Comments on Selected Issues that Influence the Application of Water Quality Standards to Urban Area and Highway Stormwater Runoff Water Quality Management

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I wish discuss several of the issues that could influence future water quality criteria/standards application to regulating the water quality impacts of urban area and highway stormwater runoff I have also included information that provides background to understanding why it is possible to significantly change existing water quality criteria/standards and still be protective of aquatic life-related beneficial uses. I have included a brief summary of each issue followed by a more comprehensive discussion.

Summary of Issues Discussed

Adjustment of the Copper Criterion Implementation Approach

The US EPA is developing a chemically-based, water effects ratio adjustment approach that will enable the development of site-specific criteria for copper that consider the detoxification of copper due to organic complexation.

Revised Ammonia Criteria

The US EPA is developing revised ammonia water quality criteria that will include the use of biological assessments to determine if winter discharges of ammonia are toxic to receiving water aquatic life.

Independent Applicability

There is growing recognition within the US EPA that the Independent Applicability Policy should be terminated in favor of appropriately conducted site-specific investigations which determine whether an exceedance of a worst-case water quality criterion/standard represents a real use impairment of the receiving waters for the discharge/runoff.

Diazinon Water Quality Criterion

Two years ago the US EPA reactivated an effort to develop a water quality criterion for diazinon that could be used to address/regulate urban area stormwater runoff aquatic life toxicity caused by this pesticide. The diazinon and other organophosphate-caused toxicity in urban stormwater runoff is one of the most important potential causes of adverse impacts to the beneficial uses of receiving waters for the stormwater runoff. In August 1997 the US EPA announced that in September 1997 it would release a draft water quality criterion for diazinon. Within a short period of scheduled release, the US EPA reassigned its personnel who were developing the criterion document to other activities. At this time, the diazinon criterion document that was scheduled to be released in September 1997 has been rescheduled for possible release in September 1998.

Allowed Standards Exceedance Frequency

Currently, the US EPA allows only one exceedance of a water quality standard of any magnitude for any regulated parameter in the receiving waters for a NPDES-permitted discharge every three years. An exceedance frequency above this amount represents violation of the NPDES permit. There are continuing discussions about the highly overly-protective nature of this exceedance frequency. These discussions include, raising the current exceedance frequency from about 0.1% to about 5% of the time. Raising this exceedance frequency to this level may not in itself provide significant relief to urban area and highway stormwater runoff water quality managers for certain of the heavy metals and possibly certain organics which cause exceedance of the water quality standards in each runoff event. Raising the exceedance frequency, coupled with other adjustments of the standards/discharge limits could provide considerable relief to urban area and highway stormwater runoff water quality managers from the over-regulation that is occurring now and could still be protective of the beneficial uses of the receiving waters for the runoff.

Protection of Zooplankton from Toxicity-Regulating Chromium in Stormwater Runoff

While ordinarily US EPA water quality criteria for heavy metals tend to be over-protective, the water quality criterion for chromium VI is considerably under-protective for some forms of aquatic life. Chromium VI could become an important constituent of concern in urban area and highway stormwater runoff through its potential toxicity to aquatic life and especially zooplankton that are important components of larval fish food. It is important that the concentrations of total chromium and chromium VI in urban area and highway stormwater runoff be measured with analytical methods that have reliable detection limits at less than 1 µg/L.

Endangered Species

The US Fish and Wildlife Service has indicated as part of its responsibility in the implementation of the Endangered Species Act that it has concerns about the US EPA proposing to use ambient water dissolved heavy metal criteria for implementation of the California Toxics Rule. This could force the US EPA to implement the heavy metal criteria based on total recoverable rather than ambient water dissolved metals. Such an

approach would be highly significant to urban area and highway stormwater dischargers' control of heavy metals in the discharges. While I am not familiar with the basis for the US FWS's concern about dissolved metal criteria, these issues have been raised by several others in connection with particulate metals accumulating in receiving water sediments where they are adverse to aquatic life within or upon the sediments. It has been the US EPA's position that the regulation of sediment quality should be based on sediment quality criteria/guidelines and not on water quality criteria. I strongly support this position as a technically valid approach for assessing the water quality significance of particulate heavy metals in urban area and highway stormwater runoff where the sediment quality evaluation is based on biological effects, i.e. toxicity, bioaccumulation, and not on chemical concentrations.

