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Achieving Adequate BMP's for Stormwater Quality Management

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Abstract

There is considerable controversy about the technical appropriateness and the cost-effectiveness of requiring cities to control contaminants in urban stormwater discharges to meet state water quality standards equivalent to US EPA numeric chemical water quality criteria. At this time and likely for the next 10 years, urban stormwater discharges will be exempt from regulation to achieve state water quality standards in receiving waters, owing to the high cost to cities of the management of contaminants in the stormwater runoff-discharge so as to prevent exceedances of water quality standards in the receiving waters. Instead of requiring the same degree of contaminant control for stormwater discharges as is required for point-source discharges of municipal and industrial wastewaters, those responsible for urban stormwater discharges will have to implement Best Management Practices (BMP's) for contaminant control.

The recommended approach for implementation of BMP's involves the use of site-specific evaluations of what, if any, real problems (use impairment) are caused by stormwater-associated contaminants in the waters receiving that stormwater discharge. From this type of information BMP's can then be developed to control those contaminants in stormwater discharges that are, in fact, impairing the beneficial uses of receiving waters.

Introduction

The urban stormwater quality management program being developed by the US EPA evolved from the US EPA's 1992 report to Congress (US EPA, 1992) which stated,

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"Based in part on national assessments conducted by the US Environmental Protection Agency (EPA) it is now recognized that nonpoint sources and certain diffuse point sources (e.g., stormwater discharges) are responsible for between one-third and two-thirds of existing and threatening impairments of the Nation's waters (US EPA, 1991)."

The US EPA (1992) report to Congress is based on an inappropriate assessment of the impact of urban stormwater-associated contaminants on receiving water quality (Lee and Jones-Lee, 1993a). In developing that assessment, the US EPA and states used the highly over-protective water quality standards equivalent to US EPA water quality criteria. There is considerable technical justification for not requiring that urban stormwater discharges be controlled so as to meet such state water quality standards at the point at which they enter a waterbody (lake, river, stream, or the ocean), because of the short-term, episodic nature of those discharges and because contaminants, such as heavy metals, in stormwater discharges are typically in chemical forms that are not available/toxic to aquatic life (Lee and Jones, 1991). Therefore for most contaminants, applying current water quality standards to stormwater discharges through the NPDES permit system used for wastewater discharges can lead to massive waste of public and private funds for contaminant control with limited improvement in the designated beneficial uses of the waters receiving the stormwater discharges.

The problems in achieving water quality standards in waters receiving stormwater discharges during the time of discharge have resulted in a relaxation of this requirement in favor of achieving stormwater contaminant control BMP's. The goal of the current US EPA stormwater quality management program for urban and industrial areas is to *"develop a comprehensive planning process which involves public participation and inter-governmental coordination to reduce the discharge of pollutants to the maximum extent practicable (MEP)."* The implementation of the regulations requires an estimate of the *"reductions in loadings of pollutants from discharges of municipal storm water constituents from municipal storm sewer systems expected as a result of the municipal storm water quality management program."* (WRCB, 1993).

The relaxation of the requirement of achieving water quality standards in waters receiving stormwater discharges and the focus on BMP's to control pollutants to the maximum extent practicable require the development of an approach by which state regulatory agencies can judge the adequacy of efforts to develop stormwater contaminant control BMP's. The California Water Resources Control Board and its Regional Boards (WRCB, 1993) have determined that the implementation of the federal regulations *"requires permittees to evaluate effectiveness of storm water management program by:*

Runoff: Reduction of pollutants discharged in storm water to the MEP

Receiving water: Discharges do not impact beneficial uses

Cause an exceedance in water quality objectives [standards]."

Stormwater quality BMP's range from non-structural contaminant control programs, such as the control of illegal connections and illicit discharges, to structural controls such as detention basins, grassy swales, and treatment works similar to those used for domestic and industrial wastewaters. The costs of the structural BMP's can be very high.

While for a period of time stormwater discharges will likely be legally exempted from regulation to meet water quality standards, the approach that is being used at the federal and state levels for definition of the control of stormwater-associated contaminants to the "maximum extent practicable" could readily result in a *de facto* implementation of current state water quality standards to stormwater discharges as the basis for judging when adequate BMP's have been implemented for a particular discharge. Such an approach could readily lead to substantial waste of public and private funds in the implementation of BMP's for stormwater-associated contaminants that have little or no impact on water quality in the receiving water.

