Unreliable Reporting of Water Quality Impairment by the US EPA's National Water Quality Inventory

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Abstract

The US EPA in its most recent biennial report, "1994 Report to Congress," released in December 1995 on the impairment of US surface waters indicates that on the order of 50% of the waters assessed are "impaired." However, a review of the basis by which a waterbody is determined to have an impaired use shows that the Agency is significantly over-estimating the amount of impaired waters in the US. The basic problem with the US EPA's approach is that a waterbody is considered to have an impaired use if an exceedance of any magnitude of a chemical-specific numeric water quality standard occurs more than once in three years. However, the water quality criteria and state standards as implemented typically fail to properly consider the aquatic chemistry and aquatic toxicology of chemical constituents. Significant exceedances of US EPA criteria and state standards numerically equal to these criteria can occur without real use impairment of the waterbody occurring. Recommendations are presented on how the National Water Quality Inventory data collection should be changed to more reliably report to Congress and the public the quality of the waters of the US than is occurring today.

Introduction

The Clean Water Act of 1987 (PL 100-4, Section 305(b)) requires that each State, Territory, and Interstate Commission develop a program to monitor the quality of its surface and groundwaters and prepare a report every two years describing the status of its water quality. The US EPA is to transmit this information to Congress. The US EPA's recent release (December 1995) of the 1994 National Water Quality Inventory reports that on the order of 40 to 60% of US waters (rivers, lakes and estuaries) that were assessed are "impaired" (US EPA, 1995a). Recently, the authors have had the opportunity to review how the US EPA and various states developed the information that became part of the US EPA's National Water Quality Inventory Report to Congress and find that a number of aspects of the approach used are technically invalid and significantly overestimate the amount of truly impaired waters in the US.

This report states in the Introduction,

"The National Water Quality Inventory Report *to Congress is the primary vehicle for informing Congress and the public about the general water quality conditions in the United States."*

A critical review of how the US EPA developed this report shows that again in 1995 the US EPA has provided significant amounts of unreliable information to Congress and the public on the general water quality conditions in the United States. As discussed, herein, many of the so-called

impaired waterbodies that are listed in this report and many of the causes of the impairment, such as urban stormwater runoff, actually are far less impaired than is indicated in the Report and many of the sources of impairment are far less important in causing real use impairment than is listed in this report.

Primary Problem - Exceedance of US EPA Water Quality Criteria and State Standards

Basically, the US EPA's December 1995 *Water Quality Inventory Report to Congress* represents, in large part, a technically invalid assessment of the current state of the nation's water quality. The basic problem relates to the instructions given to the states by the US EPA in how the states should define water quality use impairment, focusing on the use of exceedances of water quality criteria-standards as a use-impairment.

In the section labeled "Measuring Water Quality," the US EPA states,

"The States, participating Tribes, and other jurisdictions survey the quality of their waters by determining if their waters attain the water quality standards they established."

It is important to understand that many states are forced by inappropriate policies of the US EPA to adopt water quality standards that are well recognized to be over-protective, i.e. where exceedances of the standards do not represent an impairment of the designated beneficial uses of the waterbody, such as drinking water quality, propagation of fish and aquatic life, contact recreation, etc.

Further, the Agency without public review in the early 1990's adopted their Independent Applicability Policy which precludes the states from using technically valid approaches for assessing real water quality impacts associated with constituents in the states' waters that exceed water quality standards. Basically, this policy requires that the states consider the waterbody impaired due to toxic chemicals, such as heavy metals, because of an exceedance of a worst-case or near worst-case water quality standard imposed on the states by the US EPA, even though toxicity testing of the ambient waters using the same organisms as were used to originally develop the water quality criterion which became a state standard shows that the waters are non-toxic.

The chemical-specific criteria are in accord with the Agency's Independent Applicability Policy independently applicable, even though biological effects information shows that that approach is technically invalid. Recently, the Agency has indicated that it is reconsidering the appropriateness of the Independent Applicability Policy. It is important to understand, however, that that Policy was in effect when the information that was used to develop the 1994 *National Water Quality Inventory Report to Congress* was obtained.