Mercury

Mercury can become an important constituent of concern in urban area and highway stormwater runoff due to its potential presence in runoff waters above, soon to be announced revised water quality criteria for mercury and the finding that fish in many areas contain mercury above levels that are considered safe for use as food.

Lead

The Department of Toxics Substances Control (DTSC) has recently proposed to decrease the concentration of lead in wastes such as the sediment associated with urban area and highway stormwater runoff to become classified as a hazardous waste from 1000 mg/Kg to 700 mg/Kg. The adoption of this proposed critical value of lead in soils/sediments could become significant to many urban area and highway stormwater runoff water quality managers through having to manage, as a hazardous waste, sediments that have accumulated in stormwater conveyance structures and in BMPs.

Discussion

Changes in the Copper Criterion Implementation Approach

Copper in urban area streets and highway stormwater runoff typically exceeds water quality standards for protection of aquatic life for both marine and fresh waters. Copper is of concern in the runoff because of its potential toxicity to aquatic life. While there have been statements made about copper being of significance because of its accumulation in shellfish and possibly be a hazard to those who eat the shellfish, that issue is not the issue of concern relative to urban area and highway stormwater runoff. Also, copper is not of concern with respect to drinking water quality impacts, since copper is not particularly toxic to people. Drinking water standards (MCLs) for copper are based on taste considerations and are several orders of magnitude above the critical concentrations for aquatic life toxicity.

The current US EPA national criteria for copper for both fresh and marine waters are from about 3 to 5 µg/L, depending on the type of water. These criterion values are well

known to be over-protective in many waterbodies. Many years ago, the US EPA developed a Water Effects Ratio approach for adjusting a national criterion for site-specific water characteristics. Basically, this adjustment approach involves conducting toxicity tests with the reagent grade chemical (copper sulfate) added to a site water, as well as to a reference water and measuring the toxicity to sensitive forms of aquatic life in both waters. If the reference water toxicity is about the same as what others have obtained for the same reference water under the same conditions, then the ratio between the reference water toxicity and the site water toxicity is a measure of the short-term detoxification that occurs due to constituents in the site water. This ratio is the Water Effects Ratio that is used to adjust the national criterion to a site-specific criterion. In San Francisco Bay, this approach resulted in raising the national copper criterion from 2.9 µg/L to 4.9 µg/L.

The Water Effects Ratio approach used by the US EPA does not properly adjust for chemical species that are added to a water from some sources since they do not properly equilibrate with the constituents in the water that influence its toxicity. This situation and others cause waters, like San Francisco Bay, to have concentrations of copper factors of two or more above the site-specific water quality criterion developed by the US EPA's recommended approach without toxicity to highly sensitive forms of aquatic life that were used *(Mytilus edulis* larvae) to develop the national criterion as well as the site-specific criterion. The San Francisco Bay copper situation is an example of the inadequacies of the US EPA's approach to make adjustments of the national criterion values for site-specific conditions that still cause the site-specific criterion in many situations to be significantly over-protective for some sources of constituents because of the chemical forms. This is the situation for copper and urban area street and highway stormwater runoff to most waterbodies. The possible exception to this situation would be for stormwater runoff to enter pristine waterbodies with low hardness, alkalinity, suspended solids, TOC, and a low pH.

