PHOSPHORUS POLLUTION IN FLORIDA'S WATERS

The Need for Aggressive Action to Protect Florida's Rivers and Streams from Nutrient Runoff

Florida PIRG Education Fund

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Cover Photo: Algae Bloom in Lake Okeechobee, Credit: South Florida Water Management District

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Executive Summary

From the Panhandle to Florida Bay, the excess flow of nutrients into Florida's waterways has led to serious water quality problems—ranging from dramatic changes in the distribution of plant species in parts of the Everglades to algae blooms and fish kills in waterways such as Lake Apopka and Lake Okeechobee. But while Florida has made progress against nutrient pollution in some specific cases, the state's overall response has been insufficient to ensure the cleanup of already polluted waterways and the prevention of future nutrient pollution problems.

Nitrogen and phosphorus are the two substances largely responsible for Florida's nutrient-related water quality problems. Runoff from farms and urban areas contributes to the flow of both nutrients into Florida waterways. While aggressive efforts have been undertaken to reduce nutrient levels in specific waterbodies such as Lake Apopka, and while state policy encourages the reduction of nitrogen runoff from farms, Florida currently lacks an effective, statewide policy to identify nutrient-impaired rivers and streams and reduce runoff of phosphorus.

The case of phosphorus pollution of rivers and streams provides an example of how the lack of an effective nutrient policy can result in long-term degradation of water quality.

Phosphorus is a key contributor to algae blooms and other harmful changes in Florida waterways.

- Nutrient overenrichment has contributed to algae blooms that have destroyed sport fish populations in Florida lakes, the growth of toxic microorganisms that have caused fish kills and endangered human health, and threats to coral reefs and underwater vegetation in coastal areas.
- Phosphorus is commonly thought to be the most important nutrient regulating plant growth in inland waterways, while nitrogen plays a more important role in estuaries and coastal waters. Within Florida, however, phosphorus often plays an important role in coastal waters while nitrogen plays a role in some inland waters—meaning that efforts to restore many waterways must focus on control of both pollutants.

Several important Florida waterways suffer from elevated phosphorus levels, yet the Florida Department of Environmental Protection (DEP) has not designated these waterways as "impaired" for nutrients.

- Phosphorus levels in the Fenholloway River, the Suwannee River and Ochlockonee River each exceeded EPA's recommended criteria for phosphorus pollution more than 80 percent of the time during the 1990s—indicating the presence of potentially harmful levels of phosphorus. Yet, the DEP did not originally propose listing any of these three waterways as impaired for nutrients based on the state's Impaired Waters Rule. (The Suwannee River was later added back onto the impaired waters list for nutrients.)
- Since the adoption of the Impaired Waters Rule—which sets standards for identifying waterways that are "impaired" by pollution and eligible for waterway-specific cleanup plans—more than 60 stream and estuary segments have been proposed for removal from

the state's list of nutrient-impaired waters.

Flaws in Florida's Impaired Waters Rule are likely responsible for the "delisting" of many rivers and streams with nutrient pollution problems—meaning that cleanup plans for these waterways will not be completed.

- The Impaired Waters Rule relies on average mean levels of chlorophyll-a (a measure of algae growth) to determine nutrient impairment in streams and estuaries. Chlorophyll-a has been shown to be an unreliable indicator of nutrient levels in rivers and streams and does not measure the growth of all the different types of algae that can harm water quality. In addition, the use of annual mean concentrations of chlorophyll-a ignores the problems caused by seasonal spikes in chlorophyll concentrations in waterways that can lead to fish kills and other negative consequences. EPA guidance recommends using chlorophyll-a as one of several measures of nutrient impairment—not the sole measure.

- At least five loopholes in Florida's Impaired Waters Rule eliminate evidence that should be used to demonstrate nutrient impairment or other water quality problems. The loopholes serve to raise the bar for demonstrating impairment—meaning that some polluted waterways will not be cleaned up.

To clean up nutrient pollution, Florida must fix the Impaired Waters Rule, adopt strong numeric standards for phosphorus and nitrogen levels in waterways, and take action to prevent future nutrient pollution problems by reducing runoff from agricultural and urban sources.

- **Close the loopholes:** Florida should close loopholes in the Impaired Waters Rule that would allow some waterways with significant pollution problems to be deemed "not impaired" and exempted from planning and cleanup.

- **List all impaired waterways:** Florida should eliminate the annual averaging requirement for chlorophyll-a from the Impaired Waters Rule and instead require rivers and streams that demonstrate spikes in chlorophyll-a concentrations to be listed as impaired. In addition, the state should clarify the rule to require listing of waterways as impaired if nutrient-caused disruptions of flora and fauna are observed.

- **Develop tight numeric standards:** Florida should proceed with the development of tight, realistic numeric standards for phosphorus and nitrogen pollution to augment a revised chlorophyll-a standard for rivers and streams.

- **Adopt additional statewide runoff rules**: Florida should also consider new statewide policies to reduce runoff from farms and urban areas. Wisconsin, which recently adopted new rules requiring the development of nutrient management plans in agriculture and construction, is a good model for such a strategy in Florida.

Introduction

Water pollution comes in many forms—the discharge of toxic chemicals and heavy metals from industrial facilities, the deposition of health-threatening mercury into waterways from smokestacks many miles away, the release of bacteria-contaminated sewage and animal wastes.

But perhaps the most insidious and difficult-to-control problems affecting Florida's waterways stem from the flow of nutrients into the state's streams, rivers, lakes, estuaries and coastal waters. Unlike most pollutants, nutrients are actually necessary for the survival of healthy aquatic ecosystems. Too many nutrients, however, can spawn the overabundant growth of algae and toxic microorganisms, potentially causing both short-term catastrophes—such as massive fish kills—as well as long-term ecological imbalances that can take years, if not decades, to make right.

Nutrient pollution has captured headlines in Florida for its role in the degradation of several of the state's most important ecosystems. Lake Apopka, once a destination point for anglers from across the country, saw its bass population virtually disappear as nutrient-fueled algae growth turned the lake a mucky pea green. Lake Okeechobee has experienced lake-wide blooms of blue-green algae. Algae blooms, the death of turtle grass beds, the flight of tarpon and other fish species, and threats to sponge and coral populations have afflicted Florida Bay. Cattails crowd out native species in parts of the Everglades. Rising levels of nitrates have led to fears of ecological disruption in the Suwannee River and its estuary.

Thanks to the commitment of government officials, activists, and thousands of individual Floridians, efforts to restore some of these high-profile examples of nutrient impairment are now underway. However, in many parts of Florida—and particularly in the state's rivers and streams—the nutrient pollution problem receives little attention, and the response of government officials to it is inadequate.

The issue of nutrient pollution is a complex one—both in terms of the sources of pollution and in the effects such pollution has on the delicate ecological balance of Florida waterways. Not only do the sources of nutrient pollution vary from watershed to watershed, but so does the degree of pollution that can be sustained by a waterway without ecological harm.

This report offers a look at one component of the nutrient pollution problem in Florida—phosphorus—and focuses specifically on the impact of phosphorus pollution in rivers and streams. In particular, this report examines how Florida's policies for identifying nutrient pollution and preventing the flow of dangerous levels of phosphorus into rivers and streams fail to adequately address the phosphorus pollution problem.

Solving the nutrient pollution problem will not be easy, but successful models do exist. The first step in solving the problem is accurately identifying waterways that are excessively polluted with nutrients. Florida's current water quality policies are failing to meet the challenge.