The instructions provided by the US EPA to the states include listing as "impaired" any waterbody in which there is an exceedance of a chemical specific water quality standard (US EPA, 1993a). In accord with US EPA current regulatory policy, any waterbody that has an exceedance of a water quality standard for more than once in three years has to be classified as an "impaired" waterbody. Those familiar with how the US EPA water quality criteria were

developed and the aquatic chemistry and aquatic toxicology of chemical constituents in aquatic systems as they relate to causing real impairment of the designated beneficial uses of a waterbody know that the US EPA's water quality criteria, and therefore state standards numerically equal to these criteria, are in many situations highly over-protective of the designated beneficial uses of waterbodies.

The US water pollution control program is based on protection of designated beneficial uses of waterbodies, which for aquatic life would include the numbers, types and characteristics of desirable forms of fish and other aquatic organisms. As discussed by Lee *et al.* (1982), many chemical constituents exist in aquatic systems in a variety of forms, only some of which are toxic-available to aquatic life. With few exceptions, most states are utilizing total or near-total chemical constituent concentrations as a basis for implementing US EPA water quality criteria into state standards and NPDES discharge permit limits. This means, and in fact it routinely occurs, that there can be exceedances of water quality standards for ambient waters which do not represent an impairment of the designated beneficial uses of a waterbody.

While this situation has been recognized since the National Academies of Science and Engineering (NAS/NAE, 1973) developed the "Blue Book of Water Quality Criteria" in 1972 and has been acknowledged to some extent by the US EPA (1987) as part of publication of the "Gold Book of Water Quality Criteria" of 1986, the Agency has still not developed appropriate approaches for addressing this problem. The site-specific water quality criteria development approach based on the water effects ratio adjustment of the criteria-standards originally as released in the mid-1980's and including the more recent revisions of this approach (US EPA, 1994a) fall far short of providing proper adjustment of the water quality criteria and standards to cause an exceedance of a water quality criterion-standard to have a high probability of representing an actual impairment of the designated beneficial uses of waterbodies.

The original and more recently released site-specific water quality criteria-standards water effects ratio adjustment approach does not properly consider the aquatic chemistry of the chemical constituents in the discharges-runoff to the waterbody and within the waterbody. Many chemical constituents enter waterbodies in specific forms that are non-available, non-toxic and that do not equilibrate with toxic-available forms within the waterbody. This causes the water effects ratio adjustment to be significantly deficient in properly accounting for chemical-specific, source-specific and waterbody-specific effects of potentially toxic chemicals on the beneficial uses of waterbodies.

The US EPA's (1993b, 1995b) recommended approach for adjusting the heavy metal criteria to dissolved metals rather than total recoverable metals also does not adequately address this problem. Dissolved metals as typically measured will normally significantly over-estimate the water quality impacts of heavy metals on aquatic life in aquatic systems as a result of complexation of many of the metals by natural and anthropogenically-derived organics and inorganic complexing agents as well as the presence of colloidal metals which are measured as "dissolved" metals, but yet are not available-toxic to aquatic life (Allen and Hansen, 1996 and Lee and Jones-Lee, 1994a).

San Francisco Bay Copper Situation

An example of the significant over-regulation of a heavy metal in a major waterbody that is occurring today is copper in San Francisco Bay. This is also an example of the inappropriateness of the US EPA's current approach for conducting a National Water Quality Inventory which leads to the designation of waterbodies as "impaired" when the impairment is "administrative" and is an outgrowth of inappropriate approaches being used by regulatory agencies to regulate chemical constituents in aquatic systems, rather than one that reflects an actual use-impairment of the waterbody. Copper exists in San Francisco Bay as it does in many marine waterbodies at concentrations well above the US EPA's 2.9 ug/L marine waters water quality criterion. Many states adopted, or were forced to adopt, in accord with the US EPA's December 1992 National Toxics Rule, copper standards numerically equal to the US EPA water quality criterion. This leads to an "administrative" impairment of the designated beneficial uses of the waterbody since the existing concentrations in the waterbody as measured by total recoverable and, for that matter, dissolved copper, exceed the water quality criterion-state standard.

In California, the San Francisco Regional Water Quality Control Board with the US EPA's assistance and guidance attempted to develop site-specific water quality criteria for copper for San Francisco Bay. This effort resulted in raising the water quality standard (called "objectives" in California) from 2.9 ug/L to 4.9 ug/L. San Francisco Bay, however, routinely has concentrations of copper at 10 to as much as 15 ug/L (Thompson *et al.*, 1994 and AHI, 1994). Dissolved copper was found in San Francisco Bay waters in a comprehensive water quality monitoring program on several occasions in 1993 at concentrations in the order of 10 to 12 ug/L.