There are two categories of exceedances of water quality standards. One category comprises exceedances of standards that reflect the presence of sufficient concentrations of toxic/available forms of contaminants to cause an impairment of the designated beneficial uses of waterbodies. The other category comprises "administrative" exceedances in which contaminants exist in the water in concentrations greater than water quality standards without the impairment of the designated beneficial uses of the waterbody. The existence of "administrative" exceedances reflects the highly overly protective nature of the water quality standards, including the incorporation of non-toxic, unavailable forms of chemicals in the assessment of the exceedance. It is important that the BMP's developed for stormwater quality management address real water quality problems and not merely the elimination of "administrative" exceedances of overly protective, numeric water quality standards of the type that have been adopted by many states.

The approach being adopted by the California Water Resources Control Board, of using exceedances of water quality standards (objectives) as a basis for developing the contaminant control goals of BMP's in determining contaminant control to the "maximum extent practicable" can readily lead to significant over-regulation of stormwater discharges in order to address "administrative" exceedances of water quality standards that do not reflect actual use-impairment of the surface waters. The process of "ratcheting down" the allowed concentrations of contaminants in urban stormwater discharges to achieve current state water quality standards is not technically valid and is not in the best interest of cost-effective management of real water quality problems associated with stormwater discharge.

Stormwater Quality Management

Stormwater quality management entities are in the process of developing contaminant control programs for Phase I stormwater discharges. Those programs typically initially focus on the implementation of "best management practice" (BMP). Numerous guidance manuals for BMP's for stormwater have been developed and are under development by various professional groups and regulatory agencies (MWCOG, 1992; APWA, 1993). Lee and Jones (1991) and Lee and Jones-Lee (1992a) discussed the importance of focusing BMP's on real water quality problems caused by the particular discharge for the particular site of focus. At the urging of environmental groups, Congress specified in the 1972 Clean Water Act that all municipalities provide a standard basic degree of treatment for domestic wastewaters ("secondary" treatment) irrespective of the indications of the need for such treatment to protect beneficial uses of a particular receiving water. This approach should not be followed to direct the construction of contaminant control systems for stormwater discharges.

One of the common BMP approaches to "controlling" contaminants in stormwater discharges is the construction of detention basins on the discharges to effect a decrease in concentration of chemical contaminants that are discharged to receiving water. While such facilities cause removal of some of the larger particulates, contaminant forms associated with those detained particulates are largely unavailable to cause toxicity to aquatic life; detention basins allow the passage of dissolved contaminants that could adversely affect aquatic life. Thus, as discussed by Lee and Jones (1991) and Lee and Jones-Lee (1992a), the construction of detention basins on stormwater discharges is largely ineffective in controlling real water quality problems that may be caused by stormwater-associated contaminants.

Need for Control of Particulate Forms of Contaminants

Some regulatory agencies are regulating the discharge/runoff of particulate forms of contaminants that could become associated with the sediment in receiving waters, under the mistaken belief that such control would protect "sediment quality." There is no technical foundation for these approaches. First, it is not possible to translate concentrations of total heavy metals in effluents/runoff or in ambient waters to sediment quality problems. Non-toxic/unavailable forms of heavy metals associated with particulates in watercolumns usually do not lead to the formation of toxic/available forms when those particulates settle to the sediments. Further, sediments typically detoxify toxic forms of chemicals. Understanding the aqueous environmental chemistry of toxicants is critical to the proper regulation of chemical contaminants. Site-specific biological effects studies on sediments should be used to determine exceptions to the expected detoxification reactions. Properly conducted ambient water and sediment toxicity measurements should be used to determine if heavy metals are causing real toxicity in receiving

waters. "Short-term" chronic toxicity tests (using fish larvae and zooplankton) on ambient waters in conjunction with reliably determined concentrations of dissolved forms of contaminants provide a good indication of whether exceedances of discharge limitations for heavy metals and other contaminants, or of effluent toxicity are causing toxicity of significance to designated beneficial uses of the water.

Lee and Jones (1992b), Lee and Jones-Lee (1993b,d), and Jones-Lee and Lee (1993), discussed technical deficiencies in the current approaches for the development of sediment quality criteria and standards, and also alternative approaches for technically valid, cost-effective evaluation of the water quality significance of sediment-associated chemical contaminants. As they discussed, a properly conducted, non-numeric "weight of evidence" evaluation of ambient water conditions of aquatic life toxicity, bioaccumulation, and numbers and types of desirable organisms of concern to the public should override chemical concentration-based numeric criteria for the regulation of discharges/runoff and for determining the degree of clean-up of contaminated sediments needed to protect beneficial uses.

Detention Basin Sediment Quality

Not only are detention basins largely ineffective in controlling water quality problems in waters receiving stormwater drainage, but also there is increasing concern about the potential problems associated with management of particulate matter that is collected in them. Stormwaters from urban areas typically contain elevated concentrations of particulate forms of contaminants such as lead, some of which will settle out in a properly designed, operated, and maintained detention basin.