Phosphorus and the Nutrient Pollution Problem in Florida

WHAT IS NUTRIENT POLLUTION AND WHY IS IT A PROBLEM?

Nutrients are necessary for life itself. Nitrogen, for example, is used by plants and animals to create protein. Phosphorus is key to the process of photosynthesis. Both are vital to the process of cell division.

When nutrient levels in a waterway are too high, however, they can lead to excessive plant growth–growth that cannot be maintained in an ecosystem. When the plants die and decompose, oxygen levels in the water plummet, often leading to the death of fish. This process is called eutrophication.

In aquatic ecosystems, the presence of nitrogen and phosphorus—along with other factors—regulates the extent and type of plant growth. In watersheds that are unaffected by human activities, nutrient flow to waterways is generally limited because many of the nutrients are tied up in plant life along the waterway's banks. However, when land use results in the paving over of formerly vegetated areas or results in increased erosion, or when nutrient levels are artificially increased, the amount of nutrients flowing into a waterway can increase dramatically.

Eutrophication

Eutrophication is the process by which lakes evolve into dry land. Eutrophication naturally takes place over the course of centuries, but increased flows of nutrients to waterways can speed the process, leading to dramatic changes in the ecological balance of waterways in the course of months or years.

Characteristically, the pace of eutrophication is limited by the relative scarcity of one nutrient within an ecosystem—either nitrogen or phosphorus. Nitrogen has long been thought to be the "limiting nutrient" in coastal ecosystems, while phosphorus has been thought to play a limiting role in freshwater ecosystems such as rivers and lakes. However, the situation is often more complex, with phosphorus playing a limiting role in some coastal ecosystems, and nitrogen and phosphorus playing a "co-limiting" role in many waterways.

When levels of the limiting nutrient in a given waterway become too high, the growth of algae in the waterway accelerates. The dramatic growth of algae in the water column can cause the water to become turbid, limiting the penetration of sunlight to underwater vegetation. As the algae die, decomposing bacteria proliferate, consuming large amounts of oxygen and causing fish kills. Dead algae then sink to the bottom of the waterway, filling in the waterway with sediment.

As the process proceeds, organisms that can withstand higher nutrient levels can come to dominate the ecosystem. In the Everglades, for example, high phosphorus levels have encouraged the growth of cattails, which crowd out other species and change the complexion of the ecosystem.

The impacts of eutrophication are by no means limited to inland lakes. Eutrophication can cause the death of aquatic plant beds and coral reefs in ocean waters and can create oxygen-depleted "dead zones" in coastal waters similar to the zone that appears in the Gulf of Mexico each summer.

Toxic Microorganisms

Nutrient pollution can have catastrophic effects when it encourages the growth of organisms that are toxic to wildlife or humans. Blue-green algae (also known as cyanobacteria), produce toxins that—in the large amounts generated during an algae bloom—can kill domestic animals and livestock, and cause diarrhea, skin irritation, respiratory problems, and liver disease in humans.[1] Nutrient pollution is also suspected as a potential cause of other types of harmful algae blooms in coastal waters—including those related to "red tides," shellfish poisoning, and the spread of the toxic dinoflagellate *Pfiesteria*.

THE ROLE OF PHOSPHORUS

Phosphorus is one of the two main nutrients linked to eutrophication in Florida waterways. As noted above, phosphorus is commonly thought to be the limiting nutrient in freshwater ecosystems, with nitrogen the limiting nutrient in estuary and coastal waters. But the relationship between the two nutrients—particularly in Florida's unique aquatic ecosystems—is often more ambiguous. For example, phosphorus is commonly thought to be the limiting nutrient in part, if not all, of Florida Bay.[2] Meanwhile, nitrogen plays a co-limiting role in some freshwater systems in Florida.

As a result, while the primary task for restoring individual waterbodies to health may involve focusing on one particular nutrient, the interconnectedness of Florida's river, stream, estuarine and coastal ecosystems demands that state officials prioritize the reduction of both primary nutrients—nitrogen and phosphorus—throughout the state.

This report focuses on phosphorus as an example of the causes and impacts of the nutrient water pollution problem in Florida. While control of nitrogen runoff is equally important, fewer controls typically exist on sources of phosphorus runoff to the state's rivers and streams.

Sources of Phosphorus

Phosphorus in Florida's waters comes from a variety of sources, both natural and human-caused. Phosphorus enters waterways in one of two ways. Soluble forms of phosphorus (such as orthophosphate) can be dissolved in water and carried directly into waterways, becoming immediately available for biological uptake. More typically, phosphorus binds itself to soil or other small particles, which are then carried into waterways as sediment.

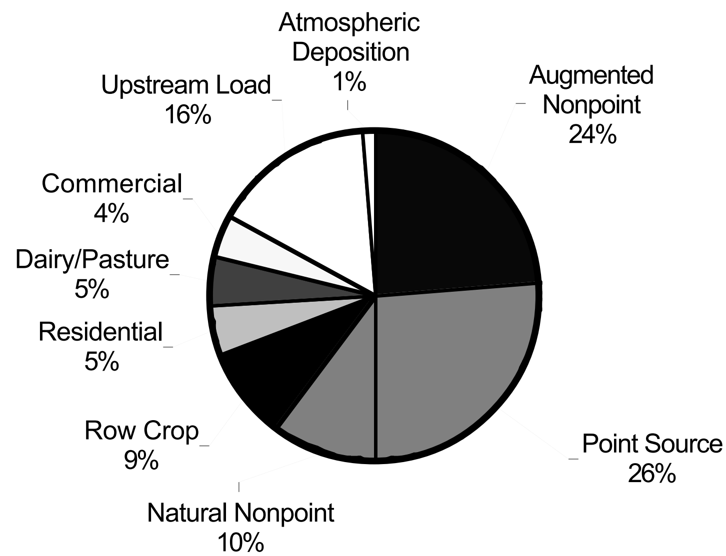
The state of Florida has attempted to estimate the sources of phosphorus loads in its recent assessments of the Lower St. Johns River and Ochlockonee River basins. These studies provide examples of the major sources of phosphorus in Florida inland waterways.

In the Lower St. Johns River, point sources (such as wastewater treatment plants) were estimated to be the largest source of phosphorus, accounting for 26 percent of phosphorus inflows to the basin's waters. Augmented nonpoint sources, which include agricultural and urban runoff, accounted for 24 percent of inflows, with upstream loading—the flow of phosphorus from further up the river—accounting for another 16 percent.[3] (See Fig. 1, next page.)

The Ochlockonee River basin study focused only on external loadings related to land use, and did not include inflows of phosphorus from sewage treatment plants or other point sources. Cropland was the single biggest contributor of phosphorus to the Ochlockonee River basin, responsible for 41 percent of land use-related phosphorus loads to the basin. Natural nonpoint sources, such as wetlands and forested areas, also were significant contributors.[4]

While these two basins may not reflect conditions throughout Florida, they do suggest that agricultural and urban runoff—

Fig. 1. Sources of External Phosphorus Loading to Lower St. Johns River Basin



along with discharge from sewage treatment plants—are major sources of phosphorus pollution in Florida waterways.

HOW MUCH PHOSPHORUS IS TOO MUCH?

Determining whether phosphorus levels in a particular waterway represent a "problem" is a complex endeavor. Natural levels of phosphorus in waterways vary from region to region within the state, and even from waterway to waterway. Whether phosphorus or nitrogen is the limiting nutrient in a waterway also could have a role in determining what levels of phosphorus might be acceptable. Finally, one must consider not only the impact of phosphorus on, for example, a river or stream, but also the impacts the nutrient might have on downstream lakes, estuaries, or coastal waters.

