Unattainable Surface-Water Quality Standards May Diminish Widespread Public Support for Water Quality Improvements

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Many state water-quality standards were established in the early years of the Clean Water Act (CWA) when a key goal of the 1972 CWA was "to eliminate pollutant discharge to navigable waters by 1985." Unfortunately, this admirable goal sometimes has resulted in required pollutant load reductions (e.g., total maximum daily loads [TMDLs]) that are based on unattainable water-quality standards that reflect the environmental euphoria of the 1970s and 1980s. In my view, it is wise to consider if we should continue to develop water-quality management plans focused on achievement of those goals or if it is better to develop realistic goals and set attainable water-quality standards.

From a pragmatic perspective, working toward unattainable water-quality standards diminishes our ability to achieve widespread buy-in on pollutant load controls. I see this reaction to water-pollutant control now in North Carolina, where unattainable standards are leading to a backlash against pollutant reduction, due primarily to extremely high costs of compliance with a TMDL. Unfortunately, this perspective may be given further support by long lag times between implementation of nonpoint source controls and observable water-quality improvements, leading to skepticism that the required pollutant load reductions will have any effect.

For example, Falls Reservoir in North Carolina has a TMDL mandating a 77 % reduction in phosphorus loading to attain the 40 μg/liter chlorophyll a water-quality criterion. Given the preponderance of nonpoint sources of phosphorus in the Falls Reservoir watershed, a 77 % phosphorus load reduction is not feasible; even if it were, the cost of attainment almost certainly will far exceed the benefits derived for designated use. Given that situation, Falls Reservoir is in need of a Use Attainability Analysis (which determines if a designated use is technologically and economically feasible) or new site-specific nutrient criteria.

I believe that realistic and achievable water-quality standards, with designated use (e.g., recreational fishing) improvements that are causally linked to attainment of water-quality criteria (e.g., chlorophyll a), are needed to gain widespread support for pollutant controls for water-quality improvements. In Falls Reservoir, the backlash against the high cost of phosphorus load reductions has resulted in a state-sponsored plan for in-lake artificial mixing (using SolarBees). This is a waste of money, as whole-lake mixing is not feasible due to the large size of Falls Reservoir, and in-lake mixing will have little effect on nutrient concentrations. While I do not believe that water-column mixing in Falls Reservoir is scientifically defensible, I do understand that local and state elected officials may feel desperate enough to embrace even ineffective "solutions" in the hope of reducing pollutant-control costs for their constituents.

Another example to consider is Chesapeake Bay. The watershed for Chesapeake Bay is quite large, with many major cities served by wastewater treatment plants. In the past 30–40 years, the United States (US) has been extraordinarily effective in reducing pollutant discharges from "point sources" such as public and private wastewater treatment plants. Many of these treatment plants are operating at or near the current limits of technology with extremely high removal efficiencies, such that further improvements could be quite costly with perhaps little additional pollutant removal.

Despite those significant reductions in pollutant discharges from point sources, to achieve compliance with water-quality standards, there is still much to be accomplished in reducing nitrogen and/or phosphorus loading to Chesapeake Bay. That is because these nutrients also enter lakes, rivers, and bays from "nonpoint sources" in the watershed, such as

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agricultural fields, feedlots, stormwater drainage from urban areas, and lawn fertilizers. In the case of Falls Reservoir, phosphorus in soils that were flooded to create the reservoir 30 years ago is likely still being released into the water, slowing recovery of the reservoir from nutrient enrichment.

Measures to control nonpoint pollution are expensive and may be imposed on communities that do not easily benefit from use of the body of water being protected. For instance, New York State and West Virginia are required as part of the Chesapeake Bay cleanup to implement a plan to reduce their nutrient loading to Chesapeake Bay, since some of their land is in the Chesapeake Bay watershed and thus contributes to the problem. Thus, perhaps it should not be surprising that legal challenges have already arisen even in the early stages of the Chesapeake Bay cleanup.