The US EPA is developing a Water Effects Ratio approach for adjusting the national criterion for copper that does not involve toxicity testing. Work done over the years, principally by Herbert Allen at the University of Delaware, and others has shown that there are only a limited number of forms of copper that are toxic. All of the particulate copper is known to be non-toxic. Many of the dissolved forms of copper are non-toxic. One of the detoxifying mechanisms for copper is complexation with organics. Many copper complexes, i.e. a type of chemical species, are also non-toxic. Natural organic matter which is measured as dissolved organic carbon (DOC) is well known to interact with copper to produce non-toxic copper complexes. It has also been known since the 1960s that the hardness/alkalinity of water influences copper toxicity. The US EPA has been incorporating hardness adjustments for copper toxicity into the criterion documents for many years. They have not, however, incorporated dissolved organic carbon complexation into adjusting the copper criterion.

The current work by the Agency in adjusting the copper criterion is devoted to a chemical approach of changing the national criterion based on hardness and dissolved organic carbon. Basically, the Agency's efforts in this regard are devoted to developing a

chemically-based water effects ratio for one chemical, namely copper. While this approach will save some money in adjusting water effects ratios, it will not produce a criterion value that will lead to a standard for aquatic life that will be appropriately protective without over-regulation based on some forms of copper added to waterbodies, such as from urban area and highway stormwater runoff. Further there are forms of copper that are measured as dissolved copper that will not be adequately corrected for in the chemically-based water effects ratio.

From a stormwater discharger's perspective, since this approach is planned to be released within about six months or so, it is important to incorporate into all stormwater runoff and receiving water monitoring programs measurement of pH, total and dissolved copper, total organic carbon and dissolved organic carbon, calcium, magnesium, specific conductance corrected to 20 C, temperature and alkalinity. If the dissolved copper concentrations found in runoff waters after site-specific adjustment exceed the adjusted water quality criterion, then the sample should be subjected to high-speed centrifugation to remove colloidal and finely divided particulate forms of copper that are measured as dissolved copper by the filtration procedure normally used. If after making these measurements, there is still excessive copper compared to the adjusted criterion, then toxicity tests should be conducted to determine if the water is, in fact, toxic to aquatic life using highly sensitive species as test organisms.

If at that point, toxicity is not found, even though the criterion is exceeded, then a petition should be filed with the regulatory agencies to obtain a variance from having to meet the copper criterion since the criterion that has been developed for the waterbody, including the site-specific criterion, does not properly reflect toxic forms of copper. If toxicity is found, then toxicity investigation evaluation (TIEs) should be conducted to determine if the toxicity is due to copper. If the toxicity is due to copper, then through a combination of forensic studies using toxicity tests and TIEs, determine the source of the toxic forms of copper and initiate source control to the maximum extent practicable. It should not be assumed that all sources of copper have the same toxicity or contribute toxic forms of copper in the same amounts relative to total copper present. Following this approach will ultimately lead to more appropriate regulation of copper in stormwater runoff from urban areas, streets and highways. Similar approaches can and should be used for most other constituents of concern in urban area and highway stormwater runoff.

Basically, the approach outlined above is the Evaluation Monitoring approach that Dr. Jones-Lee and I developed several years ago in connection with our work in Orange County/Upper Newport Bay watershed. This approach is being adopted in other areas. Similar approaches should be used for many of the other chemical constituents that exceed water quality criteria/standards for protection of aquatic life, excessive bioaccumulation of hazardous chemicals in fish tissue, and for drinking water impacts. In the case of domestic water supplies, the issues would be whether the discharge of a constituent in urban area and highway stormwater runoff at a particular location causes a water utility to experience an exceedance of a water quality standard (maximum contaminant level-MCL) in the treated water. Incorporated within this assessment would be whether this discharge causes the utility to have to spend more money for treatment of

the water to remove the constituent derived from urban area and highway stormwater runoff than would be necessary if the stormwater runoff constituent were not added to the raw water supply.