Complicating matters further is the fact that nutrients can have long-term effects that persist well after the flow of nutrients to a waterway is restricted. Like nitrogen, phosphorus can accumulate in sediments at the bottom of a waterway. These nutrients can, under certain circumstances, be reintroduced into the water column, creating an "internal load" of nutrients to the ecosystem.

Nutrient levels also do not necessarily affect plant growth in a linear fashion. Runoff of high levels of nitrogen or phosphorus—such as might occur after a heavy storm—can have a long-term effect as algae engage in "luxury consumption" of the nutrients; in effect, storing excess nutrients within their cells for use in times of nutrient scarcity.

The presence of phosphorus in a waterway, therefore, does not necessarily indicate a water-quality problem. But the presence of phosphorus in higher-than-expected concentrations, particularly over prolonged periods of time, suggests that the threat of ecological damage is possible and must be investigated.

Table 1. EPA Recommended Phosphorus Criteria for Florida Rivers and Streams (Based on 25th Percentile of All Streams)

	Ecoregion IX	Ecoregion XII	Ecoregion XIII
Total Phosphorus (micrograms/liter)	36.6	40.0	15.0

Determining the appropriate phosphorus level for every waterway in Florida would be a complex (and costly) endeavor. As a result, two options exist for determining whether phosphorus levels in a waterway pose a threat:

1) the direct measurement of phosphorus levels and their comparison with numeric criteria, or

2) the assessment of the *symptoms* of phosphorus over-enrichment.

To date, the U.S. EPA has encouraged states to take the former approach, adopting recommended numeric criteria for nutrients, while the state of Florida has taken the latter.

EPA's Recommendation: Numeric Nutrient Standards

The EPA has proposed numeric water quality standards for nutrients. Acknowledging the differences in the environmental impact of nutrients, those criteria are set on the level of "ecoregions," of which Florida is divided into three—Ecoregions IX (encompassing the northern portion of the Panhandle), XII (including the rest of the state with the exception of South Florida), and XIII (South Florida).

To develop its criteria, EPA used two methods. One method involved the identification of "reference" streams—those that have been minimally impacted by human-caused pollution. Using data on nutrient levels in these streams, the EPA judged that nutrient levels at the 75th percentile (that is, higher than three-quarters of the reference streams assessed) were associated with minimal environmental impact. These nutrient levels became the proposed standards. In cases in which reference streams were not or could not be identified, the EPA used nutrient levels at the 25th percentile of readings for all streams to set the standards. It is thought that the two measures—75th percentile of reference streams and 25th percentile of all streams—are generally equal.[5]

The EPA analysis recommended the following phosphorus criteria for rivers and streams in each of Florida's nutrient ecoregions. (See Table 1.)

EPA has suggested that states further localize their nutrient criteria based on conditions at levels smaller than the ecoregion level. However, the EPA's recommended criteria provide a basis with which to evaluate whether nutrient levels in a particular waterway show the potential for environmental damage.

Florida's Approach: Narrative Criteria for Nutrients

Unlike the numeric criteria recommended by EPA, Florida currently relies on a vague "narrative" standard for nutrients. While efforts to develop numeric standards are underway at the state level, Florida is currently limited to using proxy measures to determine when nutrients are causing problems in waterways.

The Florida Administrative Code states that:

> The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards

> contained in this chapter. Man-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242, F.A.C.[6]

For Class I through III waterways, the code further states that:

> In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.[7]

The vagueness of the nutrient standard in Florida has left the state with no clear way to measure whether Florida waterways do or do not meet the standard. Instead, the state has been forced to rely on proxy measures of nutrient impairment based on the chemical and biological characteristics of waterways.

The state is moving forward with the development of numeric standards for nutrients, which are scheduled to be proposed in late 2004 and adopted in late 2005.[8] In the meantime, however, Florida continues to assess whether waterways are "impaired" for nutrients largely through the use of proxy measures. As the next section will show, the determination of "impairment" is critical to unlock the legal and financial resources needed to clean up waterways affected by nutrient pollution.

Florida Policy Reduces Protection of Rivers and Streams from Phosphorus Pollution

WHY "IMPAIRMENT" MATTERS

The determination of whether a river or stream is officially "impaired" for nutrients may seem like a bureaucratic decision. And to a certain extent, it is. However, the results of that decision can have serious ramifications for a water body and its future.

Total Maximum Daily Loads

In order for state officials to focus on cleaning up a waterway, they must first decide that the waterway is, in fact, polluted. The federal Clean Water Act requires that states assess the quality of their waterways and create a list of those waterways that do not meet their "designated uses"—for example, fishing, swimming or use as drinking water. For waterways that do not measure up, states must create waterway-specific cleanup plans, which include a determination of the levels of water pollution to which a waterway may be exposed while maintaining its designated uses. These pollution limits are called Total Maximum Daily Loads, or TMDLs.

Once a TMDL is established for a waterway, the state must allocate portions of the load among the sources of pollution along the waterway. This includes both point sources—which typically must adhere to limits written into a discharge permit—and non-point sources of pollution. These allocations must incorporate a margin of safety to ensure that waterways will attain their designated uses.

Florida's TMDL Process

Florida's TMDL process takes place in five phases:

- Phase 1: Florida DEP conducts an initial water quality assessment in a basin and develops a "planning list" of potentially impaired waters.

- Phase 2: DEP conducts additional monitoring and develops a "verified list" of impaired waters.

- Phase 3: DEP develops TMDLs for impaired waterways. Allocations of permissable pollution loads among sources of pollution must be "reasonable and equitable" under Florida law, but the load allocations are done on a waterway-by-waterway basis.

- Phase 4: DEP develops a Basin Management Action Plan, which includes pollution load allocations, to implement the TMDLs. The plan recommends actions for achieving water quality goals, assigns responsibility for implementing those actions, and establishes a schedule for implementation and the means for evaluating progress.

- Phase 5: DEP begins implementing the plan, renewing or issuing new wastewater discharge permits consistent with the TMDLs, developing and implementing best management practices to control runoff pollution, and/or initiating new rulemakings, as required.[9]

Under the TMDL process in Florida, waterways are divided into five "basin

Table 2. Florida Basin Groups

Group 1	Group 2	Group 3	Group 4	Group 5
Everglades-West Coast	Apalachicola-Chipola	Caloosahatchee	Fisheating Creek	Everglades
Lake Okeechobee	Charlotte Harbor	Chockawatchee-St. Andrews	Kissimmee River	Florida Keys
Ochlockonee-St. Marks	Lower St. Johns	Lk. Worth Lagoon-Palm Beach Coast	Nassau-St. Marys	Indian River Lagoon
Ocklawaha	Middle St. Johns	Sarasota-Peace-Myakka	Pensacola	Perdido
Suwannee	St. Lucie-Loxahatchee	Upper St. Johns	Southeast Coast	Springs Coast
Tampa Bay	Tampa Bay Tributaries		Withlacoochee	Upper East Coast

Table 3. Schedule of TMDL Development

Group	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Group 1	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Group 2		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2	Phase 3	Phase 4
Group 3			Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2	Phase 3
Group 4				Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	Phase 2
Group 5					Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1
	High-Priority Waters — TMDLs Set First Cycle					Medium-Priority Waters — TMDLs Set Second Cycle				

groups" depending on their location. The five groups then move through the process in a staggered fashion, with waterways in Basin Group 1 going through Phase 1 in the first year of the program, waterways in Basin Group 2 going through Phase 1 in the second year, and so on.

