certain other protected waters:

> the Act's definition of "navigable waters" as "the waters of the United States" makes it clear that the term "navigable" as used in the Act is of limited import. In adopting this definition of "navigable waters," Congress evidently intended to repudiate limits that had been placed on federal regulation by earlier water pollution control statutes and to exercise its powers under the Commerce Clause to regulate at least some waters that would not be deemed "navigable" under the classical understanding of that term.[108]

Likewise, lower court decisions also reflected this broad understanding of the purpose and reach of the law. One court observed, "It seems clear Congress intended to regulate discharges made into every creek, stream, river or body of water that in any way may affect interstate commerce."[109]

Recent Supreme Court Decisions Undermine Clean Water Act, Endanger Waterways

However, the Supreme Court was called on again to look at the Clean Water Act in 2001 in *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* (*SWANCC).*[110] The *SWANCC* decision was actually quite narrow. The Court ruled that nonnavigable intrastate waters could not be classified as "waters of the United States" solely based on the government's interpretation of its Clean Water Act rules, which protected aquatic habitat that could be used by migrating birds. [111] Despite the limited holding, the opinion contained language that encouraged numerous additional attacks on the law's protection of many different kinds of nonnavigable waters. For instance, noting the limited view of the law taken by the Corps soon after its adoption, the Court said that those in favor of applying the law to the waters at issue in the case "put forward no persuasive evidence that the Corps mistook Congress' intent in 1974."[112] The Court likewise opined—unnecessarily—that "[t]he term 'navigable' [in the Act] has at least the import of showing us what Congress had in mind as its authority for enacting the CWA: its traditional jurisdiction over waters that were or had been navigable in fact or which could reasonably be so made."[113]

Emboldened by these gratuitous swipes at the law, polluters argued that the Clean Water Act was far less protective than had been commonly understood for decades. Soon after the decision, a number of cases directly challenged whether nonnavigable tributaries and wetlands could be protected under the law. Thankfully, the overwhelming majority of courts did not follow the worst implications of *SWANCC* or polluters' invitations to expand the Supreme Court's decision.

The decision was not without effect, though. *SWANCC* led to a cutback on legal protections, especially for so-called isolated water bodies. [114] Things were made worse by a policy directive from the EPA and the Corps that required the agencies' field staff to "seek formal project-specific HQ approval prior to asserting jurisdiction" over geographically isolated, nonnavigable intrastate water bodies. [115] In practice, this has operated as a signal to agency personnel that these kinds of waters should not be afforded protection.[116] Under this policy, the Corps has declared myriad water bodies to be outside the Clean Water Act's coverage.[117] A report by several conservation groups demonstrated that this policy was being applied in a harmful manner such that a number of obviously significant waters were left unprotected, including "a 150-mile-long river in New Mexico, thousands of acres of wetlands in one of Florida's most important watersheds, headwater streams in Appalachia, playa lakes in the Southwest, a sixty-nine-mile long canal used as a drinking-water supply, and even an eighty-six-acre lake in Wisconsin that is a popular fishing spot."[118]

Thousands of decisions have been made in the years since *SWANCC* by officials in the Army Corps' district offices, declaring individual water bodies to be unprotected by the Clean Water Act. By way of example, a review of the Corps' "non-jurisdictional determinations" by the Environmental Integrity Project found that the Corps made 2,794 decisions in 2004–2006 in 15 states (those states with the greatest number of decisions), which cut between 16,313.49 and 23,232.37 acres of water bodies out of the Clean Water Act.[119]

These additional limitations on Clean Water Act safeguards were apparently still not enough for some corporate lobbyists and lawyers, who claimed that *SWANCC* meant that Congress never intended to protect a wide variety of nonnavigable intrastate water bodies. Although their claims were largely rejected by the lower courts, those opposed to Clean Water Act protections were able to convince the Supreme Court to hear another case in 2006—*Rapanos v. U.S.*—which examined whether and to what extent the law protects wetlands adjacent to nonnavigable tributaries. [120]

The result was a messy split decision: essentially a 4-1-4 division, with Justice Kennedy acting as the swing vote and five justices able to agree only on sending the case back to the lower courts. The Court did not invalidate the existing rules, but the various opinions suggested different tests for what might remain protected. Justice Kennedy would require the agencies to show a physical, biological, or chemical linkage—a "significant nexus"—between a water body and an actually navigable one to protect it. [121] For wetlands adjacent to water bodies, Justice Kennedy suggested that this nexus could be shown in different ways, depending on the kind of water to which the wetland is adjacent, and stated that the cumulative effect of such waters must be considered in determining whether they are protected:

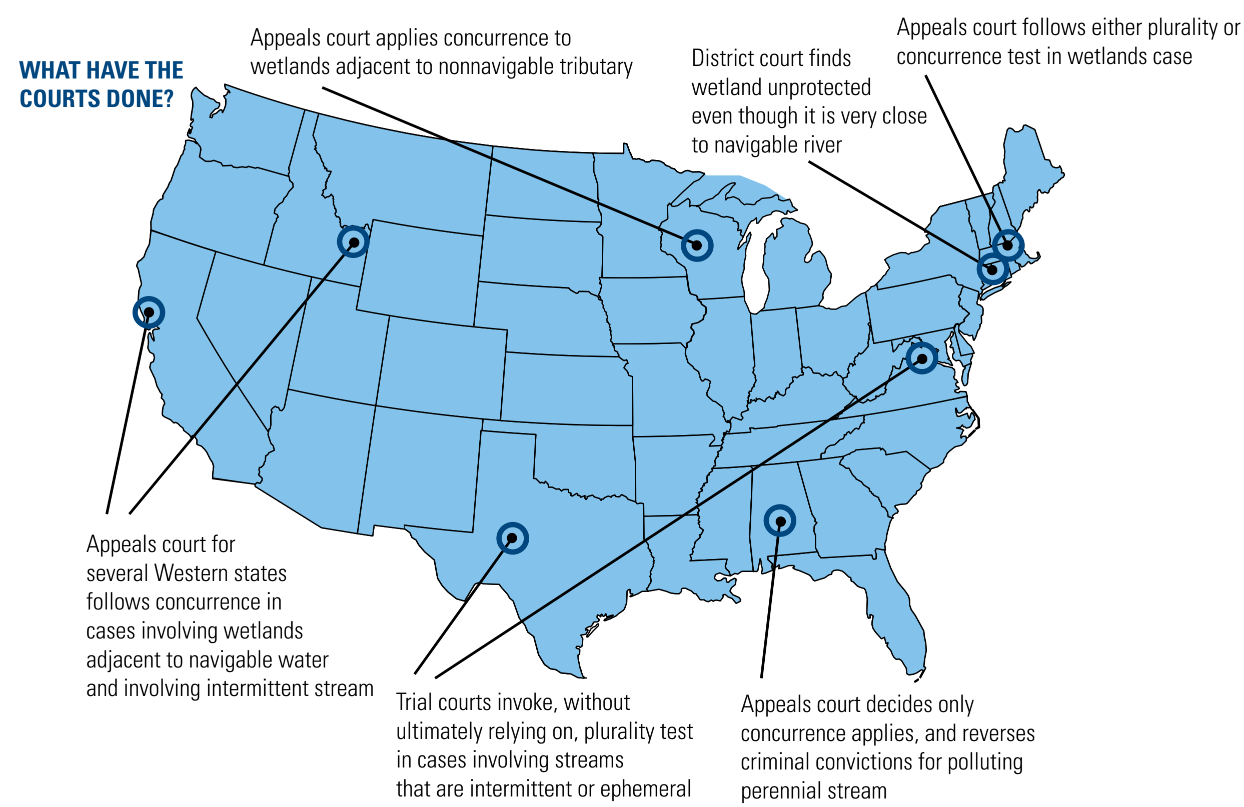
- For *wetlands adjacent to navigable-in-fact waters*, "the assertion of jurisdiction for those wetlands is sustainable under the Act by showing adjacency alone." [122]
- For *wetlands adjacent to certain major tributaries*, "it may well be the case that ... jurisdiction without any inquiry beyond adjacency" is appropriate. In particular, "[t]hrough regulations or adjudication, the Corps may choose to identify categories of tributaries that, due to their volume of flow (either annually or on average), their proximity to navigable waters, or other relevant considerations, are significant enough that wetlands adjacent to them are likely, in the majority of cases, to perform important functions for an aquatic system incorporating navigable waters." [123]
- For *wetlands adjacent to nonnavigable tributaries*, "[a]bsent more specific regulations ... the Corps must establish a significant nexus on a case-by-case basis." However, "[w]here an adequate nexus is established for a particular wetland, it may be permissible, as a matter of administrative convenience or necessity, to presume covered status for other comparable wetlands in the region." [124]