Those not knowledgeable in the aquatic chemistry of copper and its toxicology might be led to believe that such exceedances of the US EPA water quality criteria-state standards must represent an impairment of the designated beneficial uses of the waterbody. However, the reason copper is of concern to aquatic life is its potential toxicity. The water quality criterion and therefore the state standard is based on measurement of toxicity of certain forms of copper to certain forms of aquatic life. Generally, the most toxic form of copper (the aquo species) and the larval - most sensitive form of aquatic life are used. It has been found after extensive studies over several years that San Francisco Bay waters, using the same forms of aquatic life that were originally used to establish the 2.9 ug/L criterion, are non-toxic to these as well as several other sensitive forms of aquatic life. This means that not only is copper in the San Francisco Bay water column non-toxic to aquatic life, but all other constituents, both regulated and unregulated, are also non-toxic to a variety of sensitive forms of aquatic life.

Therefore the exceedance of the copper criterion–objective, including the site-specific objective, is an "administrative" exceedance that does not represent an impairment of the designated beneficial uses of San Francisco Bay waters. It also means that San Francisco Bay being listed as an "impaired" waterbody because of its size and significance is incorrectly designated as an "impaired" waterbody as a result of the "excessive" concentrations of copper. Yet the US EPA, and, for that matter, the state of California, are informing Congress that San Francisco Bay is an "impaired" waterbody because of the "excessive" copper concentrations.

The San Francisco Bay situation is not unusual; it is to be expected for most of the chemical constituents for which the US EPA has developed water quality criteria that are based on potential toxicity to aquatic life. It is technically inappropriate for the US EPA to instruct states that they must list as an "impaired" waterbody any waterbody that has an exceedance of the acute water quality standard for more than one hour once in three years or for the chronic standard, the four-day average more than once in three years.

Consequence of Inappropriate Assessment of Water Quality Impairment for San Francisco Bay. The consequences of the inappropriate approach being used by the US EPA and states in developing water pollution control programs for chemical constituents based on "administrative" exceedances of water quality criteria-standards is potentially of great significance. As it stands now, because of the "administrative" exceedance for copper in San Francisco Bay waters, the San Francisco Regional Water Quality Control Board in accord with US EPA policy has been in the process of developing a wasteload allocation and total maximum daily loads (TMDL's) for copper input to San Francisco Bay for the purpose of trying to achieve the 4.9 ug/L site-specific copper objective by reduction of copper loads to the Bay from point and non-point sources. It is estimated that over $1 billion of expenditures will be needed by stormwater dischargers in the construction and operation of treatment works to control copper inputs to the Bay.

However, even if all copper inputs to the Bay were stopped today, San Francisco Bay waters would exceed the 2.9 or, for that matter, the 4.9 ug/L copper objective more than one hour once in three years due to copper stirred into the water column from the sediments, if the objectives are implemented based on total recoverable copper. While no data are available for dissolved copper under those conditions, the same situation is likely to occur for dissolved copper as well. There is little question that the copper water quality objective for San Francisco Bay can never be achieved if the criterion for achievement is that there be no exceedances above the objective for more than one hour once in three years. It is also clear that the US EPA's one hour once in three years exceedance limit is grossly over-protective where exceedances can routinely occur above the objective without impairment of the designated beneficial uses of the waterbody.

Bioaccumulation

A situation where chemical data are reliable for assessing impairment of the designated use is for those chemicals that bioaccumulate within aquatic organism tissue, rendering them judged to be unsuitable or a hazard to their use as food for humans based on FDA Action Levels or US EPA risk-based levels. For this situation, concentrations of chemical constituents such as mercury, PCB's, DDT, dioxin, etc. that actually accumulate within organism tissue is the determiner, not the concentrations of these chemicals found in water. Again, any state that uses the concentrations of bioaccumulatable chemicals above the water quality criterion-standard as a measure of an impaired waterbody is incorrectly assessing impairment, unless that impairment results in accumulation of the chemical above the FDA Action Level or US EPA risk-based level in edible tissue of desirable organisms.