It may be that our urban/suburban lifestyle expectations are not compatible with the water quality needed to support desirable uses such as commercial and recreational fishing. Perhaps current water-quality standards will ultimately require such drastic measures as banning residential lawns, restricting agriculture, and/or limiting development and urban growth within a watershed. Given the unlikelihood that we will halt urban development or curtail agricultural activities in watersheds, it is possible that we cannot achieve current water-quality standards in some of our major US waterbodies without lifestyle changes.

We must also consider what we gain by even partial compliance with mandated pollutant controls. Does an expenditure of 70% of the total estimated costs for point and nonpoint pollution control equal a 70% gain in water-quality benefits? Not necessarily.

So, do we want blue crabs and oysters badly enough in Chesapeake Bay even if it requires that we curtail urban development and forego our manicured lawns? While this is a contentious issue, it seems prudent to engage in a discussion of these cost/benefit trade-offs (along with recognition of the distribution of costs and benefits) before proceeding too far with major public investments that yield little beneficial return.

Of course, reliance on water-quality standards requires that these standards truly reflect attainable goals. In 2001, I was in a Tallahassee courthouse defending Florida's choice to use hypothesis testing to assess noncompliance with water-quality standards. At a break in the trial, I tried unsuccessfully to explain to the other side that poor methods (e.g., ad hoc judgment) would waste resources by requiring TMDLs when they were not needed or missing violations when a TMDL is needed. This experience led me to think about the cost of type I and type II errors when using water-quality sampling to assess compliance with standards.

Effective water-quality management is built on a foundation of water-quality standards. Recognizing this, states should focus on making standards defensible from a scientific and socioeconomic perspective. However, standards must ultimately be protective, and for that, we must consider the operational enforcement of the standard.

Standards become operationally enforceable when they are stated in a manner that makes compliance assessment clear and unambiguous. Most surface-water-quality standards are expressed and evaluated based on a single, point-valued chemical criterion (e.g., 50 μg/liter arsenic for Class C Waters in North Carolina). This criterion is then used for two primary compliance assessments: (1) current water quality—based on a comparison of the criteria with measurements to determine if a waterbody is currently in compliance and (2) future water quality—based on model forecasts to determine if proposed management actions will achieve compliance.

Allowing a selected percentage of exceedances of a numeric criterion makes sense. In principle, unless there is to be an infinite penalty associated with exceedance of a criterion, an analysis of benefits and costs would lead to probabilistically based standards that included a nonzero chance of exceedance of the criterion. In practice, determining cost/benefit-based standards is a difficult task; hence, the arbitrary choice of 10% exceedances appears to be a pragmatic action by the US Environmental Protection Agency (EPA).

An additional area of concern for operationally enforceable water-quality standards relates to the recent push by the USEPA for numeric nutrient criteria, in part to remove the ambiguity of narrative criteria. However, numeric water-quality criteria can also be ambiguous. Consider the North Carolina numeric dissolved-oxygen (DO) criterion: "not less than an average of 5.0 mg/liter with a minimum instantaneous value of not less than 4.0 mg/liter." We know that DO varies naturally with temperature in both time and space. So a DO criterion can be ambiguous and non-protective unless it is operationally assessed based on: (1) the space/time variability in DO in a waterbody and (2) the "region" of space/time that the DO standard is intended to protect. Otherwise, water-quality monitoring to assess compliance with this criterion can result in compliance or noncompliance determinations solely due to a sampling design that ignores natural variability.

It is unfortunate that the laudatory goals of the Clean Water Act may not be attainable everywhere. Given that fact, I believe that the most effective way to achieve additional protection of designated uses is to adopt technologically and economically feasible water-quality standards. This is likely to result in relaxation of a limited number of current water-quality criteria. I wish that we could do better and eliminate pollutant discharges to navigable waters, but that is not going to happen. In my view, recognition of the need to set realistic water-quality goals is the best pathway to achieve and maintain meaningful water quality improvements.