The process also calls for the prioritization of waterways for cleanup plans. High-priority waterways will have TMDLs set for them in the first five-year cycle, with medium-priority waters having TMDLs set in the second cycle. As a result, all high-priority waterways in Florida that need TMDLs will begin to be affected by their provisions by 2008-09. The timeframe for actual cleanup can be much longer.

THE IMPAIRED WATERS RULE: DEFINING AWAY "IMPAIRMENT"

The process for determining whether waterways are impaired due to nutrient pollution is set forth in Florida's Impaired Waters Rule (IWR). The IWR requires the DEP to use the average annual concentration of an indicator compound as the primary means for determining impairment. For lakes, the indicator is the Trophic State Index—a combination of measurements of nitrogen, phosphorus, and chlorophyll (an indicator of algal growth). For streams and estuaries, the indicator is chlorophyll-a.

In addition, the rule stipulates that narrative criteria of nutrient impairment "shall also be considered," but the rule gives only one specific criterion for biological imbalance in rivers and streams that triggers a designation of impairment: the presence of algal mats "in sufficient quantities to pose a nuisance or hinder reproduction of a threatened or endangered species."[10] Finally, the rule allows rivers and streams to be classified as impaired if annual mean chlorophyll-a levels exceed historical levels by 50 percent for two consecutive years.

A series of weaknesses in the Impaired Waters Rule could lead—and likely already has led—to waterways with significant nutrient pollution problems being left off the state's impaired waters list, thus relieving the state of the need to create a TMDL for the waterway and endangering the chances for successful cleanup.

The Impaired Waters Rule suffers from two sets of problems. First, the methodology for determining when a waterway is "impaired" (for any pollutant) is rife with loopholes. Second, the rule's procedure for assessing nutrient impairment is inappropriate for determining impairment in rivers and streams.

Loopholes in the Impaired Waters Rule

The Impaired Waters Rule (IWR), in essence, takes an "innocent until proven guilty" approach to the determination of impairment. This approach may be the right one—if the standards of proof are sufficient to ensure that all impaired waterways actually make the list. However, several provisions of the IWR either inordinately raise the bar of proof or exclude the consideration of key pieces of evidence in determining impairment.

There are at least five significant loopholes that reduce the likelihood of a designation of impairment for all waterbodies in Florida. The IWR:

- **Imposes labor-intensive testing requirements—**In order for a waterway to be placed on the verified list of impaired waters, investigators must collect a minimum of 20 samples for a particular pollutant over 5 to 7.5 years. A 2002 review of the Impaired Waters Rule found that only one-third of all waterway assessments conducted as of 2001 contained 20 or more tests for a particular pollutant. To achieve the 20-test threshold for each of these assessments, the state would have needed to conduct an additional 192,000 tests.[11] At a time of increasingly strained resources, DEP's ability to carry out such an expanded monitoring program is questionable.

- **May ignore seasonal impairments**—No data can be considered under the IWR unless it includes samples collected in four out of four seasons. As a result, even if tests in one or more seasons show excessive levels of pollution in a waterway, the waterway cannot be placed on the verified list if data from other seasons do not exist. In addition, because some important nutrient pollution parameters—such as low dissolved oxygen and high chlorophyll-a concentrations—are more prevalent in some seasons than others, this provision could lead to some serious pollution problems being ignored.

- **Sets standard of proof unreasonably high—**For a waterway to be listed as impaired, measurements of pollution must exceed pollution standards in more than 10 percent of samples with a 90 percent confidence level. Confidence levels are statistical tools used to gauge how confident a reader of the data can be that a certain condition exists. Because it is possible for a small number of samples to not be representative of true conditions in a waterway, the establishment of a high confidence level means that more samples must be taken to prove that the 10 percent exceedance rate actually exists. The 90 percent confidence level, therefore, dramatically increases the threshold for impairment. For example, with the confidence level provision, a waterway that has been sampled 20 times must register 5 exceedances to be classified as impaired, rather than 2 exceedances (as the 10% criterion would have indcated). In this case, the confidence level provision more than doubles the amount of exceedances that need to be documented.

- **Ignores pollution from spills and bypasses**—The IWR excludes data that result from violations of water pollution laws, contaminant spills, or discharges due to upsets and bypasses from permitted facilities. The rule also excludes data collected in mixing zones downstream from effluent discharge points. While sampling these pollution "hot spots" might skew the data toward a determination of impairment, ignoring them entirely could lead to an erroneous determination that a waterway is healthy.

- **Allows unenforceable cleanup promises to substitute for enforceable plans**—The IWR states that polluted waters will not be listed if, in the judgment of the DEP,

  > reasonable assurance is provided that, as a result of existing or proposed technology-based limitations and other pollution control programs under local, state or federal authority, they will attain water quality standards in the future and reasonable progress toward attainment of water quality standards will be made by the time the next 303(d) list [of impaired waters] is scheduled to be submitted to EPA.[12] (303(d) lists are submitted every two years.)

  In effect, this provision allows for waterways to be excluded from the impaired waters list with no guarantee they will be cleaned up and no enforcement mechanism if they are not.

Measurement of Nutrients May Mask Impairment

The IWR's criteria for determining nutrient impairment of rivers and streams may result in some rivers and streams being inappropriately dropped from the list of impaired waters—and denied needed cleanup.

As noted above, the IWR uses annual mean chlorophyll-a levels as the primary means of determining nutrient impairment in rivers, streams and estuaries. For lakes, the Trophic State Index—which includes chlorophyll, nitrogen and phosphorus as indicators—is used to determine impairment.

Relying on chlorophyll-a as the primary gauge of nutrient impairment for rivers and streams is problematic for several reasons.

1) Chlorophyll-a measurements within the water column only indicate the presence of phytoplankton—the diatoms, green algae and blue-green algae that float within the water column. Such measurements do not provide a good gauge of the presence of periphyton (algae attached to aquatic vegetation or underwater structures).[13]

2) Chlorophyll-a is a response variable. By the time chlorophyll-a levels are measured that exceed standards, unacceptable algal growth has already occurred. The Florida IWR's provision that nutrient impairment be judged based on an annual average of chlorophyll-a readings further compounds the problem.

   EPA guidance for the setting of nutrient criteria for rivers and streams suggests that states measure four criteria—two causal variables (total nitrogen and total phosphorus) and two response variables (chlorophyll-a and a measure of turbidity). EPA suggests that states evaluate waterways against the criteria as follows:

   > Failure to meet either of the causal criteria should be sufficient to require remediation and typically the biological response, as measured by [chlorophyll-a] and turbidity, will follow the nutrient trend. Should the causal criteria be met, but some combination of response criteria are not met, then a decisionmaking protocol should be in place to resolve the issue of whether the stream in question meets the proposed nutrient criteria.[14]

   In other words, causal criteria—the direct measurement of nutrient levels—should be the primary means of determining nutrient problems in rivers and streams, not criteria based on response variables.

3) While chlorophyll-a can be a valid measure of nutrient enrichment in lakes, its use in streams is more problematic. Relationships between chlorophyll and nutrient levels in streams are weaker than they are in lakes, meaning that chlorophyll is a less-reliable indicator of the presence of excessive nutrients.[15] Because Florida rivers frequently feed into aquatic systems that are more susceptible to excessive algae growth (lakes, estuaries), the presence of excessive nutrients can pose problems in receiving waters, even if it does not spark excessive planktonic algae growth in the rivers and streams themselves.