It is important to understand that conventional BMPs, like retention basins, etc., will not likely be effective in removing toxic forms of copper or even dissolved forms to eliminate the exceedance of the national criterion. Advanced wastewater treatment approaches would likely be needed to achieve water quality standards so there is no more than one exceedance every three years in urban area and highway stormwater runoff.

Additional information on regulating copper in urban area and highway stormwater runoff can be found in a paper "Regulating Copper in San Francisco Bay: Importance of Appropriate Use of Aquatic Chemistry and Toxicology" that was presented at the Fourth International Conference on the Biogeochemistry of Trace Elements June 1997. A copy of the slides used in this paper as well as other discussions on this topic are available from my website.

Adjustment of Ammonia Criterion

I have information which summarizes US EPA studies in the form of several figures that present information on how the toxicity of ammonia is influenced by a variety of factors. If members of the Task Force wish to receive a copy of this information, please let me know and I will fax it to you.

I have been involved with ammonia toxicity issues on behalf of POTWs for many years. I was part of the US EPA peer review panel that established the original ammonia criteria in the early 1980s. I am, therefore, aware of the highly conservative nature of the criteria as they have been implemented since they were adopted in the mid-1980s. Because of the importance of ammonia as a constituent of concern in domestic wastewater discharges, the Agency has given a high priority to revising the ammonia criteria to try to eliminate some of the conservatism in the criteria values. Last September, the Agency issued for peer review a revised ammonia criteria document. The Agency has backed away from addressing some of the key issues that need to be addressed to eliminate the significant over-regulation of ammonia that occurs in POTW discharges. To my knowledge, ammonia is not a problem in urban area, street and highway stormwater runoff as a toxicant. It does contribute to potential nutrient problems, usually in a small way.

The Agency is currently considering a significant change in approach with respect to implementation of the ammonia criteria where for the first time, the Agency, if it proceeds with the currently proposed approach, will utilize organism biological assemblage information in the receiving waters to determine whether winter discharges of ammonia are toxic to aquatic life. The reason for adopting this approach is that the chemical data on ammonia toxicity under cold weather conditions are not adequate to define a reliable criterion value during these conditions. This is the critical period of the year in many parts of the country with respect to domestic wastewater discharges since

POTWs typically have difficulties nitrifying (converting ammonia to nitrate) the effluent during cold weather conditions.

Basically, the Agency is contemplating relying on biological assessments of winter toxicity to assess whether cold weather discharges of ammonia are adverse to the numbers and types of aquatic life in the receiving waters for the discharge. This approach is similar to an approach that Dr. Jones-Lee and I developed in the early 1980s through our work with five different POTWs in the Colorado Front Range (Fort Collins (2), Loveland, Pueblo and Colorado Springs) where we advocated the use of Department of Interior Instream Flow Methodology to determine whether a particular wastewater discharge was adverse to the numbers, types and characteristics of desirable forms of aquatic life downstream of the discharge. Our work on this topic was published as "An Approach for Evaluating the Potential Significance of Chemical Contaminants in Aquatic Habitat Assessment" (1982) in the proceedings of the American Fisheries Society symposium, "Acquisition and Utilization of Aquatic Habitat Inventory Information." Basically, it focuses on wastewater discharges to streams and small rivers where the habitat characteristics of the receiving waters are examined to determine the numbers and types of aquatic life present under certain habitat conditions. Based on the habitat conditions in the area of potential impact from the wastewater discharge an evaluation is made as to whether the wastewater discharge contains constituents that are adverse to the aquatic life-related beneficial uses of the receiving waters for the discharge. This approach was successful in saving the communities on the order of $50 million in unnecessary treatment of the wastewater discharges since we demonstrated that installing this treatment would not likely result in a significant improvement in the beneficial uses of the receiving waters for the discharges.