On the whole, Justice Kennedy's approach would give the implementing agencies a significant amount of authority to reach wetlands adjacent to protected waters. The EPA and the Corps could continue to protect wetlands adjacent to navigable waters and could declare that wetlands adjacent to certain kinds of tributaries (like ones in a given watershed, ones of specified size, or ones performing identified functions) remain protected. Moreover, nothing in Justice Kennedy's opinion requires the agencies to declaim protection for the tributaries themselves; to the contrary, Justice Kennedy indicated that the Corps could properly assert categorical jurisdiction over tributaries by applying its regulations consistently. [125]

The four-justice plurality led by Justice Scalia had a much more restrictive approach than Justice Kennedy. The plurality would protect only "relatively permanent, standing or flowing bodies of water" and would require wetlands to have a "continuous surface connection" to such waters to be protected. [126] By contrast, four Justices said in dissent that the protection of adjacent wetlands was controlled by a prior Court decision and that, in general, the courts should not be dictating what kinds of water bodies the law could cover. [127] The dissenters did go out of their way to say that "all four Justices who have joined this opinion would uphold the Corps' jurisdiction in both of these cases—and in all other cases in which either the plurality's or Justice Kennedy's test is satisfied," arguing that in the future any water body that meets either test should be protected. [128]

In the wake of these opinions, the scope of the Clean Water Act is in significant dispute. Since *Rapanos*, cases of this nature have turned on two fundamental questions: First, what test—the plurality's, Justice Kennedy's, both, or neither—is the rule from the decision? And second, do the facts satisfy the relevant test and establish jurisdiction? Litigation has been rampant, and neither the parties' arguments in the cases nor the decisions that have been issued have consistently interpreted the Supreme Court's decision. The federal appeals court with authority over one region has said conclusively that waters can be protected if they meet either the plurality or Justice Kennedy's test,[129] while a different appeals court has ruled that only Justice Kennedy's approach is relevant,[130] and others have been more ambiguous.[131] A couple of trial courts have even suggested that the plurality's narrow test might be relevant to determining whether something no longer is protected (fortunately, that reasoning was not part of the ultimate decision in those cases).[132] Numerous cases require the government or concerned citizens to present more evidence than the governing regulations require, in order to establish that the waters in question are protected. Some of these cases are included on the map below.

FIGURE 10: Court Decisions Across the Country in the Wake of the *Rapanos* Decision



And these cases reflect only the disputes that have gotten to court. Like the *SWANCC* decision, much of the impact of *Rapanos* will likely be below the judicial radar screen. Indeed, as discussed next, the post-*Rapanos* landscape is starting to shape up very much like the post-*SWANCC* landscape, with the agencies charged with implementing the Clean Water Act giving regulated industry and the public very confused and confusing direction about what the government will seek to protect in the future.

The EPA and the Army Corps Offer Guidance Documents But Little Actual Guidance

In the wake of the Supreme Court's fractured decision, the EPA and the Corps promised to quickly provide guidance to help explain how the agencies would read the opinions.[133] Moreover, there were some initial positive signs that the guidance would be good—that is, the administration would not over-react to the decision and broadly declare water bodies to be unprotected. For example, Ann Klee, EPA general counsel at the time, reportedly stated that the Bush administration "remains committed to protecting wetlands to the maximum extent allowable under the law."[134] Similarly, the EPA and the Corps submitted joint testimony to the Subcommittee on Fisheries, Wildlife, and Water of the Senate Environment and Public Works Committee stating that the agencies "remain fully committed to protecting all CWA jurisdictional waters as was intended by Congress."[135]

However, the process of developing post-*Rapanos* policy dragged on for nearly a year, during which time there was significant behind-the-scenes lobbying to influence the direction of the agencies' guidance as it might apply to certain kinds of water bodies. For instance, one industry representative urged the administration to adopt guidelines that would limit protections to water bodies based on such considerations as the stream's position in the watershed or its rate of flow, [136] while another suggested that tributaries apart from "[p]rimary and perhaps secondary" tributaries usually should be excluded from protection.[137] And a law firm representing companies regulated under the Clean Water Act encouraged the agencies not to consider the cumulative impact of wetlands in a region to determine whether individual water bodies are protected by the law.[138]

Even more egregiously, in September 2006 the Pacific Legal Foundation (PLF) petitioned the EPA and the Corps to gut the regulatory definition of "waters of the United States" so that only those water bodies protected under the *Rapanos* plurality opinion would remain covered. The petition claimed:

> The Scalia opinion provides a common denominator such that when its jurisdictional test is met, it would garner a unanimous Supreme Court vote. Additionally, it is the only definition of "waters of the United States" that is readily determinable by both the public and regulatory officials. It also hews more closely to the plain statutory language and the government's original interpretation of the Act in 1974 when it concluded that "waters of the United States" meant navigable-in-fact waters. More importantly, the Scalia approach is the most likely to produce consistent and predictable enforcement standards that satisfy constitutional safeguards for fairness and justice.[139]

In other words, PLF argued that because the plurality's test would clearly regulate many fewer waters, and because the Supreme Court could at least agree on protecting those (even though a majority of Justices would hold that the Act applies much more broadly), the agencies should adopt the most restrictive (and least protective) standard articulated in the case.

Some of these assaults paid off. Although the agencies have not completely retrenched on protecting water bodies, by the time they issued a host of guidance documents in June of 2007 they had missed several opportunities to safeguard waters that had historically been protected.[140] As a result, many waters across the nation will be at risk of increased pollution or even destruction without enforcement of the Clean Water Act's basic requirements. Several such important changes are described below:

- Tributary streams are not categorically protected, even though neither *Rapanos* nor *SWANCC* required the agencies to change their long-standing regulatory coverage of tributaries to various waters.[141]
- Despite the clear direction from Justice Kennedy to consider not only the functions of particular adjacent wetlands in determining whether they are protected, but also the functions of "similarly situated" wetlands in the "region" when determining whether a "significant nexus" is present, the agencies indicate that they will only examine wetlands adjacent to specific segments of individual streams.[142] Likewise, the agencies have not followed Justice Kennedy's suggestion to avoid the burden of case-by-case analysis by "identify[ing] categories of tributaries that, due to their volume of flow (either annually or on average), their proximity to navigable waters, or other relevant considerations, are significant enough that wetlands adjacent to them are likely, in the majority of cases, to perform important functions for an aquatic system incorporating navigable waters."[143]
- Incredibly, the "guidance" does almost nothing to explain how Justice Kennedy's "significant nexus" test should be implemented. It says about a dozen different factors must be considered, without detailing how they should be balanced or how to determine whether any of these factors will be considered "significant."[144] Indeed, though the Corps' published a 60-page guidebook for its field staff and presented numerous photographs of the kinds of water bodies to which the "significant nexus" test applies, it does not indicate

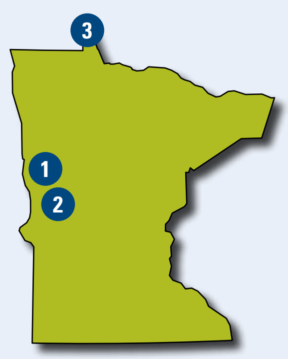
whether any such waters actually have such a nexus so that they are protected under the Act.[145] As a result, agency personnel and the public will be at a loss as to what is still covered.

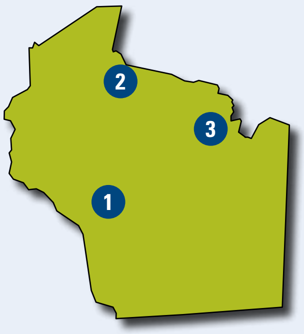
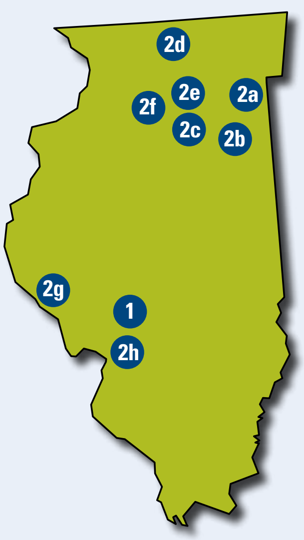
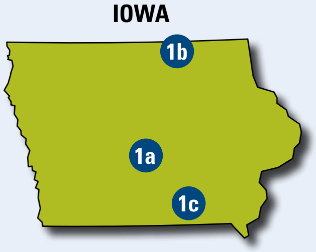
- The "guidance" essentially reaffirms the 2003 policy issued by the agencies concerning so-called isolated waters. [146] This is a mistake for at least two reasons. First, as discussed above, that policy has had the effect of eliminating protections for thousands of water bodies around the country and has been widely condemned. In fact, the U.S. House of Representatives specifically voted to halt the agencies' use of the policy in May 2006.[147] Second, the reasoning of *Rapanos* actually provides more—not less—support for the continued protection of "isolated" waters. As Justice Kennedy points out, "[I]t may be the absence of an interchange of waters prior to the dredge and fill activity that makes protection of the wetlands critical to the statutory scheme." [148]

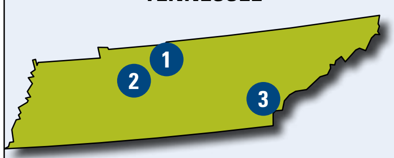
Because of these flaws, the agencies "guidance" documents do far more harm than good, exacerbating the rollbacks and misinterpretations that the Supreme Court instigated.