Nutrient Related Water Quality Problems

Aquatic plant nutrients are listed by the US EPA (1995a) as one of the major causes of impairment of the designated beneficial uses of the nation's waters. There are two approaches for assessment of nutrient-related impairment. One is based on chemical concentrations of nutrients such as the values provided in the "Gold Book" water quality criteria (US EPA, 1987) for phosphorus; the other is based on excessive growth of aquatic plants. As discussed by Lee *et al.*(1979), the US EPA's 1986 "Gold Book" criteria for phosphorus, which are the same as the US EPA's "Red Book" 1976 criteria for phosphorus, are highly unreliable for assessing eutrophication-related water quality problems in the nation's rivers, lakes and estuaries. Eutrophication-related water quality problems must be assessed based on the actual growth of excessive amounts of algae and/or other aquatic plants in the waterbodies, i.e. biological effects-based approaches.

The US EPA in their guidance for the states for development of information for the National Water Quality Inventory suggests that the states should classify the lakes and estuaries in terms of whether the waterbodies are oligotrophic, mesotrophic, eutrophic, hypereutrophic, etc. Typically, states utilize the Carlson Index approach for this purpose. However, a review of the technical base for the Carlson Index shows that it is based on a very limited number of waterbodies in one geographic region (Minnesota area) and that it does not necessarily provide reliable results that are comparable to other classification schemes that have a much larger, more technically valid database than that used by Carlson. Further, while the Carlson Index uses a response parameter, planktonic algal chlorophyll, as one of the components of the Index, it also uses phosphorus and Secchi depth information, both of which can be highly unreliable in establishing the trophic state of a waterbody. Phosphorus concentrations are a causative factor and are not directly related to a response parameter and therefore, in themselves, are unreliable as a trophic state indicator. As reported by Lee *et al.* (1980), significant amounts of the phosphorus tributary to or within a waterbody can be in non-algal available forms. This is especially true for particulate forms of phosphorus where only about 20 per cent of such forms are available to support algal growth.

Secchi depth, in addition to being influenced by planktonic algae, is influenced by natural color and inorganic turbidity. Waterbodies with appreciable inorganic turbidity will have low Secchi depths, but still produce excessive growths of planktonic algae, impairing the waterbodies' uses.

In the 1970's, the US and 21 other countries in western Europe, North America, Japan, and Australia undertook a five-year study of about 200 waterbodies for the purpose of establishing nutrient load eutrophication response relationships. The US part of these results were published in a US EPA report, Rast and Lee (1978), as well as by Lee *et al.* (1978). The overall original OECD studies were published by the OECD (1982). These studies were formulated and directed by Dr. Richard Vollenweider. Jones and Lee (1982, 1986) have published updated information on the US OECD studies as well as studies that have been done in other countries. As part of developing the US part of the OECD studies, Rast and Lee examined the relationship between planktonic algal chlorophyll, Secchi depth and phosphorus concentrations in waterbodies. They utilized not only the data from the US part of the OECD study waterbodies which was a much larger database than that used by Carlson in developing his trophic state index, but also data from

the literature on these relationships. They found that the Carlson relationships are not necessarily in accord with the information available from the much larger database representing lakes and reservoirs throughout the US as well as those representing lakes and reservoirs in other parts of the world.

R. Vollenweider (OECD, 1982) as part of the OECD eutrophication studies conducted an assessment of the relationship between planktonic algal chlorophyll in waterbodies and what the international OECD eutrophication study participants judged to be the trophic state of waterbodies as described by oligotrophic, mesotrophic and eutrophic. At a meeting in Austria held in the mid-1970's, the OECD study participants in a secret ballot independently provided their assessment of the relationship between planktonic algal chlorophyll and trophic state. It is important to emphasize that the trophic state of a waterbody is subjective dependent on the views of those conducting the assessment. Vollenweider's efforts worked towards standardizing the subjective nature of trophic state classification in terms of a probability function. Some scientists and engineers who have recognized expertise in western Europe, North America, Japan and Australia and who participated in the OECD eutrophication study and the workshop where this material was developed and formulated, recommended this approach to properly classify the trophic state of a waterbody and not the Carlson Index approach which can readily lead to erroneous conclusions concerning a waterbody's trophic state.