The habitat assessment approach originally developed by the Department of the Interior should be incorporated into assessing the impacts of urban area and highway stormwater runoff on the beneficial uses of the receiving waters. It is becoming increasingly clear that the greatest impacts of stormwater runoff from paved areas are associated with altering the flow in the receiving water streams rather than the commonly assumed toxicity due to chemical constituents in the stormwater runoff. It will be important to be certain that the habitat characteristics of the area of concern with respect to stormwater runoff impacts are similar to any reference areas that are used to assess whether impacts are occurring in any stormwater runoff impact evaluations..

The fact that the Agency is beginning to incorporate biological assessment as part of implementation of the ammonia criteria is a major step toward developing an approach that would enable urban area and highway stormwater dischargers to obtain relief from overly-protective chemically-based criteria. Through properly conducted biological assessments and toxicity testing, it will ultimately be possible to demonstrate that the chemically based criteria can be relaxed for particular discharges and still be protective of the beneficial uses. Ultimately, through characterization of the types of discharges and types of waterbodies, it will be possible to make these kinds of adjustments in the chemical criteria without having to do the detailed site-specific studies at every site. The implementation of this approach will ultimately get the water pollution control program

of this country back on track to focusing on control of chemical impacts as opposed to chemical concentrations.

One of the problems that was addressed by the peer review panel for the ammonia criteria that I served on in the early 1980s was called the "red gill" problem in which it was found that trout exposed to un-ionized ammonia above about 0.02 mg/L as NH_3 showed under microscopic examination a reddish coloration of the gills. These trout, however, grew, reproduced and in all other respects were the same as trout with concentrations of ammonia that did not cause red gills. The peer review panel voted 3 to 2 against including red gills as an endpoint for toxicity which would have significantly raised the ammonia criterion from about 0.02 to about 0.06 or 0.07 mg/L NH_3 and thereby save POTWs large amounts of money in the degree of treatment necessary to achieve ammonia discharge standards. The Agency over-ruled the advice of its peer review panel and included red gills as a basis for assessing ammonia toxicity. The Agency has reversed its position on this issue and is no longer including red gills as an appropriate endpoint for ammonia toxicity. While this would, based on the original database, have caused the criterion to be significantly raised, some new blue gill fish ammonia toxicity data show that ammonia is more highly toxic to blue gills than originally thought. It turns out that the revised proposed water quality criterion for ammonia is largely controlled by blue gill toxicity which is an important sports fish in many parts of the US, rather than the toxicity for eight families of aquatic organisms which typically serves as the basis for developing water quality criteria.

While the Agency has well-defined rules for developing the criterion value based on toxicity to eight different aquatic life families in which through a formula, toxicity found is used to define the criterion value, the Agency does on some occasions where there is a particularly important species that is found to be affected by the toxicant, base the criterion almost exclusively on the toxicity to that particular organism. The proposed revised ammonia criterion which is based largely on blue gill toxicity is an example of this situation. The copper marine criterion which is based largely on the toxicity to *Mytilus edulis* larvae (marine mussel) is another example of how a single species can impact the criterion value.

Independent Applicability

The Agency's position with respect to Independent Applicability where meeting chemical constituent concentrations dictated by water quality standards under conditions where toxicity and/or biological assessments shows that the standards are over-protective, i.e. do not properly reflect water quality use impairments is changing. There is growing recognition within the Agency that the Independent Applicability Policy is inappropriate. The importance of focusing water pollution control on chemical impacts rather than chemical concentrations relative to water quality standards is beginning to be better understood. The incorporation of biological assessments under cold weather conditions for implementing the ammonia criteria as is currently being developed within the Agency is a significant step toward focusing on chemical -ammonia impacts as opposed to concentrations.

It is my assessment as a long-term watcher of how changes in the water pollution control programs occur that what is needed to cause Independent Applicability to completely die is a demonstration at a number of locations that biological - water quality impact assessment is a far more reliable approach for developing technically valid, cost-effective water pollution control programs than a chemical concentration based approach.