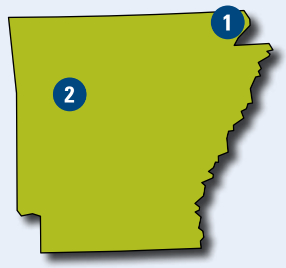
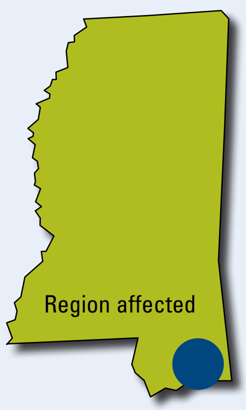
Problems with the policy and with the Supreme Court's decision are already starting to emerge as agencies and the courts struggle to determine the status of individual water bodies after *Rapanos*. Some examples of the kinds of disputes that have materialized are shown below and on the following pages. Although a number of these examples ultimately resulted in the government or a court finding that the water body in question was protected, even those instances illustrate the potential for exploiting this legal issue and causing additional time and resources to be spent defending the water as being covered by the law.

Table 7. Threats to Water Bodies in Mississippi Basin States in the Aftermath of the *Rapanos* Decision

STATE	LOCATION	DESCRIPTION
MINNESOTA  	1. Boyer Lake: a 310-acre lake in Becker County, Minnesota, about 35 miles east of the North Dakota border off Highway 10 2. Bah Lakes: about 75 miles northwest of Minneapolis on the border between Grant and Douglas counties	1 & 2: Despite the capacity for these waters to be used by boaters, the local office of the Corps of Engineers initially concluded that each of these lakes is an "isolated, non jurisdictional water with no substantial connection to interstate (or foreign) commerce." This determination would have removed Clean Water Act protection for these two lakes, meaning that the Act would no longer constrain polluters from discharging into, or even destroying, nearly 400 acres of Minnesota's freshwater lakes. Although the initial decisions to drop Clean Water Act protections were reversed—one by the EPA and Corps headquarters together, one by the EPA alone—the cases underscore the threat to the health and safety of Minnesota's waters and waters nationwide as polluters and developers try to shrink the scope of the federal law.[149]
	3. Western shore of Lake of the Woods, Minnesota	3. A developer who had polluted wetlands near Lake of the Woods, an over 900,000-acre international lake[150] that a local tourism bureau dubbed "the Walleye Capital of the World,"[151] refused to comply with an order to restore the area. When brought to court over it, he argued that the plurality opinion in *Rapanos* governs and prevents the Clean Water Act from applying. [152]

WISCONSIN 	1. Near Tomah, Wisconsin: Nonnavigable tributaries to the Wisconsin River 2. Little Star Lake, Wisconsin: Wetlands "connected by a series of perennial streams and lakes to the Wisconsin River, a traditional navigable water that flows into the Mississippi River" 3. Ranch Lake, Oconto County, Wisconsin	1. Defendants sought to avoid liability in a government enforcement case over wetlands adjacent to nonnavigable tributaries.[153] 2. A defendant who had built a road through a wetland asked the Supreme Court to undo a government enforcement action by questioning whether the waters were protected.[154] 3. The field staff of the Corps determined that Ranch Lake was "isolated" and lacked connection to interstate commerce. EPA headquarters—in apparent disagreement with Corps headquarters—overruled the initial decision; the EPA found that the 48-acre lake is actually navigable, "based on several factors, including presence of public boat ramps and beaches, actual current use for recreational navigation, availability of commercial facilities such as boat ramps and bait shops to users of Ranch Lake, and the lake's location in an area that attracts interstate travelers...."[155]
ILLINOIS 	1. Carlinville, Illinois: 1 mile from Sangamon River 2. Numerous determinations: a. Minooka, Illinois b. Bourbonnais, Illinois c. Grundy, Illinois d. Rockford, Illinois e. Oswego, Illinois f. Rochelle, Illinois g. Quincy, Illinois h. Livingston County, Illinois	1. A criminal defendant charged with causing the release of boron-contaminated wastewater into unnamed streams without a pollution discharge permit sought to have his indictment dismissed by claiming that, after *Rapanos*, the law had become unconstitutionally vague with regard to what waters are protected.[156] 2. In the months since the latest *Rapanos* guidance, the Rock Island District of the Corps has found numerous small water bodies to be "isolated" and, based on that finding, declared them to be unprotected. In many of these cases, the Corps acknowledged that the water bodies would have previously been protected.[157]
IOWA 	1. Numerous determinations: a. West Des Moines, Iowa b. Worth County, Iowa c. Appanoose County, Iowa	In Iowa, the Corps has declared multiple waters to be unprotected in the wake of *Rapanos* and the 2007 policy directive. The agency excluded "isolated" waters and, in one case, declared that "[r]oad ditches are not regulated," despite the fact that pollution of man-made tributaries had historically been included in the law.[158]

MISSOURI  	1. Sedalia, Missouri	In a nonjurisdictional determination for a five-acre lake, the Corps undertook absolutely no analysis of the potential effects of using, degrading, or destroying the water body, instead concluding that the water lacked protection solely because it is an "[u]pland lake, man-made, not connection [sic] to any juridictional [sic] waters or wetlands."[159]
KENTUCKY  	1. Adjacent to Pond & Caney Creeks in Muhlenberg County, Kentucky	In response to government enforcement action for discharges affecting wetlands on properties adjacent to tributaries to the Green River, which leads to the Ohio River, defendants have argued that the wetlands are not protected by the Clean Water Act after *Rapanos*.[160]
TENNESSEE  	1. Lebanon, Tennessee	1. The Nashville District rejected Clean Water Act protections for three ephemeral streams, despite acknowledging the potential importance of such waters. In each case, the district based its assessment of the likelihood of a downstream effect primarily on distance and its unsubstantiated conclusion that such distance would attenuate the impact. As the district said in each case: "It is possible during a heavy precipitation event that the unnamed tributary to Horn Springs Branch could carry pollutants and flood waters to TNW along with transferring nutrients and oranic [sic] carbon. However, due to the fact that the water has to travel through two tributaries and between 5-10 river miles to the TNW, the impacts, if any would be very minor."[161]
	2. WIlliamson County, Tennessee	2. A developer tried to get a citizens' suit thrown out by claiming that the streams on its site were not protected by the law, under either the plurality's or Justice Kennedy's opinion, despite the fact that they are tributaries to the Harpeth and Little Harpeth rivers, which in turn are tributaries to the Ohio River.[162]
	3. Monroe County, Tennessee	3. In a case involving alleged harm to Kinser Branch from bulldozing activity, the court found that the citizen plaintiffs had not produced evidence that would entitle them to judgment on whether the stream is protected.[163]

ARKANSAS 	1.Clay County, Arkansas 2. Russellville, Arkansas	1. A 10-acre wetland found to be unprotected based solely on its "isolation" from other waters. The Corps' determination concedes that, prior to 2001, the water body would have been protected by the Act.[164] 2. Without further explanation, the Corps said that a water body was unprotected based on its finding that it was an "[u]pland pond."[165]
MISSISSIPPI 	Jackson County, Mississippi. The western portions of the Big Hill Acres development drain into Bayou Costapia. which empties into the Tchoutacabouffa River, which then flows into the Gulf of Mexico. The central portions of the site drain through tributaries into Old Fort Bayou Creek. And Old Fort Bayou Creek connects to Old Fort Bayou, which is a protected coastal preserve emptying into the Gulf of Mexico. The eastern portions of the site drain into the headwaters of Little Bluff Creek, which then connects to Bluff Creek, which flows into the Pascagoula River and on to the Gulf of Mexico.	Criminal defendants tried to get their convictions overturned by claiming that the wetlands in which they had installed septic systems were not protected waters.[166]
LOUISIANA 	1. Near city of Burnside, Ascension Parish, Louisiana	Developer sued the Corps; one initial claim was that, after *Rapanos*, the Clean Water Act does not protect wetlands on the site.[167]

Analysis by the EPA Documents Scope of Post-*Rapanos* Uncertainty

Beyond these examples where the law's applicability has been questioned or denied, two members of Congress recently revealed that the current legal mess has hamstrung the government's enforcement of the Clean Water Act.[168] The lawmakers released an analysis conducted by the EPA's Office of Enforcement and Compliance Assurance (OECA) concluding that between July 2006 and December 2007 EPA regional offices "decided not to pursue formal enforcement in 304 separate instances where there were potential CWA violations because of jurisdictional uncertainty" in the wake of *Rapanos* and the release of the agencies' guidance. In addition, "the regions identified 147 instances where the priority of an enforcement case was lowered," which could include "changing from a formal to an informal enforcement response, reducing the amount of the civil penalty, or significantly delaying the initiation of a case." Finally, the analysis indicated that "lack of CWA jurisdiction has been asserted as an affirmative defense in 61 enforcement cases since July 2006," presumably encompassing some of the cases mentioned above.[169]