Caution should be exercised in listing any waterbody that becomes classified as eutrophic as an "impaired" waterbody. While waterbodies with planktonic algal chlorophyll greater than 10 ug/L (typically classified as eutrophic) may occasionally have an excessive planktonic algal bloom that would represent a short-term impairment, these waterbodies also present some of the best warm water fisheries and therefore would be considered highly desirable waterbodies from a fisheries perspective (Lee and Jones, 1991b). The authors have also found in their work on eutrophication related water quality problems for various parts of the US and other countries, that there are significant differences in what the population of the region and their associated regulatory agencies consider to be excessive aquatic plant growth in a waterbody. While individuals from the upper midwest and New England area (glacial lake states) may consider a waterbody with planktonic algal chlorophyll greater than about 10 ug/L (eutrophic) as "impaired," reservoirs in the southeast, southwest and some other parts of the US with 10 ug/L planktonic algal chlorophyll would be considered highly desirable and certainly not impaired. Lee *et al.* (1994) have provided additional discussion of the use of the OECD eutrophication study results for properly developing a trophic state classification of a waterbody.

Suspended Sediment - Siltation

The impairment of waterbodies by silt derived from erosion is another area where significant errors can be made in assessing real water quality impacts. The concentrations of turbidity from suspended solids in the water column are not generally reliable for assessing impacts. Erosion-derived suspended solids discharged from point and non-point sources or derived from streambed scour should be assessed based on an actual impairment of the designated beneficial uses, such as accumulations of silt which interfere with boating, affect aquatic life habitat, significantly alter the primary productivity of waterbodies so that a waterbody's tropic status above a desirable trophic status for a particular region is adversely impacted, etc. While often

there are claims made about adverse impacts of suspended solids to fish gills, etc., such claims are not supported by the experimental data that have been obtained on this topic. As discussed by Jones and Lee (1978), many fish are routinely exposed to high levels of suspended solids due to natural causes during high flows in rivers or storms in lakes, bays and estuaries. Studies of these situations do not reveal significant adverse impacts on the fish populations.

During the 1970's under the US COE Dredged Material Research Program extensive studies were done on the impact of suspended sediment on aquatic organisms. It was found that suspended sediment can significantly adversely impact aquatic life habitat through changes in characteristics. It can also adversely affect certain sessile organisms through burial. Many benthic and epibenthic organisms, however, with limited mobility can survive sediment burial through movement up through the deposited sediment. The work of Peddicord *et al.* (1975), clearly demonstrated the ability of fish and other organisms to be able to withstand high concentrations of suspended sediment for long periods of time without significant adverse impacts. Further, appreciable turbidity-suspended solids can be present in a waterbody without changing the trophic status of the waterbody. Waterbodies have been found to produce about the same amount of chlorophyll and planktonic algal growth with substantial inorganic turbidity or color for the same nutrient and other conditions as waterbodies that do not have the turbidity derived from inorganic or colored sources (Jones and Lee, 1986).

Sediment Contamination

There are a number of other aspects of the US EPA's National Water Quality Inventory that result in an unreliable assessment of the degree of impairment of the nation's waters. One of the more significant ones is the US EPA's instructions to states to include sediment contamination as a reason for listing a waterbody as an "impaired" waterbody. To the extent that states interpret this requirement to mean elevated concentrations of various potentially toxic or otherwise deleterious chemicals in sediments without properly assessing whether the concentration of chemicals in sediments is, in fact, impairing the designated beneficial uses of the waterbody, then any waterbody that is classified as "impaired" based on sediment contamination is potentially unreliably classified. It is well-known that aquatic sediments can accumulate high concentrations of a wide variety of chemical constituents without adverse impact on the designated beneficial uses of waters. Aquatic sediments have the ability to detoxify a wide variety of chemical constituents, converting them into non-toxic, non-available forms.

As discussed by Lee and Jones (1991c,1993a), it has been known since the 1960's that the total concentration of chemical constituents in sediments is an unreliable approach for assessing potential water quality impacts. Further, it is well-known that approaches such as those suggested by the US EPA (1993a) based on the Long and Morgan co-occurrence-derived values for chemical constituent impacts is also highly unreliable in assessing impacts of specific chemical constituents in aquatic sediments. By suggesting that the Long and Morgan co-occurrence-based values can serve as a basis for judging excessive sediment contamination and therefore impairment of waterbodies, the US EPA is providing unreliable guidance to states in this area. The unreliable nature of co-occurrence-based sediment quality evaluation procedures has been discussed by Lee and Jones-Lee (1993a,1994b).