The state of Ohio's biological assessment approach focusing on fish populations is recognized nationally as a significant advance in more appropriate regulatory approaches than the chemically-based approach that is currently being used throughout most of the country. Several years ago, Dr. Jones-Lee and I were asked to develop a review paper as a feature paper in a new journal, *Health and Ecological Risk Assessment,* devoted to water quality criteria and standards development and implementation. We developed the paper, "Appropriate Use of Numeric Chemical Water Quality Criteria" (1996) where we advocated that US EPA water quality criteria and state standards based on these criteria should be used as triggers for indicating potential water quality problems in which the entity responsible for any discharge/runoff that exceeds a water quality standard is provided the opportunity to demonstrate on a site-specific basis whether this exceedance represents a real water quality use impairment in the receiving waters for the runoff. While initially this approach would be more expensive than the current approach of simply monitoring runoff waters and then assuming that any exceedance of a water quality standard for a regulated constituent represents a significant use impairment in the receiving waters for the runoff, it would eventually lead to a low-cost, technically valid approach for formulating cost-effective stormwater runoff management programs that are based on controlling chemical impacts rather than chemical concentrations.

Exceedance Frequency

One of the areas that contributes to the highly over-protective nature of the Agency's arbitrarily developed exceedance frequency of only one exceedance of a criterion value in a particular discharge of any magnitude every three years. An exceedance of any magnitude that occurs more frequently than once every three years is a violation of an NPDES permit under current US EPA water quality criteria and state standards implementation approaches. While the State Water Resources Control Board in its receiving water language associated with the Environmental Health Coalition appeal of the San Diego Regional Board's Orange County stormwater permit included wording to the effect that a single exceedance should not cause the initiation of the BMP ratcheting-down process, I understand that the US EPA Region 9 has indicated that they will not approve an NPDES stormwater permit with that provision in the permit. This means that NPDES stormwater discharges must meet the same frequency of exceedance limitations as NPDES wastewater discharges of no more than one exceedance of any magnitude for any parameter every three years.

There are some who feel that a frequency of exceedance of water quality standards on the order of 5% could be more appropriate than the current once every three years which is a frequency of exceedance of about 0.1%. While the 5% would be protective and provide considerable relief for POTW type discharges, adoption of this approach will not

eliminate the problems for urban area and highway stormwater runoff with respect to the exceedance of several heavy metal criteria/standards. With few exceptions, these accedences occur with each stormwater runoff event and therefore changing the frequency of exceedance from 0.1% to 5%, while in the right direction for wise use of public funds for protecting aquatic life-related beneficial uses, would not eliminate the overly-protective nature of the criteria when applied to urban area and highway stormwater runoff. Raising this exceedance frequency to the 5% level may not in itself provide significant relief to urban area and highway stormwater runoff water quality managers for certain of the heavy metals and possibly certain organics which cause exceedance of the water quality standards in each runoff event. Raising the exceedance frequency, coupled with other adjustments of the standards/discharge limits could provide considerable relief to urban area and highway stormwater runoff water quality managers from the over-regulation that is occurring now and still be protective of the beneficial uses of the receiving waters for the runoff.

Diazinon Water Quality Criterion

Several years ago, the US EPA began to develop a water quality criterion for diazinon, an organophosphate pesticide that has been found to be a widespread cause of urban stormwater runoff aquatic life toxicity throughout California and many other places in the US where it has been examined, as well as Canada. Diazinon and chlorpyrifos as well as other organophosphate pesticides are used by homeowners, commercial establishments and industry for residential, structural and lawn and garden pest control. Stormwater runoff throughout California has now been documented to be highly toxic to certain forms of zooplankton (Ceriodaphnia) which are considered key components of larval fish food. At this time, diazinon is one of the unregulated chemical constituents in urban area stormwater runoff that could be adverse to the beneficial uses of receiving waters for the runoff. By being unregulated it is meant that there are no water quality criteria/standards upon which excessive concentrations of diazinon could be readily assessed. While regulatory agencies have narrative standards for the control of toxicity, the implementation of these standards in the case of urban area stormwater runoff to control toxicity from diazinon and chlorpyrifos is being met with substantial opposition by agricultural interests, pesticide manufacturers and formulators. While this problem is an urban stormwater runoff problem, similar kinds of problems occur with agricultural stormwater runoff for diazinon and other pesticides/herbicides.