That hundreds of cases could be adversely affected in approximately a year and a half demonstrates the significant impact of the legal uncertainty following the *Rapanos* decision, especially when one considers that the EPA's civil enforcement docket for fiscal year 2007 included roughly 1,000 cases.[170] And this is true in the Mississippi Basin as well; the EPA regional offices that cover the main stem Mississippi states accounted for a significant percentage of the enforcement retreat. Table 8 below indicates the enforcement statistics from OECA's analysis for EPA Region 4 (which includes Kentucky, Tennessee, and Mississippi), Region 5 (which includes Minnesota, Wisconsin, and Illinois), Region 6 (which includes Arkansas and Louisiana), and Region 7 (which includes Iowa and Missouri). Importantly, these cases involve several different Clean Water Act programs, ranging from the Oil Pollution Act (OPA) requirements to the "section 402" industrial and municipal pollution discharge permit program, to the "section 404" provisions governing the discharge of dredged or fill materials.[171]

Table 8: EPA Analysis of Clean Water Act Enforcement Following *Rapanos*

EPA Region	Formal enforcement action not pursued	Region "lowered the priority" of action	Lack of CWA jurisdiction raised as defense by alleged discharger
Region 4	13 (OPA); 8 (402)	19 (404); 6 (402)	14 (404)
Region 5	3 (404)	14 (404); 15 (402)	6 (404); 1 (402)
Region 6	86 (OPA); 52 (402/404)	4 (402/404)	3 (OPA); 2 (402/404)
Region 7	3 (OPA); 10 (402); 4 (404)	5 (OPA); 3 (404); 19 (402)	2 (OPA); 1 (404); 3 (402)

Note that these regions encompass states other than those touching the Mississippi (Region 6, for instance, also includes Texas, Oklahoma, and New Mexico), so not all of these cases are necessarily in the Mississippi Basin. However, given that nearly 300 cases appear to have been adversely affected in these four regions, it is highly likely that the real world impact for the states in the main stem of the Mississippi basin has been significant as well.

This litigation, "guidance," and resulting disagreement about the proper legal analysis does not bode well for the small aquatic resources of the Mississippi River. It is unclear whether and to what extent the government will protect many of the smaller streams in the region, much less whether any wetlands adjacent to such streams or any so-called isolated water bodies, are protected. If the agencies' guidance is followed, these disputes will play out water body by water body, with many waters losing legal safeguards. Destroying or polluting many individual waters can cumulatively increase the threats of nutrient pollution, flooding, and habitat loss, but the agencies' approach will allow these effects largely to be ignored. Unfortunately, environmental enforcement officials and citizens will need to spend considerable time and resources trying to establish the obvious fact that numerous water bodies contribute to the health of the aquatic system and, when considered cumulatively, are important enough to warrant protection.

CHAPTER 4

Recommendations for Restoring Protections Throughout the Mississippi Basin

Our political leaders can act to significantly improve and restore protections throughout the Mississippi Basin. Most importantly, Congress can adopt legislation to restore the law's protections to waters whose status is now in question. Moreover, as discussed previously, both *SWANCC* and *Rapanos* were narrow decisions, and neither required a wholesale change in the general practice of broadly protecting water bodies. Indeed, neither case invalidated any part of the Corps' or the EPA's comprehensive regulatory requirements. These agencies—which the law entrusts with the responsibility "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters"—must commit to applying the law's protections to the greatest extent the law allows.[172] If they do so, the vast majority of the Mississippi's waters could be protected from unregulated pollution and destruction. NRDC makes the following recommendations for safeguarding our nation's waterways:

Congress Must Pass the Clean Water Restoration Act

The Clean Water Act works best when citizens, affected businesses, and government regulators clearly understand what waters it covers. Because the Supreme Court's decisions turn in large part on what water bodies Congress intended to protect, Congress is the most appropriate branch of government to clarify the law's scope. To restore the protections that existed before the Supreme Court's recent interventions, we need federal legislation that will do three things: (1) delete the phrase "navigable waters" from the Act—a phrase that both of the Court's recent decisions used to justify at least some limitations on the Act—to implement the historic understanding that the Act broadly protects the nation's waters from pollution without regard to their navigability; (2) ensure the law's protections apply to all "waters of the United States," and define that term based on the agencies' longstanding regulations; and (3) explain why Congress has ample constitutional authority over the nation's waters, as defined in the Act, including so-called "isolated" waters, headwater streams, small rivers, ponds, lakes, and wetlands.

The Clean Water Restoration Act accomplishes all of these goals. In the 110th Congress, supporters included four former EPA administrators, 10 governors, a host of other leading state officials, and a wide assortment of hunting and angling groups, to name only a few. Despite a significant lobbying campaign by industry opponents of comprehensive Clean Water Act protections, the bill (H.R. 2421/S. 1870) attracted significant support in Congress; more than 170 Representatives and 20 Senators co-sponsored the bill. With water bodies across the country in jeopardy and the legal status of their protection unclear, passage of the Restoration Act in the 111th Congress must be a high priority.

The Agencies Must Restore Full Protections to Tributary Streams

The agencies should immediately disavow their position that the law does not protect certain kinds of tributary streams. One of the critical errors the agencies made in this guidance was to decide that the *Rapanos* decision placed any limits at all on Clean Water Act protections for tributary streams. As noted above, the legal status of tributaries was not changed by *Rapanos*. In the case of streams that are less than "relatively permanent," the guidance requires a case-by-case demonstration of a "significant nexus" with downstream traditional navigable waters and does not protect those streams for which this demonstration is not made.[173] This approach conflicts with the agencies' still-applicable regulations, which include tributaries of other specified regulated "waters of the United States," without qualification.[174]

The Agencies Must Reverse Policy of Leaving "Isolated" Waters Unprotected

The agencies must fully enforce the requirement of their rules that identifies, as a protected "water of the United States," any water body, "the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce."[175] Although the *SWANCC* case questioned one particular application of this requirement in one particular place—the idea that waters susceptible to use as migratory bird habitat would satisfy it—the Court left intact the regulation itself. Unfortunately, in practice, intrastate water bodies that are nonnavigable and "isolated" are now largely excluded from the Clean Water Act; indeed, the EPA and the Corps are treating the regulatory provision as a dead letter.[176] This reinterpretation is obviously wrong, as there remain important ways apart from bird habitat in which water bodies' use, degradation, or destruction can impact commerce. The dead zone in the Gulf of Mexico is perhaps the most dramatic example. As a recent scientific overview of hypoxia in the gulf observed:

> The Gulf of Mexico ecosystem is a tremendously valuable resource from economic, ecological and social perspectives. In 2004, the value of commercial fish harvest in the Gulf of Mexico was $670 million (NOAA, 2007). The Gulf of Mexico shrimp fishery is among the most valuable fisheries in the nation, with a total value in 2004 of about $370 million, and about $140 million in Louisiana alone. Additionally, an estimated 24.6 million recreational fishing days occurred in the Gulf of Mexico in 2004, with about 4.8 million of those occurring in Louisiana waters (NOAA, 2007). The Gulf of Mexico also serves as habitat for a host of other species, including endangered sea turtles and marine mammals.[177]

These economic values are directly protected by water bodies, including "isolated" water bodies, in the Mississippi River Basin because, as discussed above, they help intercept the nutrients that fuel the dead zone. In turn, the destruction or degradation of these waters surely could have a harmful impact on interstate commerce.

The Agencies Must Take Into Account Broad Ecological Contributions When Protecting Water Bodies

The EPA and the Corps need to revisit the constraints that their post-*Rapanos* policy has imposed on protecting wetlands adjacent to nonnavigable tributaries. Recall that Justice Kennedy, the swing vote in *Rapanos*, said that such wetlands are covered by the law when they have a biological, chemical, and/or physical "significant nexus" to a traditionally navigable water body. In spelling out how the "significant nexus" standard should work in practice, Justice Kennedy clearly intended for the agencies to have the ability to continue to protect wetlands when they collectively affect water quality and to apply that protection to all similar water bodies across a significant area. His opinion focused on the role that such wetlands play "in connection" with one another over a "region."

The natural reading of these passages is that the EPA and the Corps, using their expert judgment, can evaluate available information about specific wetlands, establish that a "significant nexus" is present, and then notify the regulated community and the public that wetlands of the same type over a broad geographic area will be considered protected waters. The agencies also can identify categories of tributaries that are important enough, given relevant characteristics (such as flow, position in the watershed, pollution burden, etc.), that the adjacent wetlands will likely have a significant water quality effect (physical, chemical, or biological) on downstream traditionally navigable waters. However, the agencies' policy directive acknowledges virtually none of this and does not provide a mechanism for making categorical or regional wetlands assessments, effectively making Justice Kennedy's test far more demanding than *Rapanos* dictates.