A second problem with the Impaired Waters Rule's treatment of nutrient pollution in streams is that the threshold for chlorophyll-a appears to be set unreasonably high.

In developing its recommended numeric criteria for nutrients (as described on p. 10), EPA also developed recommended criteria for chlorophyll-a. For rivers and streams in Ecoregion IX, the EPA recommended a threshold of 0.93 micrograms/liter (μg/l), based on the 25th percentile of chlorophyll-a measurements in all streams. For Ecoregion XII, the recommended criterion was 0.4 μg/l.[16] No criterion was recommended for Ecoregion XIII.

In contrast, the chlorophyll-a threshold for rivers and streams set in the Impaired Waters Rule is 20 μg/l—21 times higher than the EPA-recommended criterion for Ecoregion IX and 50 times higher than the criterion for Ecoregion XII. Florida DEP states that the 20 μg/l standard for chlorophyll-a corresponds to approximately the 80th percentile of readings in Florida streams and serves as "a clear indication that an imbalanced situation is occurring."[17] DEP has defended this choice by noting that, combined with other sections of the rule, the chlorophyll-a level was "thought to be something that would hold the line on future [nutrient] enrichment."[18]

DEP's logic that other sections of the rule would allow for the appropriate determination of impairment for nutrient-fouled waterways is undermined by both the text of the Impaired Waters Rule itself and its implementation thus far. The IWR clearly states that annual mean chlorophyll-a values—not other evidence of impairment—"shall be the primary means for assessing whether a water should be assessed further for nutrient impairment" in the development of the planning list of impaired waters.[19] Further, only a handful of waterways in Basin Groups 1 and 2 have thus far been determined to be impaired for nutrients based on measures other than mean average chlorophyll-a levels or increases over historic chlorophyll-a levels.

The questionable accuracy of chlorophyll-a as a measure of the threats nutrients pose to waterways—as well as the apparently high threshold for chlorophyll-a readings in the IWR—suggest that the IWR's approach to determining nutrient impairment in rivers and streams may be seriously flawed. But what has been the real-life impact on the nutrient impairment determinations made to date by DEP?

LISTED NUTRIENT IMPAIRMENTS DROP UNDER IMPAIRED WATERS RULE

Environmental advocates, many of whom opposed adoption of the IWR, claimed that the rule would allow dozens, perhaps hundreds, of Florida waterways with serious pollution problems to be "delisted" from the state's impaired waters list, eliminating the need for TMDL development and reducing chances for cleanup.

To date, DEP has finalized its list of impaired waters for waterways in Basin Group 1 and drafted verified lists of impaired waters for waterways in Basin Group 2. The listings shed light on the degree to which the IWR has caused waterways to be delisted for nutrient impairment.

Florida's list of Basin Group 1 impaired and delisted waters does not allow the straightforward distinction of streams versus estuaries and lakes. To determine the impact of the chlorophyll-a standard, waterways can be broken down into two categories: those for which chlorophyll-a is the primary measure of nutrient impairment (streams and estuaries) and those for which it is not (lakes).

Using IWR criteria to indicate impairment, 24 river and estuary segments were delisted from the impaired waters list in Basin Group 1, compared to 49 segments that remained listed from, or were added to, the 1998 impaired waters list. In comparison, only 12 lake segments were delisted, compared to 49 segments that remained on the list. Of the 12 delisted lake segments, 9 were segments of Lake Okeechobee that were delisted due to the completion of a TMDL for phosphorus in that waterway, leaving only three lake segments that were truly "delisted."[20] The list of verified waterways also includes four stream segments and one lake segment that EPA ordered be placed on the verified impaired waters list, overruling DEP's initial decision to exclude the waterways.

Table 4. Basin Group 1 Waterways[21]

	Verified	Delisted	Ratio of Delisted to Verified
Streams/Estuaries	49	24	0.49
Lakes	49	12	0.24

The draft verified list for Basin Group 2 waterways provides a clearer distinction between streams and estuaries, which confirms the impact of the chlorophyll-a standard on the listing status of streams. On the draft list, 41 stream segments remain listed as impaired for nutrients, while 36 stream segments have been delisted. In comparison, 67 lake segments remain impaired, with only 2 delisted under the IWR. For estuaries—which also rely on chlorophyll-a as a measurement of nutrient impairment—20 segments remained listed as impaired, with 7 segments delisted.

Table 5. Basin Group 2 Waterways[22]

	Verified	Delisted	Ratio of Delisted to Verified
Streams	41	36	0.88
Estuaries	20	7	0.35
Lakes	67	2	0.03

The dramatic drop in the number of stream segments listed as impaired for nutrients between 1998 and 2002/2003 could theoretically be caused by one of three factors.

1) Nutrient pollution of these waterways could have dropped significantly over the past four years. This is unlikely. Florida's federally mandated assessment of statewide water quality for 2002 found that, of those streams for which sufficient data existed, only 14 percent demonstrated improved water quality over a 10-year period, with 82 percent demonstrating stable water quality and 4 percent degraded water quality.[23] It is unlikely, therefore, that significant reductions in pollution are responsible for the large number of rivers and streams that have been delisted for nutrients under the IWR.

2) The method of determining impairment for streams in 1998 could have been overbroad, including many waterways without significant nutrient problems. The criteria for determining nutrient impairment in streams for the 1998 list *were* methodologically questionable. Determinations of impairment for streams were based in part on the Water Quality Index (WQI)—an aggregation of several measures of water quality ranked based on their distribution within typical water quality values in Florida. One problem with the WQI is that it does not specifically quantify nutrient impairment (although concentrations of nitrogen and phosphorus are part of the measure). A second problem is that it

is a relative measure of water quality in comparison with other water bodies that may not share the same natural characteristics.

However, for two reasons, the use of the WQI is unlikely to have resulted in the inclusion of an overabundance of stream segments that were not actually impaired. First, the relative nature of the WQI suggests that it was just as likely to understate the number of impaired waterways as to overstate them. Second, a number of waterways that have been delisted under the IWR continue to show signs of nutrient overabundance, suggesting that the former methodology was not incorrect in identifying these streams as impaired.

3) Finally, the current method of determining nutrient impairment in streams could be insufficient to detect true nutrient impairment of waterways. Given the concerns above about the accuracy of chlorophyll-a as a measuring tool in streams, and the EPA's guidance that several causative and result-oriented factors be considered in assessing impairment, this appears to be the most likely option.

PHOSPHORUS PROBLEMS IN FLORIDA RIVERS AND STREAMS: FOUR EXAMPLES

To determine whether a measurement error, or a real change in conditions is the cause of the nutrient delistings under the IWR, it is necessary to look at conditions in the waterways themselves. A detailed analysis of nutrient levels in Florida rivers and streams is beyond the scope of this report. But a look at four major Florida rivers suggests that nutrient problems—particularly problems caused by phosphorus—in those waterways are longstanding, and may not be properly addressed by the IWR.