Recommended Approach

All chemical concentration-based exceedances for the water column and sediments that are being recommended by the US EPA and used by states in reporting impaired waterbodies are inherently unreliable and, in many cases, will significantly over-estimate the true designated beneficial use impairment of the waterbody. The approach that should be taken is to stop using the excessive chemical concentrations in the water column as an absolute standard, but instead use it as a trigger for toxicity or other assessment. Lee and Jones-Lee (1995a) have discussed the appropriate use of numeric chemical water quality criteria in evaluation of water quality - use impairment of waterbodies. Waterbodies should only be listed as "impaired" due to a chemical constituent that is of concern because of its toxicity to aquatic life, when in fact the waters are toxic to aquatic life of concern to the beneficial uses of the waterbody. The ultimate determiner for impairment for potentially toxic chemicals must be toxicity, not chemical concentrations. Similarly, for chemical constituents that are of concern because of potential bioaccumulation in higher trophic level organism tissue, the impairment of designated beneficial uses must be based on the actual bioaccumulation in tissue above a regulatory value.

For those chemicals that stimulate aquatic plant growth, the presence of excessive aquatic plants in waterbodies in a particular region should be used as a basis for determining whether there is, in fact, eutrophication-related impairment of water quality in the region's waterbodies.

It is highly inappropriate for the US EPA to persist with its Independent Applicability Policy in which waterbodies that are shown to be non-toxic to aquatic life, such as San Francisco Bay, are listed as "impaired," resulting in regulatory agencies developing wasteload allocations and TMDL's. Such situations represent "administrative" exceedances of the criterion-standard. The inappropriateness of the US EPA Independent Applicability Policy has been reviewed by Lee and Jones-Lee (1995b).

Impact of Unreliable Information

The consequences of the US EPA's failure to provide appropriate guidance to states and for the US EPA and states to provide reliable information on the impairment of the nation's waters in the biennial National Water Quality Inventory Report to Congress is quite significant. It is causing various groups who have not critically reviewed how the impairment information was developed to conclude that major shifts or new emphasis for funding should be addressed toward controlling certain types of sources of chemical constituents such as for non-point source contaminants. While there is no question that non-point diffuse sources of chemical constituents such as from urban and rural runoff can have adverse impacts on designated beneficial uses of waterbodies, the degree to which the US EPA's National Water Quality Inventory indicates that this is occurring today is to some unknown extent over-estimated. This is especially true for urban stormwater drainage. Urban runoff is listed in the 1994 National Water Quality Inventory as either the first or fourth-ranked cause of "impaired" waters in the United States.

Over-regulating Urban Stormwater Runoff. One of the areas of particular concern to the authors of these comments is the Agency's reporting on the water quality use impairment associated with storm sewers/urban runoff. The Agency in its 1994 report states that storm sewers/urban runoff

represent runoff from impervious surfaces, including streets, parking lots, buildings, lawns and other paved areas. This is a separate issue from the combined sewer situation where the urban runoff contains domestic wastewaters which are discharged to surface water courses during periods of high flow.

The report states that urban runoff/storm sewers is the fourth-ranked cause of water quality impairment of the nation's rivers, the third-ranked cause of water quality impairment in the nation's lakes, and the first-ranked cause of impairment in the nation's estuaries. For the nation's rivers, the report indicates that the nation has about 3.5 million miles of rivers. Only 17 per cent of these rivers were surveyed in this report. That means that 83 per cent of the river waters in this country were not surveyed. Of the 17 per cent surveyed which represent 616,000 miles, 64 per cent had "good" water quality with 34 per cent or 224,000 miles with so-called "impaired" water quality. It is stated that 12 per cent of the impairment of rivers is due to urban runoff and storm sewer discharges.

While the Agency does not list the specific cause of the use impairment of stormwater runoff in their report, that value is certainly significantly higher than the real water quality use impairment that is occurring in the nation's rivers today due to urban stormwater runoff arising from the inappropriate approaches that the Agency has used to define water quality use impairment.

The US EPA indicates that only 42 per cent of the lakes in the US were included in the 1994 Report to Congress. It is indicated that 63 per cent of the lakes are considered to have "good" water quality; 37 per cent are considered "impaired." Nineteen per cent of the impaired lakes, 18 per cent of the surveyed lakes are reportedly impaired due to constituents in urban runoff and storm sewers. Again, that is certainly high, since one of the principal causes of impairment of lakes is aquatic plant nutrients. As discussed herein, many of the aquatic plant nutrients of urban stormwater runoff are in non-toxic, non-available forms.