The EPA and the Corps should immediately abandon this myopic approach to determining whether a "significant nexus" exists. And they could start with the Mississippi River Basin by promptly announcing that there is strong proof that wetlands throughout the basin have a "significant nexus" to the river and the gulf and are therefore covered by the law. The small streams and associated wetlands in the Mississippi watershed can be significant sources and sinks of nutrient pollution, and the collective contribution of numerous sources of nutrients to many sub-watersheds in the basin leads to hypoxia in the gulf. As such, these waters are crucial to the chemical and biological health of at least two unquestionably navigable water bodies—the Mississippi itself and the Gulf of Mexico. Justice Kennedy specifically remarked on this very fact in his opinion in *Rapanos*; in rejecting the plurality's "dismissive" attitude toward the resources at issue in the case, Justice Kennedy said: "Important public interests are served by the Clean Water Act in general and by the protection of wetlands in particular. To give just one example, *amici* here have noted that nutrient-rich runoff from the Mississippi River has created a hypoxic, or oxygen-depleted, dead zone in the Gulf of Mexico that at times approaches the size of Massachusetts and New Jersey."[178]

State Officials Must Protect Their Own Water Resources

Finally, state decision-makers must act if the federal government does not. For instance, Wisconsin adopted a statute aimed at regulating discharges into wetlands affected by the *SWANCC* decision.[179]

There are, of course, limits to what states can do. Their ability to protect against harms to water bodies they share with other states is limited if the upstream states do not fully protect the headwaters. Also, states may have laws that limit the extent to which they can be more protective than federal law. In the absence of federal leadership, however, states must take the initiative to protect these resources by enacting or enforcing strong laws to prevent them from being lost.

Endnotes

1 See generally Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003 (Dec. 2007).

2 *Id.* at 10.

3 *See* Deborah A. Kramer, Nitrogen, online at http://minerals.usgs.gov/minerals/pubs/commodity/nitrogen/480400.pdf.

4 David K. Mueller, & Norman E. Spahr, Nutrients in streams and rivers across the Nation—1992–2001: U.S. Geological Survey Scientific Investigations Report 2006–5107 (2006) (citing Goolsby, D.A., and Battaglin, W.A., 1995, Effects of episodic events on the transport of nutrients to the Gulf of Mexico: Proceedings of First Gulf of Mexico Hypoxia Management Conference, December 5–6, Kenner, La., p. 8).

5 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 67 (Dec. 2007).

6 U.S. Environmental Protection Agency, National Water Quality Inventory: Report to Congress, 2002 Reporting Cycle, at 9 (Oct. 2007), available at http://www.epa.gov/305b/2002report.

7 United States Environmental Protection Agency, Wadeable streams assessment. EPA 841-B-06-002. December 2006. Available at www.epa.gov/owow/streamsurvey.

8 Memorandum from Benjamin H. Grumbles, EPA Assistant Administrator for Water, to State Water Program Directors et al., "Nutrient pollution and numeric water quality standards," at 1-2 (May 25, 2007).

9 David K. Mueller, & Norman E. Spahr, Nutrients in streams and rivers across the Nation—1992–2001: U.S. Geological Survey Scientific Investigations Report 2006–5107, at 27 (2006).

10 Janice Woodard et al., Virginia Cooperative Extension, National Ag Safety Database: Nitrates in Household Water, available at http://www.cdc.gov/nasd/docs/d001201-d001300/d001233/d001233.html.

11 U.S. EPA, Office of Water, Factoids: Drinking Water and Ground Water Statistics for 2007 (March 2008).

12 U.S. EPA, Nutrient Criteria, Technical Guidance Manual, Rivers and Streams, EPA-822-B-00-002, at pp. 4–5 (July 2000) (citations omitted).

13 U.S. EPA, Office of Water, Factoids: Drinking Water and Ground Water Statistics for 2007 (March 2008).

14 United States Environmental Protection Agency, Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams, EPA 841-B-06-002, at 34 (Dec. 2006), available at www.epa.gov/owow/streamsurvey.

15 David K. Mueller, & Norman E. Spahr, Nutrients in streams and rivers across the Nation—1992–2001: U.S. Geological Survey Scientific Investigations Report 2006–5107, at 2 (2006).

16 *See generally* Harmful Algal Research and Response: A National Environmental Science Strategy 2005–2015, at 7-20 (Ramsdell et al., eds., 2005).

17 *Id.* at 17 (citation omitted).

18 National Science and Technology Council, Committee on Environment and Natural Resources, Integrated Assessment of Hypoxia in the Northern Gulf of Mexico, at 13 (May 2000)

19 Louisiana Universities Marine Consortium, Press Release: Dead Zone Size Near Top End (July 28, 2007), available at www.gulfhypoxia.net/news/documents/PressRelease07.pdf. Several hypoxic zones are known to have occurred prior to the use of man-made fertilizers. Lisa E. Osterman et al., Reconstructing a 180 yr record of natural and anthropogenic induced low-oxygen conditions from Louisiana and continental shelf sediments, 33 *Geology* No. 4, pp. 329-332 (Apr. 2005), available at http://geology.geoscienceworld.org/cgi/content/abstract/33/4/329. These are thought to have been caused by the natural variation in freshwater flow and nutrient loads. The size of the hypoxic zone has increased dramatically over the last several decades.

20 Louisiana Universities Marine Consortium, Press Release: 'Dead Zone' Again Rivals Record Size (Jul. 28, 2008), available at http://www.gulfhypoxia.net/research/shelfwidecruises/2008/PressRelease08.pdf.

21 Press Release: 'Dead Zone' Present and Growing, Record Year Predicted (June 10, 2008), available at http://epa.gov/gmpo/pdf/deadzone-pressrelease08.pdf.

22 National Oceanic and Atmospheric Administration, Survey Cruise Records Second-Largest "Dead Zone" in Gulf of Mexico Since Measurements Began in 1985 (July 28, 2008), available at http://www.noaanews.noaa.gov/stories2008/20080728_deadzone.html.

23 National Research Council, Mississippi River Water Quality and the Clean Water Act: Progress, Challenges, and Opportunities, at 61 (2008) (citations omitted).

24 National Science and Technology Council, Committee on Environment and Natural Resources, An Integrated Assessment: of Hypoxia in the Northern Gulf of Mexico (May 2000); Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico, at 9 (Jan. 2001).

25 Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin, at 17-20 (2008).

26 Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Action Plan for Reducing, Mitigating, and Controlling Hypoxia, at 5 (Jan. 2001); Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin, at 14 (2008).

27 *See, e.g.*, David K. Mueller, & Norman E. Spahr, Nutrients in streams and rivers across the Nation—1992–2001: U.S. Geological Survey Scientific Investigations Report 2006–5107, at 2 (2006).

28 Steven E. Lohrenz et al., Nutrients, irradiance, and mixing as factors regulating primary production in coastal waters impacted by the Mississippi River plume, 19 *Continental Shelf Research*, p. 1113-1141 (1999); Jason B. Sylvan, et al., Phosphorus Limits Phytoplankton Growth on the Louisiana Shelf During the Period of Hypoxia Formation, 40 *Environmental Science and Technology* pp. 7548-7553 (2006).

29 National Science & Technology Council, Committtee on Environment & Natural Resources, Integrated Assessment of Hypoxia in the Northern Gulf of Mexico, at 11 (May 2000).

30 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 71 (Dec. 2007).

31 *Id.* at 4.

32 Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Action Plan for Reducing, Mitigating, and Controlling Hypoxia, at 21 (Jan. 2001); Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 2 (Dec. 2007).

33 Richard B. Alexander et al., Differences in Phosphorus and Nitrogen Delivery to the Gulf of Mexico from the Mississippi River Basin, 42 *Environ. Sci. Technol.* No. 3, 822, at 827 (2008).

34 U.S. Geological Survey, Differences in Phosphorus and Nitrogen Delivery to the Gulf of Mexico from the Mississippi River Basin: Primary sources of nitrogen and phosphorus (2008), available at http://water.usgs.gov/nawqa/sparrow/gulf_findings/primary_sources.html.

35 U.S. Department of the Interior, U.S. Geological Survey, Nutrient contributions to the Gulf, by state, available at http://water.usgs.gov/nawqa/sparrow/gulf_findings/by_state.html.

36 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 76 (Dec. 2007).

37 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 84 (Dec. 2007).

38 Zachary Sugg, World Resources Institute, Assessing U.S. Farm Drainage: Can GIS Lead to Better Estimates of Subsurface Drainage Extent? at 7 (Aug. 2007), available at http://www.wri.org/publication/assessing-u-s-farm-drainage-can-gis-lead-better-estimates-subsurface-drainage-exten#.

39 U.S. Geological Survey, North Carolina Water Science Center, Artificial Drainage, available at http://nc.water.usgs.gov/projects/tile_drains/.

40 U.S. EPA, Ag 101: Drainage, available at http://www.epa.gov/oecaagct/ag101/cropdrainage.html.

41 Jim Ringelman et al., Biofuels: Impacts on Prairie Pothole Wetlands, 30 *National Wetlands Newsletter* No. 2, at 3 (March-April 2008) (citation omitted).