Suwannee River

The Suwannee River is one of Florida's great treasures. Fed by nearly 200 freshwater springs, the Suwannee has been virtually unaltered in its physical form by humans and hosts a wide variety of wildlife, including species such as the endangered West Indian manatee.[24]

Over the past several decades, however, levels of nitrate in the river have been rising—due largely to runoff and groundwater infiltration of nutrients from agricultural operations. Nutrient over-enrichment has led to the development of algal mats in portions of the river. The National Oceanic and Atmospheric Administration (NOAA) assesses eutrophic conditions in the Suwannee River estuary as "moderate," with evidence of excessive chlorophyll, macroalgae, low dissolved oxygen, and nuisance and toxic algae blooms. NOAA anticipates that symptoms of eutrophication in the estuary will worsen between now and 2020.[25]

Nitrogen is thought to be the limiting nutrient in the Suwannee River and its estuary. However, phosphorus levels in the river—while thought to be naturally high—have historically exceeded EPA's recommended nutrient criteria.[26] (See box on next page.)

Unenforceable Promises for Nitrogen Cleanup in the Suwannee River

Florida's IWR allows waterway segments to be excluded from the impaired waters list if "reasonable assurance is provided that, as a result of existing or proposed technology-based limitations and other pollution control programs under local, state, or federal authority, they will attain water quality standards in the future and reasonable progress towards attainment of water quality standards will be made by the time the next 303(d) list is scheduled to be submitted to EPA."[27]

Translated into layperson's terms, this means that the state can define a waterway as not impaired—regardless of how polluted it may be—if it is reasonably sure that the waterway will get cleaned up at some point in the future.

Using this provision, DEP had proposed excluding the Suwannee River from listing as an impaired waterway for nutrients. As a result, no TMDL for nutrients was to have been required for the waterway.

The Suwannee River Partnership is a group consisting of 24 members including federal, state and local government agencies and private industry, whose stated goal is to "encourage those who would be most impacted by regulations to change how they operate in hopes that regulations might be avoided."[28] The Partnership created a management plan for limiting nitrogen inflows to the Suwannee River that, in DEP's view, provided reasonable assurance that the waterway would be cleaned up. The plan relied on agricultural Best Management Practices (BMPs) as the primary means to reduce flows of nitrogen to ground and surface waters in the Suwannee River basin, with the goal of getting all animal producers and 80 percent of row crop producers in the basin to implement BMPs by 2008.[29] The partnership anticipated that these actions would result in nitrogen levels in the Suwannee River returning to 1979 levels by about 2028.[30]

The problem with the reasonable assurance approach is that there is no enforceable guarantee that the nutrient problem will be solved, merely a voluntary commitment. Moreover, because the partners project that it will take until 2013 for significant reductions in nitrogen loading to occur, it will be difficult to determine whether the program is making an impact.

Voluntary projects such as the Suwannee River Partnership can be useful and beneficial as *supplements to*, but not as *substitutes for* required anti-pollution programs, especially not when their existence allows DEP to classify a waterway with nutrient problems as "not impaired."

In recognition of these problems, the EPA has reversed the proposed de-listing of the Suwannee River for nutrients, adding the waterway back to the state's impaired waters list. However, acknowledging support for the partnership approach—despite its unenforceable cleanup promises—EPA has assigned a low priority to the completion of a TMDL for nutrients in the waterway.[31]

Table 6 (next page) shows the frequency of exceedances of EPA's recommended numeric criterion for phosphorus levels in Florida portions of the Suwannee River between 1990 and 1998. An "exceedance" in this case is defined as any sample reading that exceeds the EPA criterion. While both the rate of exceedance and average total phosphorus levels have dropped since the early 1990s, the average phosphorus level in the river in 1998 remained nearly four times higher than the EPA's recommended criterion.

Again, it is possible that the high total phosphorus levels in the Suwannee River may be due in part to natural conditions. But the high rate of exceedance of phosphorus criteria in the river suggests that the

Table 6. Suwannee River Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
1998	174	155	89%	0.04	0.81	0.15
1997	139	87	63%	0.04	1.31	0.10
1996	135	129	96%	0.04	1.17	0.21
1995	144	139	97%	0.04	1.34	0.15
1994	136	132	97%	0.04	1.84	0.22
1993	155	152	98%	0.04	1.32	0.23
1992	198	194	98%	0.04	1.58	0.22
1991	206	206	100%	0.04	3.40	0.28
1990	185	185	100%	0.04	8.90	0.49

phosphorus pollution problem cannot be ignored—even if (and perhaps especially if) nitrogen inflows to the waterway are reduced.

Fenholloway River

As part of the Suwannee River basin, the Fenholloway's nutrient problems are somewhat related to those of the Suwannee River itself. But the Fenholloway is also a case unto itself due to the waterway's history as, for all intents and purposes, an industrial sewer.

In 1947 the Fenholloway was legally classified as an industrial use river as a means to attract industry to the region.[32] In fact, until its designation was changed in 1998, the Fenholloway was the only river in Florida to have a Class V designation, which requires water quality to "be maintained only at a level sufficient to support navigation, utility, and industrial uses."[33] Even in its historically polluted state, however, the Fenholloway does have a significant role as a feeder of the Gulf of Mexico.

Under the IWR, no part of the Fenholloway River is currently listed as impaired for nutrients. The only section of the river to previously appear on the impaired waters list for nutrients—the section of the Fenholloway River above the pulp mill—has been delisted.

However, phosphorus levels in the Fenholloway River have historically been very high, with the waterway exceeding EPA-proposed numeric standards for phosphorus in more than 80 percent of samples between 1990 and 1999. (See Table 7.)

Table 7. Fenholloway River Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
1999	4	4	100%	0.04	4.10	1.45
1998	21	17	81%	0.04	3.00	0.65
1997	14	6	43%	0.04	2.38	0.47
1996	15	12	80%	0.04	2.54	0.86
1995	18	17	94%	0.04	2.47	1.03
1994	18	14	78%	0.04	2.59	0.85
1993	18	17	94%	0.04	2.34	0.93
1992	11	10	91%	0.04	2.32	0.87
1991	8	8	100%	0.04	2.36	0.75
1990	9	9	100%	0.04	4.80	1.99

Table 8. Ocklockonee River Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
1998	20	19	95%	0.04	0.19	0.1
1997	5	5	100%	0.04	0.11	0.08
1996	15	15	100%	0.04	0.23	0.14
1995	16	16	100%	0.04	0.17	0.12
1994	13	12	92%	0.04	0.19	0.11
1993	15	12	80%	0.04	0.32	0.11
1992	13	12	92%	0.04	0.8	0.22
1991	3	2	67%	0.04	0.11	0.06
1990	7	5	71%	0.04	0.14	0.08

Such high phosphorus levels also have the potential to affect conditions in the Gulf of Mexico. In 2001, the Fenholloway was responsible for the loading of 135 tons of phosphorus to the Gulf.[34] Again, while nitrogen may be the limiting nutrient in Gulf coastal waters, phosphorus pollution cannot be safely ignored.

Ochlockonee River

The Ochlockonee River flows from Georgia through northwestern Florida, before it empties into Ochlockonee Bay. Eutrophication has been evident at Lake Talquin, an artificial reservoir created by the damming of the Ochlockonee.

Like the Fenholloway and the Suwannee Rivers, the Ochlockonee has historically registered phosphorus levels far in exceedance of the EPA's recommended numeric criterion. Over the 1990-1998 time frame, measurements of phosphorus levels in the river exceeded the criterion more than 90 percent of the time. (See Table 8.)

Despite these high levels of phosphorus, no part of the Ochlockonee River is currently listed as impaired by nutrients. The two segments that had been listed as impaired for nutrients on the 1998 impaired waters list have been since been removed.