A number of groups concerned about this urban stormwater runoff diazinon toxicity problem have recommended to the US EPA that they reactivate the former efforts and develop diazinon water quality criteria. While three years ago those responsible within the Agency for establishing priorities indicated that they did not plan to develop a diazinon criterion, two years ago the Agency reversed its position and was working toward this goal. In August 1997, the US EPA Criteria and Standards group in Washington, D.C. released a so-called US EPA "fact sheet" which listed the new criteria under development. That "fact sheet," which was dated August 1997, indicated that by September 30, 1997 the diazinon criterion would be available for public review. Within approximately one month from when the "fact sheet" was published and when the

criterion was to be released, the Agency gave a low priority for finalizing the criterion which must have been very close to being final at the time of publication of the "fact sheet." I checked further into this matter by calling the person listed on the "fact sheet" as the contact for further information. While he did not discuss the reasons for the change in the Agency's position, it was his statement that the Agency had assigned other higher priorities to the staff's time than completing the diazinon criterion document so it could be reviewed by the public.

I know from discussions with others, that there is considerable political pressure on the Agency and within the Agency to not develop new water quality criteria for pesticides. It is difficult for me to understand how the Agency which can publish a "fact sheet" dated within one month of the date that states within the "fact sheet" when the final criterion document will be released, to suddenly change its priorities and assign staff and other resources to other activities, especially in light of the fact that diazinon has now been well documented to be probably one of the most important causes of urban area stormwater runoff toxicity. The toxicity of diazinon and chlorpyrifos causes them to be ranked as one of the most important, if not the most important, chemical constituents in urban area stormwater runoff that are, in fact, potentially adversely impacting the beneficial uses of the runoff receiving waters.

Endangered Species Act Implications

Recently, I have become aware that the US Fish and Wildlife Service (USFWS) is concerned about mercury, selenium, pentachlorophenol and dissolved metals criteria in connection with the proposed implementation of the California Toxics Rule. The USFWS has considerable potential clout in influencing regulations that could impact endangered species within the Sacramento River watershed and Delta. If the USFWS prevails, then the California Toxics Rule heavy metal criteria could have to be implemented as total recoverable metals rather than dissolved metals as currently proposed by the US EPA. While I am not familiar with the basis for the USFWS's concern about dissolved metal criteria, these issues have been raised by a number others in connection with particulate metals accumulating in receiving water sediments where they are adverse to aquatic life within or upon the sediments. It has been the US EPA's position that the regulation of sediment quality should be done by sediment quality criteria/guidelines and not through water quality criteria. I strongly support this position as a technically valid approach for assessing the water quality significance of particulate heavy metals in urban area and highway stormwater runoff where the sediment quality evaluation is based on biological effects, i.e. toxicity, bioaccumulation, and not on chemical concentrations. Dr. Jones-Lee and I have published extensively on this topic. Copies of our papers are available on our website under the sediment quality section.

Mercury

Mercury is a chemical that could become a constituent of concern for urban area and highway stormwater runoff especially when US EPA decreases the water quality criterion for total recoverable mercury to about 5 ng/L**.** The current water quality criterion to

protect against excessive mercury bioaccumulation in fish that represents a threat to those who use the fish's food is 12 ng/L. While the California Toxics Rule will increase the criterion for mercury bioaccumulation to 50 ng/L, this increase is administrative and is a result of a change in the approach being used to develop the criterion values**.** As a result of the national mercury reviews being conducted by the US EPA, the criterion will likely decrease in a year or so to about 5 ng/L. The ultimate decrease of the mercury criterion/standard to about 5 ng/L reflects an adjustment in the potential threat that mercury represents to pregnant women/fetuses and the increased fish consumption rates for populations of people that consume more than one meal of fish from local waters per month. There is substantial evidence that some populations consume more than one meal of locally caught fish per week, and in some cases several meals per week. This increased consumption rate necessitates a decrease in the water quality criterion for mercury.