42 Renewable Fuels Association, Changing the Climate: Ethanol Industry Outlook 2008, at 2 (Feb. 2008), available at http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2008.pdf.

43 Pub. L. 110-140, 110th Cong., 1st Sess., § 302 (Dec. 19, 2007).

44 National Research Council, Division on Earth and Life Studies, Water Science and Technology Board, Committee on Water Implications of Biofuels Production in the United States (Oct. 10, 2007) (prepublication copy).

45 *Id.* at 11.

46 *Id.* at 23 (citation omitted).

47 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 203-05 (Dec. 2007).

48 Judy L. Meyer et al., Where Rivers Are Born: The Scientific Imperative for Defending Small Streams and Wetlands, at 8 (American Rivers & Sierra Club, Feb. 2007), available at http://www.americanrivers.org/site/DocServer/WhereRiversAreBorn1.pdf?docID=182.

49 *Id.* at 14.

50 Richard B. Alexander et al., Differences in Phosphorus and Nitrogen Delivery to the Gulf of Mexico from the Mississippi River Basin, 42 *Environ. Sci. Technol.* No. 3, pp. 822–830 (2008).

51 Frank J. Triska et al., DIN Retention-Transport Through Four Hydrologically Connected Zones in a Headwater Catchment of the Upper Mississippi River, 43 *Journal of the American Water Resources Association*, pp. 60-71 (Feb. 2007).

52 Todd V. Royer et al., Transport and Fate of Nitrate in Headwater Agricultural Streams in Illinois, 33 J *Environ Qual.*, pp. 1296-1304 (2004); Walter K. Dodds et al., Quantification of the Nitrogen Cycle in a Prairie Stream, 3 *Ecosystems* pp. 574-589 (2000); Michael A. Urban, Conceptualizing Anthropogenic Change in Fluvial Systems: Drainage Development on the Upper Embarras River, Illinois, 54 *The Professional Geographer*, pp. 204-217 (May 2002).

53 Richard B. Alexander et al., Effect of stream channel size on the delivery of nitrogen to the Gulf of Mexico, 403 *Nature*, pp. 758–761 (2000).

54 National Research Council, Mississippi River Water Quality and the Clean Water Act: Progress, Challenges, and Opportunities, at 31 (2008).

55 Jon Kusler and Teresa Opheim, Environmental Law Institute, Our National Wetland Heritage: A Protection Guide, at 6 (2d ed., Aug. 1996).

56 U.S. Environmental Protection Agency, May is American Wetlands Month, available at http://www.epa.gov/owow/wetlands/awm/#why; *see also* National Wildlife Federation and Natural Resources Defense Council, Wetlands at Risk—Imperiled Treasures, at 3 (July 2002).

57 *Id.*

58 Judy L. Meyer et al., Where Rivers Are Born: The Scientific Imperative for Defending Small Streams and Wetlands, at 8 (Feb. 2007), available at http://www.americanrivers.org/site/DocServer/WhereRiversAreBorn1.pdf?docID=182.

59 *Id.*

60 Dennis F. Whigham and Thomas E. Jordan, Isolated Wetlands & Water Quality, 23 *Wetlands* 541 (Sept. 2003).

61 David A. Kovacic et al., Use of created wetlands to improve water quality in the Midwest—Lake Bloomington case study, 28 *Ecological Engineering*, pp. 258–270 (2006).

62 Daniel F. Fink and William J. Mitsch, Effectiveness of a newly constructed wetland on agricultural run-off, Olentangy River Wetland Research Park 1999 Annual Report, at 191 (2000). Ohio State Research News, Man-Made Wetland's Effectiveness Similar to Natural Marsh (March 7, 2005), available at http://researchnews.osu.edu/archive/creatwet.htm.

63 National Park Service, General Information about the Mississippi River, available at http://www.nps.gov/miss/riverfacts.htm.

64 U.S. EPA, Table 1: State-by-State NHD Analyses of Stream Categories and Drinking Water Data (on file with NRDC) (note that the "start reach" and intermittent/ephemeral categories overlap somewhat). These are not precise figures; EPA cautions that its "data generally do not capture streams under one mile in length" and that "[w]ashes in the arid western U.S. are not consistently demarcated."

65 U.S. EPA, Table 1: State-by-state analyses of individual NPDES permits on NHD intermittent/ephemeral and "start reach" streams that have location data in PCS (on file with NRDC).

66 *Id.*

67 Brief of the States of New York, Michigan, Arizona, Arkansas, California, Connecticut, Delaware, Florida, Hawaii, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Vermont, Washington, and Wisconsin, the District of Columbia, the Pennsylvania Department of Environmental Protection, and the International Association of Fish and Wildlife Agencies as *Amici Curiae* in Support of Respondents, *Rapanos v. U.S.* & *Carabell v. U.S. Army Corps of Eng'rs*, Nos. 04-1034, 04-1384.

68 Ralph W. Tiner, U.S. Department of the Interior, Fish and Wildlife Service, Northeast Region, Estimated Extent of Geographically Isolated Wetlands in Selected Areas of the United States, 23 *Wetlands* No. 3, pp. 636-652 (Sept. 2003).

69 U.S. General Accounting Office, Waters and Wetlands: Corps of Engineers Needs to Evaluate Its District Office Practices in Determining Jurisdiction, at 14 (Feb. 2004).

70 *Id.*

71 Comments of the Minnesota Department of Natural Resources re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 2 (April 8, 2003), available online at http://www.earthjustice.org/library/legal_docs/MN-20DNR-201745.pdf.

72 *Id.* at 5.

73 *Id.* at 11.

74 Comments of the Wisconsin Department of Natural Resources re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 2 (April 8, 2003), available online at http://www.earthjustice.org/library/legal_docs/WI-20DNR-201303.pdf.

75 *Id.*

76 *Id.* at 3.

77 Comments of the Illinois Department of Natural Resources re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 1 (April 11, 2003), available online at http://www.earthjustice.org/library/legal_docs/IL-20DNR1342.pdf.

78 Memorandum from Jo Lynn Traub, Water Division Director, EPA Region 5, to Tracy Mehan, Assistant Administrator for Water, at 1 (undated), available online at http://www.earthjustice.org/library/legal_docs/Region_5.pdf.

79 Comments of the Iowa Department of Natural Resources re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 2 (March 31, 2003), available

online at http://www.earthjustice.org/library/legal_docs/IA-20DNR-201742.pdf.

80 *Id*.

81 Judy L Meyer et al., Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands, at 22 (American Rivers &Sierra Club, Feb. 2007).

82 Comments of the Missouri Department of Conservation re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 2 (Feb. 28, 2003), available online at http://www.earthjustice.org/library/legal_docs/MO-20DEC-200556.pdf.

83 Comments of the Kentucky Natural Resources & Environmental Protection Cabinet, Department for Environmental Protection re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 1 (March 13, 2003), available online at http://www.earthjustice.org/library/legal_docs/KY-20Natural-20Resources-200545.pdf.

84 *Id*.

85 Comments of the Tennessee Wildlife Resources Agency re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 1 (Feb. 26, 2003), available online at http://www.earthjustice.org/library/legal_docs/TN-20Wildlife-20Resources-200544.pdf.

86 Comments of the Arkansas Game & Fish Commission re: Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of "Waters of the United States," at 2 (April 15, 2003), available online at http://www.earthjustice.org/library/legal_docs/AR-20Dept-20Game-20and-20Fish-20Com.pdf.

87 *Id.* at 3.

88 Judy L Meyer et al., Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands, at 10-11 (American Rivers & Sierra Club, Feb. 2007).

89 United States Environmental Protection Agency, Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams, EPA 841-B-06-002,(Dec. 2006), available at www.epa.gov/owow/streamsurvey.

90 Judy L Meyer et al., Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands, at 7-8 (American Rivers & Sierra Club, Feb. 2007).

91 U.S. EPA, Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams, at 19 (Dec. 2006).

92 Thomas E. Dahl, U.S. Department of the Interior, Fish & Wildlife Service, *Wetlands Losses in the United States 1780's to 1980's*, at 1 (1990).

93 According to the U.S. Department of Agriculture, the land area of Iowa is approximately 35.76 million acres. U.S. Dept. of Agric., Economic Research Serv., State Fact Sheets: Iowa, available online at http://www.ers.usda.gov/StateFacts/IA.HTM.

94 Leslie Hewes, The Northern Wet Prairie of the United States: Nature, Sources of Information, and Extent, 41 *Annals of the Association of American Geographers,* No. 4, pp. 307–323 (Dec. 1951).

95 Zachary Sugg, World Resources Institute, Assessing U.S. Farm Drainage: Can GIS Lead to Better Estimates of Subsurface Drainage Extent? at 7 (Aug. 2007).