The Agency reported to Congress and the public that its 1994 report surveyed 78 per cent of the US estuaries. Sixty-three per cent of those surveyed were listed as having "good" water quality. Thirty-seven per cent were listed as having "impaired" water quality. Urban runoff/storm sewers were reported as being responsible for 46 per cent of the impairment. This was the leading cause of impairment of the estuaries. Information is not provided by the Agency, however, on what specific constituents in the urban runoff storm sewer discharges are responsible for impairment.

The amount of "impaired" waters due to urban stormwater runoff is likely significantly over-estimated based on the approaches used by the US EPA and the states in developing the National Water Quality Inventory. It is not possible to reliably assess the impact of urban stormwater runoff-associated chemical constituents on designated beneficial uses of receiving waters based on a mechanical comparison between concentrations of regulated chemicals in such runoff and water quality criteria-standards (Lee and Jones-Lee, 1995c,d). As discussed by Lee and Jones (1991a), Lee and Jones-Lee (1993b) and Jones-Lee and Lee (1994) in order to assess whether urban stormwater runoff-associated chemical constituents are impairing the designated beneficial uses of the waterbody which receives the runoff, it is necessary to conduct detailed, site-specific investigations. Thus far, few investigations of this type have been conducted. However, where they have been conducted, they almost universally show that the stormwater runoff is not

significantly adversely affecting the designated beneficial uses of the waterbody receiving the runoff.

This assessment applies to urban stormwater runoff from typical urban, residential, and commercial areas, streets and highways and does not apply to combined sewer overflows or situations in which there are illegal connections and illicit dumping of large amounts of chemical constituents in storm sewers by industrial and commercial activities.

The 1994 *National Water Quality Inventory Report to Congress* provides a discussion of approaches for improving water quality in the nation's waters. Great caution has to be exercised, however, in accepting the Agency's recommendations in this regard since they are directed, to some extent, toward the control of constituents that are not adverse to the real beneficial use of waterbodies.

National environmental groups and others are being misled by the unreliable approaches being used by the US EPA to regulate and to report on impaired waterbodies due to toxics. For example, Trout Unlimited (1994) used the US EPA National Water Quality Inventory data to inform its members and the public about the inadequate implementation of the Clean Water Act for non-point source pollution. While there is no doubt that non-point source pollution, such as from agricultural runoff, is adversely affecting the nation's water quality, the magnitude of the problem is less than that reported by the US EPA in their National Water Quality Inventory.

The inappropriate approaches being used by the US EPA and the states in developing the National Water Quality Inventory and in regulating toxics is having adverse impacts on water quality program development in several areas. For example, the GAO (1994) was critical of the US EPA's program to control the discharge of toxics to surface waters because of exceedances of aquatic life criteria. The GAO however did not discuss the fact that many of these exceedances are "administrative" and do not necessarily represent a real use impairment. The GAO therefore incorrectly informed Congress, through the February 1994 report, that the US EPA was failing to control toxics to a much greater extent than would have occurred if the approach they had used was based on a real use impairment associated with the toxic releases that exceed US EPA criteria.

Conclusion

There is an urgent need to change the way by which the US EPA conducts the National Water Quality Inventory so that it more reliably assesses truly impaired waterbodies than is occurring today. Failure to do so will continue to result in a mis-application of funds available for water pollution control to address problems arising out of inappropriate administrative approaches that have little or nothing to do with water quality of concern to the public. Because of the limited financial resources available for water pollution control today, it is important that this country start to direct its efforts toward controlling real water quality problems of significance to the public who ultimately must pay for these programs and stop directing funds to control chemical constituents that are mis-classified as adverse to the beneficial uses of a waterbody by the approaches being used at the federal and state level today (Lee and Jones-Lee, 1995e).

In the early 1970's the National Academies of Science and Engineering committees recommended that toxicity for heavy metal discharges be assessed based on assessment of toxicity and not based on chemical concentrations. While the US EPA in the mid-1970's accepted this approach, with the change in administration in the early 1980's, the Agency opted for a bureaucratically simpler, but technically invalid approach of focusing on the control of chemicals irrespective of whether they are adverse to the designated beneficial uses of waterbodies. The Agency needs to re-direct its efforts back to controlling real biological impacts, focusing on biological effects-based approaches for water and sediments and bioaccumulation, rather than on what are clearly unreliable approaches based on chemical concentrations in the water column and sediments.

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