Ocklawaha and St. Johns Rivers

The Ocklawaha and St. Johns river basins occupy most of the northeastern quarter of Florida. The Ocklawaha is a major tributary of the St. Johns, and is fed by rivers, streams, and a series of lakes in Central Florida. The St. Johns is an unusual hydrologic system—a north-flowing river with a gentle gradient that opens into a series of lakes as it makes its way from Indian River County to the Atlantic Ocean in Duval County. Tides at the mouth of the St. Johns can affect the river's flow as far as 160 miles upstream, while the river's overall "lazy" flow can make it difficult for the system to flush itself of pollutants.

The two basins demonstrate the damage that nutrient overenrichment—particularly phosphorus overenrichment—can have on waterways, as well as the potential for concerted government action to address the problem. Among the impacts of high nutrient levels in the St. Johns River have been algae blooms, fish kills, loss of shoreline vegetation, low levels of dissolved oxygen and the presence of toxic microorganisms. All of these problems can be linked to eutrophication.[35]

Phosphorus levels in both the Ocklawaha and St. Johns rivers have regu-

Table 9. Ocklawaha River Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
1999	3	3	100%	0.04	0.11	0.09
1998	44	38	86%	0.04	2.02	0.11
1997	20	18	90%	0.04	0.18	0.07
1996	20	19	95%	0.04	0.14	0.07
1995	16	15	94%	0.04	0.10	0.06
1994	15	11	73%	0.04	0.09	0.06

larly exceeded EPA's recommended numeric criterion. In the Ocklawaha River, approximately 88 percent of all samples taken between 1994 and 1999 exceeded the EPA's recommended numeric criterion for phosphorus. (See Table 9.) Meanwhile, about 82 percent of all tests in stream segments of the St. Johns River exceeded the EPA phosphorus criterion. (See Table 10.)

Unlike many other rivers and streams with high levels of phosphorus, much of the St. Johns and Ocklawaha rivers remain classified as "impaired" for nutrients under the Impaired Waters Rule. While assessments for the Upper St. Johns River basin have not yet been completed, numerous segments of the lower and middle St. Johns River have demonstrated sufficient chlorophyll-a levels to be classified as impaired. It should be noted, however, that many segments of the lower St. Johns are classified as estuaries or lakes, and are therefore subject to different standards.

The Ocklawaha and St. Johns rivers are prime examples of the importance of appropriate determinations of nutrient impairment. TMDLs for nutrients have been proposed for the lower St. Johns River and water bodies in the Ocklawaha River basin.

Summary

The TMDL process offers an effective way of dealing with the phosphorus pollution problem in Florida's rivers and

Table 10. St. Johns River Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
2001	30	28	93%	0.04	0.19	0.10
2000	60	60	100%	0.04	0.29	0.12
1999	51	51	100%	0.04	0.32	0.11
1998	56	47	84%	0.04	0.18	0.07
1997	105	97	92%	0.04	0.26	0.09
1996	252	205	81%	0.04	0.38	0.08
1995	89	69	78%	0.04	0.27	0.07
1994	4	4	100%	0.04	0.18	0.10
1993	163	106	65%	0.04	0.22	0.06
1992	194	185	95%	0.04	0.28	0.08
1991	179	134	75%	0.04	0.22	0.07
1990	36	11	31%	0.04	0.11	0.04

streams. But the weaknesses and loopholes in Florida's Impaired Waters Rule will likely prevent many rivers and streams with legitimate nutrient enrichment problems from being listed as impaired waterways and cleaned up.

The weakness of the IWR is apparent in the delisting of several waterway segments with levels of phosphorus well over the EPA's recommended criterion—and in the disproportionate delisting of rivers and streams versus other types of waterways. While some waterways may experience naturally higher levels of nutrients such as phosphorus, the data presented above suggest that the state of Florida is failing to properly diagnose or treat the phosphorus pollution problem.

How Florida Can Control Phosphorus Pollution

Florida has two avenues through which to reduce nutrient pollution—and particularly phosphorus pollution—of state waterways.

The first avenue is through the process of creating and implementing TMDLs. This watershed-specific approach requires state officials to accurately assess the condition of nutrient-impaired waterways, determine the sources of nutrient pollution, and implement cleanup plans that will curb overall nutrient inflows to the waterways.

A second avenue is through the setting of statewide policy to reduce nutrient discharges at the source, particularly from agricultural and urban runoff. The longstanding and persistent problems posed by nutrient pollution throughout Florida suggest that both avenues must be pursued.

WATERSHED-BASED SOLUTIONS

The development of effective, watershed-based strategies to curtail nutrient runoff into specific waterbodies depends upon a proper understanding of the nutrient problem. To this end, revising the Impaired Waters Rule's process for identifying nutrient-impaired rivers and streams is critical.

Florida should make three changes to ensure that the state accurately identifies waterways with nutrient problems:

1) The IWR should be revised to no longer rely on mean annual chlorophyll-a levels as the primary means of determining nutrient impairment in streams. At minimum, the rule should be revised to allow seasonal spikes of chlorophyll-a to trigger a listing of impairment, instead of relying only on annual averaging, which can mask temporary, but still dangerous, algal blooms.

   Ideally, the IWR should also allow for consideration of causal variables—such as measured nitrogen and phosphorus levels—as an indicator of potential impairment. The EPA's recommended numeric criteria for nutrients could be used as the benchmark for potential impairment while Florida develops its own, state-specific numeric standards for nutrients.

   Finally, the IWR should specifically require that waterways demonstrating observed imbalances of flora and fauna be listed as impaired. Currently, the IWR states that imbalances such as

   > algal blooms, excessive macrophyte growth, decrease in the distribution . . . of seagrasses or other submerged aquatic vegetation, changes in algal species richness, and excessive diel oxygen swings shall also be considered.[36]

   However, no mechanism is provided for requiring waterways exhibiting such traits to be listed as impaired. The presence of algal mats "in sufficient quantities to pose a nuisance or hinder reproduction of a threatened or endangered species" is the only observed imbalance that triggers automatic listing on the IWR.

2) Provisions in the IWR that set unduly high thresholds for the number of exceedances needed to

determine impairment, exclude evidence of impairment, impose unreasonable seasonal averaging requirements, or allow for "reasonable assurance" exceptions to TMDL development should be removed from the rule.

3) Florida should move forward expeditiously with the adoption of numeric water-quality standards for nutrients, to be implemented no later than 2005, and revise the IWR to reflect these standards immediately upon their adoption. The state should take local or regional environmental conditions into account when setting the standards to the extent possible—including developing methods to accurately measure the presence of natural background levels of nutrients. But the standards should be based primarily on reducing nutrient levels to levels reflecting natural conditions.

   Several Florida waterways that have been identified as suffering from nutrient pollution have begun to be cleaned up. (See "Lake Apopka: A Case Study," next page.) And with Florida finally moving ahead with the development of TMDLs for impaired waterways, the cleanup of additional waterways should begin soon. But without proper procedures to identify nutrient-impaired waterways, many rivers and streams could remain polluted for the long term.