The assessment of lead-contaminated soil, sediment, or waste for its classification as "hazardous waste" was originally made based on the results of EP-Tox test and is now made based on the results of the US EPA's TCLP test. The prescribed basis for establishing the allowed level of lead that can be leached in the TCLP test procedure without the tested material's being classified as "hazardous waste" is the drinking water standard of 50 μg/L, multiplied by a factor of 100; on that basis, 5 mg/L lead is allowed to leach from the soil, sediment, or waste under the test conditions before the material is classified as a "hazardous waste" and in need of management as such.

The US EPA and some state regulatory agencies have recently reduced the accepted concentration of lead in drinking water to 15 μg/L. This change would be expected to cause a substantial reduction in the amount of leachable lead that would "pass" the TCLP, and cause more materials to be classified as "hazardous waste." It will likely be found that some soils that accumulate in stormwater detention basins will contain sufficient amounts of TCLP-leachable lead to be

classified as "hazardous waste." Therefore those responsible for operation and maintenance of stormwater detention basins could find themselves in the position of having to manage the collected solids as "hazardous waste." This increases the cost of disposal from a few tens of dollars per ton to a few hundred dollars per ton for management in a "hazardous waste landfill."

Infiltration Basins

Another approach that is often considered to be BMP for stormwater-associated contaminants is the construction of infiltration basins to promote the passage of stormwaters into the groundwater aquifer system. In the past, the construction of infiltration basins has been done with little or no regard for the potential for groundwater pollution by contaminants in the stormwater. Lee and Jones-Lee (1993c) discussed the importance of the proper evaluation of the potential for groundwater pollution by contaminants in waters that are directly or incidently introduced into groundwaters.

Implementation of BMP's

The first step that should be taken in defining a BMP for a particular stormwater discharge is to define the specific water quality impairment being caused by stormwater-derived contaminants. The authors have yet to find a documented aquatic life toxicity problem caused by stormwater discharges to receiving waters that was not due to illegal or illicit disposal/connections. Thus, as discussed by Lee and Jones (1991) and Lee and Jones-Lee (1992a) if a real water quality problem is identified, the first "BMP" that should be undertaken is the careful examination of the system for illegal or illicit disposal or connections of industrial or commercial waste to the stormwater system. If rectifying those conditions does not resolve the water quality problem, a more detailed evaluation of the source of the contaminants causing the problem should be made to determine if they can be controlled at the source. Only after these actions have been taken without resolution of the water quality impairment should consideration be given to structural BMP treatment options for the stormwater runoff.

Stormwater treatment should focus on those components of the stormwater responsible for the specific water quality impairment of the particular receiving water. Because the stormwater-associated contaminant(s) that may cause an impairment of a beneficial use would be site-specific, and because of the rarity of aquatic life toxicity problems caused by urban stormwater runoff not due to illegal or illicit disposal or connections, a "standard" off-the-shelf BMP cannot and should not be prescribed for stormwater runoff treatment. For example, detention basins should not be constructed if there are no impairments of beneficial uses in the receiving waters caused by those materials that would be removed in such a facility at the site in question.

Far too often contaminant control entities construct treatment works to "solve" a what is defined as "problem" based on inappropriate regulatory requirements, rather than to challenge the validity of the regulatory requirements. This is especially important in the area of stormwater quality evaluation and management since it is well-known that the existing US EPA water quality criteria and standards that are applied to waters receiving such discharges are largely inappropriate for assessing the potential impact of stormwater-associated contaminants on beneficial uses of the receiving water. Thus, the entity making the water quality evaluation should take assertive action to ensure that any regulatory requirements imposed on the discharge are technically valid and will result in a significant, discernible improvement in the designated beneficial uses of the receiving water.

These recommendations are consistent with those made by the Water Environment Federation for changes in the Clean Water Act. WEF (1992) stated with regard to management of stormwater discharges,

> *"The permitting process, however, must take into account the inherent difference between conventional discharges and stormwater discharges."*
>
> *"Discharge-specific permits should be limited only to those discharges which are having a quantifiable and significant adverse impact on receiving water quality."*

Conclusion

The current approach for BMP implementation is often not technically valid and will result in substantial waste of public and private funds with little or no improvement in the designated beneficial uses in the receiving waters for stormwater discharges. The implementation of BMP's for control of stormwater-associated contaminants to the maximum extent practicable should be based on finding a real water quality problem - use-impairment that can be solved by the BMP.

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