Appropriate Goals for TMDL Development: Regulating Copper in Urban Stormwater Runoff[1]

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The development of TMDLs for 303(d)-listed "impaired" waterbodies must include the development of a TMDL goal. This goal is typically the water quality standard/objective that caused the listing. Normally, the water quality standard is the same as or derived from US EPA national water quality criteria. A review of how the US EPA develops these criteria and their implementation into state standards shows that, for many constituents that cause 303(d) listings of a waterbody, the standard can be exceeded, in some cases by large amounts, without significant impairment of the beneficial uses of the listed waterbody. This situation arises from the fact that the US EPA national criteria are designed to be protective of aquatic life and other beneficial uses under worst case or near worst case conditions of 100 percent toxic/available forms and extended exposure to these forms.

In many situations where TMDLs need to be developed to control exceedances of water quality standards, the regulated constituents exist in a variety of chemical forms, only some of which are toxic/available. This is especially true for heavy metals and many organics. The development of TMDLs for constituents of this type requires evaluation of an appropriate TMDL goal that will protect the beneficial uses of the listed waters without significant unnecessary expenditures for constituent control. This discussion focuses on the appropriate approach for regulating copper in urban area street and highway stormwater runoff where receiving waters for this runoff contain copper above the US EPA national water quality criterion or a site-specific water quality standard/objective.

The concentrations of copper in urban area street and highway stormwater runoff frequently exceed the US EPA national water quality criterion for fresh and marine waters for total and dissolved copper. Since some waterbodies that are impacted by runoff from urban areas contain copper above the national criterion, as well as the recently promulgated California Toxics Rule (CTR) criterion (US EPA, 2000), state regulatory agencies are required to list these waterbodies on a 303(d) list of impaired waterbodies. This, in turn, mandates that a TMDL be developed to control the copper present in all sources for the waterbody so that the exceedance of the water quality standard (objective) does not occur by any amount more than once every three years.

NPDES-permitted urban area and highway stormwater runoff managers will, under current regulatory approaches, be required to control the copper concentrations in the runoff so that they do not cause or contribute to violations of water quality standards at the point of

[1] Reference as Lee, G.F. and Jones-Lee, A., "Appropriate Goals for TMDL Development: Regulating Copper in Urban Stormwater Runoff," Report of G. Fred Lee & Associates, El Macero, CA (2000).

discharge for the runoff. Under CTR, the copper will be regulated based on dissolved concentrations in the ambient receiving waters. If the dissolved copper, either directly or through a translator, in the runoff waters exceeds the water quality standard (objective), then the stormwater runoff can be judged to be a contributor to the water quality standard violation and will require a wasteload/load allocation as part of TMDL implementation.

Some groups, such as Sustainable Conservation (2000), are advocating that the use of copper in automobile brake pads be curtailed/eliminated in order to reduce the copper in street and highway stormwater runoff. This approach is not based on an evaluation that shows that the copper present in the stormwater runoff from highways and streets is in a toxic/available form. It has evolved out of a mechanical comparison between the concentrations of copper in street and highway runoff to national water quality criteria and state standards. It is important to note that, from the information available, it appears that the elimination of copper from automobile brake pads will not eliminate the exceedance of the copper criterion at the point of discharge of urban area and highway stormwater runoff to receiving waters.

A number of studies of urban area street and highway stormwater runoff (see review by Lee and Taylor, 1999) have shown, however, that the heavy metals in this runoff are in nontoxic/non-available forms. Therefore, from the substantial evidence available, it appears that the exceedance of the national or site-specific water quality criterion/standard for copper in urban area and highway stormwater runoff at the point of discharge represents an "administrative" exceedance that reflects the overly protective nature of the criteria/standards when applied to urban area street and highway stormwater runoff.

As discussed by Lee and Jones-Lee (1997), this is to be expected, based on the aqueous environmental chemistry of copper. Only a small part of the total copper and, for some sources, dissolved copper is in a toxic/available form. From the information available, it appears that the brake pad-derived copper is in nontoxic/non-available forms. That situation does not apply to all sources of copper in all waterbodies. Copper from some industrial and mining sources is in a toxic form and, while for many waterbodies it is rapidly converted to nontoxic forms through chemical reactions, there are some types of waters where it would remain or could become toxic. As a result, in evaluating the need to eliminate the use of copper in automobile brake pads, as well as developing stormwater runoff treatment works to control copper concentrations from all sources, it is important to conduct the necessary studies to determine whether the copper in the stormwater runoff is in a toxic/available form at the point of discharge, as well as in the receiving water column and sediments.

Lee and Jones-Lee (1995, 2000) have discussed the need to conduct more comprehensive evaluations of aquatic chemistry, toxicology and biology than is typically done today in regulating many chemical constituents in aquatic systems. Conducting these studies will likely show that, with respect to urban area street and highway stormwater runoff-associated copper, there is no need to restrict the concentrations of copper in the runoff for many receiving waters for this type of runoff.

If a stormwater management agency finds, after appropriately conducting studies and adjusting the water quality criteria/standards for site-specific conditions in accord with current US EPA (1994) guidance, that the state and/or federal regulatory agencies are requiring that funds be spent unnecessarily to control copper in stormwater runoff because of an administrative exceedance of a water quality standard, then the stormwater management agency may need to work with their federal and state legislators to bring about changes in US EPA and/or state policy so that funds spent for copper control in urban area street and highway stormwater runoff address real, significant water quality problems/impairment of beneficial uses of concern to the public.

While there may be some who attempt to argue that elimination/banning of the use of copper in automobile brake pads is "pollution prevention," as discussed by Lee and Jones-Lee (1997), such approaches ignore the fact that brake pad manufacturers can substitute other products for copper without a proper evaluation of the potential impacts of the substitute on public health and the environment. Without such an evaluation, it is possible that the substitute could cause real, significant public health and environmental impacts.

An aspect of the copper-brake pad issue that needs to be considered is that there are different types of copper used in brake pads. Some of this copper is derived from chipping brass, while other forms of copper are used in brake pads. If water quality problems are found due to the copper in brake pads, it is likely that there may be significant differences in the potential impact of the copper derived from brake pad wear, dependent on the type of copper used.

An important component of the Lee and Jones-Lee (1997) suggested approach for regulating copper in urban area street and highway stormwater runoff is that it incorporates funding that would enable a comprehensive ongoing search for beneficial use-water quality problems due to copper in brake pads as well as other sources. This approach should involve a stakeholder consensus-guided evaluation of the study approach and results of the investigation.

The appropriate development of a TMDL for potentially toxic constituents wasteload/ load allocation should focus the TMDL on controlling toxic/available forms of constituents that significantly impair the beneficial uses of waterbodies. The wasteload/load allocation should be based on allocating the loads of toxic/available forms of the constituents that are present in the receiving waters at the point of concern for water quality-beneficial use impacts. The use of this approach will require incorporation of current aquatic chemistry and aquatic toxicology/biology and water quality in TMDL development and allocation. The adoption of this approach will lead to a much more technically valid, cost-effective management of real, significant water quality-use impairments in the TMDL process than has occurred and will likely continue to occur..

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