STATEWIDE SOLUTIONS

As noted above, runoff (primarily from agriculture but also from urban areas) is a major source of nutrient contamination of waterways, along with point source discharges from sewage treatment plants. Since 1994, Florida has encouraged, by statute, the development and implementation of Best Management Practices (BMPs) to limit the discharge of nitrogen by agriculture. The 1994 law created funding for the development of BMPs and to support cost-sharing plans with farmers. In addition, the law gave two regulatory incentives to farmers that adopted BMPs: an exemption from the cost of cleaning up nitrate-polluted groundwater and a "presumption of compliance" with water quality standards.[39]

The 1994 law did not specifically acknowledge the need for BMPs for phosphorus. But BMPs for phosphorus have been part of the restoration plans for waterbodies such as Lake Okeechobee.[40]

While BMPs are generally undertaken voluntarily, they have been mandated in certain instances. Landowners in the Everglades Agricultural Area who discharge water to the "works" of the water management district are required to obtain a permit and implement BMPs. The program, which was required by the Everglades Protection Act of 1991, has succeeded in significantly reducing phosphorus loads to the Everglades.[41]

Florida also regulates stormwater discharges from new developments (except single-family dwellings) through a permitting program implemented by water management districts. Projects must implement BMPs to reduce stormwater pollution of suspended solids by 80 percent or by 95 percent for outstanding Florida waters, waters that do not meet standards, or other sensitive waters.[42]

As Florida grapples with the problem of nutrient pollution, a possible model for action can be found in Wisconsin, where the state adopted a sweeping package of runoff management rules in 2002. Those rules:

(continued on page 28)

Reclaiming Lake Apopka: A Case Study

Lake Apopka in central Florida was once one of the state's great bass fisheries, attracting anglers from across the country. But, beginning in the 1940s, a series of changes around the lake sent the waterbody into a spiral of decline. In 1947, a hurricane destroyed much of the lake's aquatic vegetation. At roughly the same time, agricultural development around the lake boomed; a total of 20,000 acres of wetlands around the lake were lost to agriculture in the 1940s. Those agricultural areas produced discharges of phosphorus that made their way into the lake, along with phosphorus discharges from wastewater and citrus processing plants.[37]

Soon, it became apparent that Lake Apopka was in trouble. Phosphorus inflows to the lake caused algal blooms and turbid waters. Sport fish came to be replaced by shad by the early 1960s. By the late 1960s, the lake bottom was covered with a layer of muck more than four feet deep.[38] Pollution from the lake began to move downstream throughout the Harris Chain of Lakes, which acts as the headwaters of the Ocklawaha River.

Beginning in 1985, the St. Johns River Water Management District, working with other government agencies, attempted to reverse Lake Apopka's slide, by taking more than 18,000 acres around the lake out of agricultural production, replacing native vegetation, harvesting gizzard shad, and constructing a marsh "flow-way" to filter pollutants out of lake water.

Recent measurements of phosphorus concentrations in the lake suggest that the approach is beginning to make an impact. As of 1998, phosphorus levels in the lake still regularly exceeded EPA's recommended nutrient criteria for phosphorus for lakes in Ecoregion XII, but average phosphorus levels have dropped consistently since 1990. (See Table 11.)

The example of Lake Apopka shows that efforts to reduce phosphorus loading to waterways can succeed. But the intensity of effort that has been expended in the restoration of Lake Apopka—along with other areas such as Lake Okeechobee and the Everglades—is unlikely to be carried out statewide. To reduce nutrient-related water-quality problems across Florida, other steps—including reducing the flow of nutrients into waterways through runoff standards and removal of phosphorus already in aquatic systems through vegetative treatment—will have to be taken to reduce levels of phosphorus in the state's waterways.

Table 11. Lake Apopka Exceedances of Recommended EPA Phosphorus Criterion

Year	Samples	Exceedances	Exceedance Percentage	Recommended Criterion (mg/l)	Maximum Measured (mg/l)	Average (mg/l)
1998	71	59	83%	0.01	0.11	0.03
1997	108	104	96%	0.01	0.44	0.08
1996	124	124	100%	0.01	0.22	0.07
1995	89	88	99%	0.01	0.64	0.13
1994	70	70	100%	0.01	0.3	0.16
1993	34	34	100%	0.01	0.36	0.25
1992	67	67	100%	0.01	0.28	0.18
1991	160	159	99%	0.01	2.37	0.23
1990	80	79	99%	0.01	4.5	0.24

- Impose new runoff standards for agriculture, including requirements for the development of nutrient management plans for fertilizer use, improved manure management standards, and cropland erosion standards. The standards are mandatory for large animal feedlots that are required to obtain a state discharge permit, and for any landowner who has been offered state funding equivalent to 70 percent of the cost of implementing the standards.

- Impose standards to reduce sediment erosion from construction sites and runoff from new transportation and development projects. The standards are mandatory for large construction sites and transportation projects. Many municipalities will be required to develop rules that achieve certain targeted reductions in runoff.[43]

While the Wisconsin standards currently address only nitrogen, phosphorus will be included once the Natural Resources Conservation Service develops nutrient management standards for phosphorus in or around 2005. Florida should consider the adoption of similar standards for both nitrogen and phosphorus.

THE NEED TO ACT

Clean water is the economic and emotional heart and soul of Florida. Nutrient pollution has already shown the potential to wreck inland fisheries, degrade the quality of rivers, streams and lakes, and alter the delicate ecological balance in one-of-a-kind ecosystems such as the Everglades and Florida Bay. The stakes—for the health of the state's tourism industry and for all Floridians—are very high.

Yet, despite a growing awareness of the nutrient problem, and successful restoration efforts in some waterways, Florida's current water policies represent an inadequate response to the problem—particularly as it relates to rivers and streams. The ongoing process to develop numeric standards for nutrient pollution provides Florida with a golden opportunity to develop a scientifically sound methodology for ensuring that every waterway in the state that is negatively impacted by nutrients is cleaned up.

But Florida cannot afford to wait for new numeric standards for nutrients to take action on the nutrient problem. It is time for the state to repair the obvious flaws of the Impaired Waters Rule, and to begin to build consensus behind an expanded nutrient management strategy that will result in significant reductions in nutrient pollution of the state's waterways within the near term.

The examples of the Everglades, Lake Apopka, Lake Okeechobee and countless other waterways in Florida should remind us that the cost of repairing nutrient-damaged waterways and ecosystems is usually far greater than the cost of preventing pollution in the first place. Florida must make the commitment to address the nutrient pollution problem now, or it will undoubtedly pay the price later.

METHODOLOGY

Data on phosphorus levels in Florida waterways were derived from a query of the EPA's STORET database performed in March 2003. For the years 1990 through 1998, phosphorus levels are based on parameter number 00665. For 1999 through 2003, phosphorus levels reported under parameters 00662 and 00665 were used.

The number of "exceedances" of phosphorus criteria was based on the highest recommended phosphorus criterion among Florida's three ecoregions as proposed by EPA. This level corresponds with 0.04 mg/l for rivers and streams.

Data from legacy STORET records with remark codes of A, C, D, L, or S, or no remark code were used. Data from STORET records with remark codes I, K and M were retained but the values used were half the values reported in STORET. Data with remark codes of B, E, F, G, H, J, N, O, P, Q, R, V, Y, and Z were deleted from the database. Entries with a remark code of T, U, or W were kept, but their values were replaced with zero in the database. These procedures are per U.S. EPA, Ambient Water Criteria Recommendations, *Information Supporting the Development of State and Tribal Nutrient Criteria, Lakes and Reservoirs in Nutrient Ecoregion XIII*, December 2000, Appendix A.

Records indicating identical readings on the same date from the same sampling station were determined to be duplicates and were excluded from the results.

NOTES

1. Lora E. Fleming, Wendy Stephan, *Report to the Florida Harmful Algae Bloom Taskforce: Blue Green Algae, Their Toxins and Public Health Issues*, October 2001.

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