96 Thomas E. Dahl, U.S. Department of the Interior, Fish & Wildlife Service, *Wetlands Losses in the United States 1780's to 1980's*, at 9 (1990).

97 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, EPA-SAB-08-003, at 84 (Dec. 2007).

98 *Id.*at 103.

99 *See U.S. v. Ashland Oil & Transp. Co.*, 504 F.2d 1317, 1326 (6th Cir. 1974). ("Two of the important rivers of this circuit, the Rouge River in Dearborn, Michigan, and the Cuyahoga River in Cleveland, Ohio, reached a point of pollution by flammable materials in the last ten years that they repeatedly caught fire.")

100 Written testimony of Dr. Stephen B. Brandt, Director, Great Lakes Environmental Research Laboratory National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce, before the Subcommittee on Water Resources & Environment of the House Transportation & Infrastructure Committee, United States House of Representatives (May 20, 2004), available online at http://www.legislative.noaa.gov/Testimony/052004brandt.htm.

101 Robert W. Adler et al., *The Clean Water Act 20 Years Later* 5 (1993), citing David Zwick and Marcy Benstock, *Water Wasteland* (1971).

102 33 U.S.C. § 1362(7).

103 39 Fed. Reg. 12,115 (April 3, 1974).

104 38 Fed. Reg. 13,527 (May 22, 1973) (defining as "navigable waters" tributaries to certain water bodies, interstate waters, and intrastate waters with links to interstate commerce).

105 *Natural Resources Defense Council v. Callaway*, 392 F.Supp. 685, 686 (D.D.C. 1975) (citation omitted). Indeed, one longtime Clean Water Act practitioner stated: "The historic record demonstrates that the Corps' final rule of April 3, 1974, was not a legitimate, thoughtful effort to discern and implement 'the true intent of Congress' regarding the geographic jurisdiction of the FWPCA of 1972 as a whole, or even of FWPCA §404. Instead, the rule was the Corps' 'long shot' effort to construe the FWPCA §404 program's geographic jurisdiction extremely narrowly, while recognizing that the 1974 rule would probably not be upheld by the federal courts." Lance D. Wood, Don't Be Misled: CWA

Jurisdiction Extends to All Nonnavigable Tributaries of the Traditional Navigable Waters and to Their Adjacent Wetlands (A Response to the Virginia Albrecht/Stephen Nickelsburg ELR Article, to the Fifth Circuit's Decision in re Needham, and to the Supreme Court's Dicta in *SWANCC*), 34 *Environ. Law Rep.* 10,187, 10,205 (Feb. 2004).

106 *Intl. Paper Co. v. Ouellette*, 479 U.S. 481, 492 (1987).

107 *U.S. v. Riverside Bayview Homes,* 474 U.S. 121, 133 (1985).

108 *Id.*

109 *U.S. v. Earth Sciences, Inc.*, 599 F.2d 368, 375 (10th Cir. 1979).

110 531 U.S. 159 (2001).

111 *Id.* at 174.

112 *Id.* at 168.

113 *Id.* at 172.

114 *See, e.g., U.S. v. Rapanos,* 376 F.3d 629, 638 (6th Cir. 2004) ("the majority of courts have interpreted *SWANCC* narrowly to hold that while the CWA does not reach isolated waters having no connection with navigable waters, it does reach inland waters that share a hydrological connection with navigable waters."), *vacated*, 547 U.S. 715 (2006).

115 68 Fed. Reg. 1995, 1997-98 (Jan. 15, 2003).

116 U.S. Government Accountability Office, Waters and Wetlands: Corps of Engineers Needs to Better Support Its Decisions for Not Asserting Jurisdiction, at 6 (Sept. 2005).

117 U.S. Government Accountability Office, Waters and Wetlands: Corps of Engineers Needs to Better Support Its Decisions for Not Asserting Jurisdiction at 5 (Sept. 2005). ("Subsequent to the *SWANCC* ruling, the Corps is generally not asserting jurisdiction over isolated, intrastate, nonnavigable waters using its remaining authority" under existing regulations to reach waters if their use or degradation could affect interstate commerce.)

118 Earthjustice et al., Reckless Abandon: How the Bush Administration Is Exposing America's Waters to Harm, at 1 (Aug. 2004).

119 Environmental Integrity Project, Drying Out: Wetlands Opened for Development by U.S. Supreme Court and U.S. Army Corps (Sept. 15, 2005), available at http://www.environmentalintegrity.org/pubs/drying%20out.pdf. National Non-Jurisdictional Determination Comparison, by State (June 22, 2006), available at http://www.environmentalintegrity.org/pubs/National%20NJD%20Comparison%20Top%2015%20Update%202%20excel.xls (update of data from initial report).

120 547 U.S. 715 (2006).

121 *Id.* at 780.

122 *Id.* (emphasis added) (citing *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121 (1985)).

123 *Id.* at 780-81 (emphasis added).

124 *Id.* at 782 (emphasis added).

125 *Id.* at 781 (after stating that the Corps' protected tributaries bearing an "ordinary high water mark," Justice Kennedy stated, "[a]ssuming [this standard] is subject to reasonably consistent application, it may well provide a reasonable measure of whether specific minor tributaries bear a sufficient nexus with other regulated waters to constitute 'navigable waters' under the Act." (citation omitted)).

126 *Id.* at 732 & 742.

127 *Id.* at 792 & 799.

128 *Id.* at 810.

129 *U.S. v. Johnson*, 467 F.3d 56 (1st Cir. 2006), *cert. denied, 128 S.Ct. 375 (Oct. 9, 2007).*

130 *U.S. v. Robison*, 505 F.3d 1208 (11th Cir. 2007), *petition for cert. filed,* 77 USLW 31055 (Aug 21, 2008).

131 *Northern Calif. Riverwatch v. City of Healdsburg*, 496 F.3d 993 (9th Cir. 2007), *cert. denied*, 128 S.Ct. 1225 (2008); *U.S. v. Gerke Excavating, Inc.* 464 F.3d 723 (7th Cir. 2006), *cert. denied*, 128 S.Ct. 45 (Oct. 1, 2007).

132 *NRDC v. Kempthorne*, 525 F.Supp.2d 115 (D.D.C. 2007); *U.S. v. Chevron Pipe Line Co.*, 437 F.Supp.2d 605 (N.D. Tex. 2006).

133 Email from Mark Sudol to multiple recipients, Interim Guidance on the *Rapanos* and *Carabell* Supreme Court Decision (July 5, 2006) (indicating guidance forthcoming "as soon as possible and in the very near future" and recommending that staff delay making jurisdictional decisions if possible outside of "traditional navigable waters ... for the next three weeks"), available online at http://www.craig-environmental-law.com/forms/ArmyCorpsReactiontoRapanos.pdf.

134 Washington State Water Resources Association, *Carabell* and *Rapanos* Rulings: How Will They Change the CWA? (July 26, 2006) (interview transcript with Ann Klee), available online at http://www.wswra.org/files_for_news_archives/carabell_rapanos_rulings.html.

135 Statement of Benjamin H. Grumbles and John Paul Woodley, Jr. before the Subcommittee on Fisheries, Wildlife, and Water of the Senate Environment and Public Works Committee (Aug. 1, 2006).

136 Email from Rusty Ashcraft, Alliance Coal, LLC, to James Connaughton & Gregory T. Schildwachter, Council on Environmental Quality, *Rapanos* Guidance (Oct. 30, 2006) (on file with NRDC)

137 Letter from Kelly House, president, El Dorado Holdings, Inc., to James L. Connaughton, CEQ

Chairman (Aug. 21, 2006) (on file with NRDC).

138 Fax from Hunton & Williams to Greg (Sept. 21, 2006) (on file with NRDC).

139 Pacific Legal Foundation, Petition for Rulemaking Under Administrative Procedure Act to amend regulatory definition of "waters of the United States" as found in 33 C.F.R. § 328.3, at 2 (Sept. 25, 2006) (citation omitted).

140 *See generally* U.S. Army Corps of Eng'rs, CWA Guidance to Implement the U.S. Supreme Court Decision for the *Rapanos* and *Carabell* Cases (collected documents), available at http://www.usace.army.mil/cw/cecwo/reg/cwa_guide/cwa_guide.htm.

141 U.S. EPA & U.S. Army Corps of Eng'rs, Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in *Rapanos v. United States* & *Carabell v. United States*, at 5-6 (June 5, 2007) (hereinafter "*Rapanos* Guidance") (discussing status of nonnavigable tributaries).

142 *Rapanos* Guidance at 7.

143 547 U.S. at 781.

144 *Rapanos* Guidance at 7. The only indication that the agencies give about how they plan to implement this list of considerations is that the "[p]rincipal considerations when evaluating significant nexus include the volume, duration, and frequency of the flow of water in the tributary and the proximity of the tributary to a traditional navigable water." *Id.* at 9. But this focus on physical factors is irrational; it has no basis in either the Clean Water Act or Justice Kennedy's opinion, which focus equally on "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a).

145 U.S. Army Corps of Eng'rs, Jurisdictional Determination Form Instructional Guidebook, at 23-25 (May 30, 2007).

146 *Rapanos* Guidance at 8, n. 29.

147 H. Amend. 854 to H.R. 5386, 109th Cong., 2d. Sess., Roll Call Vote 169 (May 18, 2006).

148 547 U.S. at 775 (Kennedy, J., concurring); *see also id.* at 786 ("Given the role wetlands play in pollutant filtering, flood control, and runoff storage, it may well be the absence of hydrologic connection (in the sense of interchange of waters) that shows the wetlands' significance for the aquatic system").

149 U.S. EPA & U.S. Army Corps of Eng'rs, Determination of Boyer Lake as Traditional Navigable Water (TNW) for Jurisdictional Determination (JD) # MVP-2007-1497-RQM (Dec. 11, 2007), available at http://www.usace.army.mil/cw/cecwo/reg/cwa_guide/TNW_MVP-2007-1497.pdf. U.S. EPA, Determination of Bah Lakes as Traditional Navigable Water (TNW) for Jurisdictional Determination (JD) # 2007-04488-EMN (Jan 16, 2008), available at http://www.usace.army.mil/cw/cecwo/reg/cwa_guide/BahLakeEPA_memo2007-04488.pdf.

150 Minnesota Dept. of Natural Resources, Lakes, rivers, and wetlands facts, available at http://www.dnr.state.mn.us/faq/mnfacts/water.html.

151 http://www.lakeofthewoodsmn.com/

152 *U.S. v. Bailey, 516 F.Supp. 2d 998 (D.Minn. 2007).* The district court rejected the defendant's claim based on the plurality test. *See id* at 1005-06; *U.S. v. Bailey,* 556 F.Supp.2d 977 (D.Minn. 2008) (denying stay of judgment pending appeal).

153 *U.S. v. Gerke Excavating, Inc.*, 464 F.3d 723 (7th Cir. 2006), cert. denied, 128 S.Ct. 45 (2007). The appeals court sent the case down to the trial court with directions to apply Justice Kennedy's test. Id. at 725.

154 *U.S. v. Heinrich,* 2006 WL 1586029 (7th Cir., June 6, 2006), cert. denied, 127 S.Ct. 2974 (2007); Brief of United States, Heinrich v. U.S., No. 06-1271 (U.S., May 2007), available at http://www.usdoj.gov/osg/briefs/2006/0responses/2006-1271.resp.pdf. The government argued that the defendant had not preserved the issue for appeal, but in any event the water body was protected. Id. at 12. The Supreme Court denied review. 127 S.Ct. 2974 (June 18, 2007).

155 U.S. EPA, Determination of Ranch Lake and its adjacent wetlands as waters of the United States for Jurisdictional Determination (JD) #2007-5500-LMK (March 3, 2008), available at http://www.usace.army.mil/cw/cecwo/reg/cwa_guide/epa_mvp-2007-5500.pdf.

156 *U.S. v. Lippold,* No. 06-30002, 2007 WL 3232483 (C.D.Ill., Oct. 31, 2007). The court rejected this argument. *Id.* at *6 ("Provided the Government can establish that the Curry and Joint Streams possess a significant nexus to the Sangamon River, a conviction of Lippold for discharging pollutants into those streams would not violate due process.")

157 U.S. Army Corps of Eng'rs, Rock Island District, Approved Jurisdictional Determinations Nos. CEMVR-OD-P-2007-1575 (undated); 2007-1819 (Nov. 9, 2007); 2007-1820 (Nov. 15, 2007); 2007-1923 (Dec. 19, 2007); 2007-1939 (Dec. 18, 2007); CEMVR-OD-P-2007-1578 (Feb. 12, 2008); CEMVR-OD-P-2007-1862 (Nov. 14, 2007); 2007-1982 (Dec. 6, 2007).

158 U.S. Army Corps of Eng'rs, Rock Island District, Approved Jurisdictional Determinations Nos. 2008-38 (Jan. 17, 2008); 2007-1419 (Aug. 3, 2007); CEMVR-OD-P-2007-1802B (Nov. 1, 2007).

159 U.S. Army Corps of Eng'rs, Kansas City District, Approved Jurisdictional Determination: Menard Inc., 2007-02074, at 1 (Nov. 27, 2007), available at http://www.nwk.usace.army.mil/regulatory/Rapanos%20JD%20Decision-5%20Jun%202007/2007-2074-JD.pdf.

160 *United States v. Cundiff*, 480 F. Supp. 2d 940 (W. D. Ky 2007). The judge found that the wetlands on the site were protected under either the plurality or Justice Kennedy's test. *Id*. at 945-47.

161 U.S. Army Corps of Eng'rs, Nashville District, Approved Jurisdictional Determinations: Horn Springs Group, 200701845, 200701844, and 200701843, at 6 (Sept. 5, 2007).

162 Memorandum in support of defendants' joint motion for summary judgment, *Hooker v. Chickering Properties, LLC*, No. 3:06-cv-00849 (M.D. Tenn., May 10, 2007). This case settled before resolution of the issue of whether the waters were protected. Order, *Hooker v. Chickering Properties, LLC,* NO. 3:06-0849 (M.D. Tenn., undated).

163 *Tungett v. Papierski*, 2007 WL 708601 (E.D. Tenn., March 6, 2007).

164 U.S. Army Corps of Eng'rs, Little Rock District, Approved Jurisdictional Determination No. #2007-00430 (Oct. 12, 2007), available at http://www.swl.usace.army.mil/regulatory/jurisdeter/2007-00430.pdf.

165 U.S. Army Corps of Eng'rs, Little Rock District, Approved Jurisdictional Determination No. #2007-00453 (Nov. 13, 2007), available at http://www.swl.usace.army.mil/regulatory/jurisdeter/2007-00453.htm.

166 *U.S. v. Lucas,* 516 F.3d 316 (5th Cir. 2008), *cert. denied,* 2008 WL 2307360 (Oct. 6, 2008). The appeals court rejected this argument. *Id.* at 327 ("the evidence presented at trial supports all three of the *Rapanos* standards").

167 Complaint, *Lakewood Development LLC v. U.S. Army Corps of Eng'rs*, 07-9035 (E.D. La., Nov. 20, 2007). This argument appears not to have been pursued in subsequent proceedings in the case, which the court ultimately dismissed. Order & Reasons, *Lakewood Development LLC v. U.S. Army Corps of Eng'rs,* 07-9035 (E.D. La., Aug. 7, 2008).

168 *See* House Committee on Transportation & Infrastructure, Press Release: Chairmen Oberstar and Waxman question Environmental Protection Agency's enforcement efforts under the Clean Water Act (July 7, 2008), available at http://transportation.house.gov/News/PRArticle.aspx?NewsID=700.

169 Letter from Chairman James L. Oberstar, House Committee on Transportation & Infrastructure & Chairman Henry A. Waxman, House Committee on Oversight & Government Reform, to Administrator Stephen L. Johnson, U.S. EPA (July 7, 2008) (attaching memorandum from Granta Y. Nakayama, Assistant Administrator for Enforcement & Compliance Assurance, to Benjamin Grumbles, Assistant Administrator for Water (Mar. 4, 2008)).

170 *Id.*

171 *Id.*

172 33 U.S.C. 1251(a).

173 Guidance at 1 (providing for "significant nexus" analysis for "[n]on-navigable tributaries that are not relatively permanent").

174 40 C.F.R. § 122.2; 33 C.F.R. § 328.3(a)(5).

175 40 C.F.R. § 122.2 (definition of "waters of the United States," subparagraph (c)).

176 *See* 68 Fed. Reg. 1995, 1996 (Jan. 15, 2003) ("in light of *SWANCC*, it is uncertain whether there remains any basis for jurisdiction under [applicable regulatory provisions] over isolated, nonnavigable, intrastate waters"); U.S. Government Accountability Office, Waters and Wetlands: Corps of Engineers Needs to Better Support Its Decisions for Not Asserting Jurisdiction, at 5 (Sept. 2005) ("Subsequent to the *SWANCC* ruling, the Corps is generally not asserting jurisdiction over isolated, intrastate, nonnavigable waters using its remaining authority in [the regulations]."); Testimony of Benjamin H. Grumbles, EPA Assistant Administrator for Water, Hearing of House Transportation & Infrastructure Committee: "The 35th Anniversary of the Clean Water Act: Successes and Future Challenges" (Oct. 18, 2007) (informal transcription) ("Well, there are two guidances that we are working under, the 2003 *SWANCC* guidance – and the basic point there is in the guidance we held open the possibility that there could be circumstances under ... our regulations where there could be an assertion of jurisdiction over isolate[d] interstate (sic) non-navigable waters without relying on the migratory bird rule provisions. As a legal matter, that is still possible, but as a practical matter, we had not asserted jurisdiction over those types of wetlands based on that guidance, which is still in place.").

177 Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board, at 51.

178 547 U.S. at 777.

179 Wisconsin Statutes Annotated § 281.36.

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