Typically, stormwater runoff and ambient water monitoring programs do not measure mercury with sufficient sensitivity to determine mercury at the existing, much less new or soon to be promulgated mercury criterion values**.** As a result of the US EPA decreasing the critical levels of mercury in fish tissue used as food, fish in many waterbodies are being found to contain excessive mercury. While there is limited data on the mercury content of urban stormwater runoff recently it has been found that the city of Sacramento stormwater runoff monitoring program has reported mercury in the runoff waters at concentrations well above the existing water quality criterion of 12 ng/L. This is of particular significance since the Sacramento River from Shasta to below Sacramento is on the Central Valley Regional Water Quality Control Boards 303(d) list for use impaired water quality due to excessive mercury in fish. The stormwater discharge of mercury above the water quality criterion for bioaccumulation to a waterbody in which the fish have excessive mercury could result in having to develop BMPs to control mercury in stormwater runoff as part of a TMDL process.

The key to assessing whether there is a problem with stormwater runoff mercury is to first determine whether the fish in the receiving water for the runoff waters contain excessive mercury based on US EPA guideline values. The critical value is 0.14 mg/Kg mercury in edible tissue for a fish consumption rate of one meal per week of fish taken from the local waterbody of concern. If excessive mercury is found in fish tissue, then studies should be done to determine if the stormwater runoff is a source of mercury of greater than about 5 ng/L. Before these studies are conducted, it is important to determine whether the elevated concentrations of mercury have been properly measured. It is difficult to reliably determine mercury at the few ng/L concentration range without contaminating the sample.

If mercury is found in the runoff waters above the 5 ng/L amount, then studies should be conducted to determine if mercury in the runoff waters is in a bioavailable form when present in receiving waters/sediments for the runoff. This information would enable the stormwater managers and the regulatory agencies to determine whether there is need, from a technical perspective, to control the mercury in the urban area stormwater runoff through the BMP racheting down process to achieve the water quality standard in the discharge waters. If it is found that the mercury above the water quality criterion/standard

is in non-bioavailable forms and/or the fish in the receiving water do not have excessive mercury in their edible flesh, then the mercury problem is an administrative problem related to the overprotective nature of the US EPA water quality criterion for mercury from many sources and in many waterbodies.

Additional information on the changes in regulation of mercury are available in a poster session paper, "Development of Technically Valid, Cost-Effective Hg Control for Sacramento River Delta & Upper San Francisco Bay" (1997), that was presented at the national Society for Environmental Toxicology and Chemistry meeting that was held in November 1997. A copy of the poster items covering this presentation is available from my web site in the water quality - wastewater section.

As discussed in our paper, it is important to understand that the exceedance of a US EPA water quality criterion for mercury does not necessarily mean that excessive mercury bioaccumulation will occur in the receiving water fish. The US EPA criterion for controlling bioaccumulation is based on worst-case assumptions of the mercury being in a form that can be methylated at a sufficient rate by certain forms of bacteria to form methylmercury that bioaccumulates in edible fish tissue to excessive levels for human consumption. There are many situations where excessive mercury concentrations occur in waterbodies relative to US EPA worst-case water quality criteria/standards without excessive bioaccumulation of mercury. The basis for regulating mercury should be based on excessive edible tissue levels, not exceedance of the worst-case mercury criterion. If the fish and other aquatic life in the receiving waters for a particular discharge do not have excessive mercury in their tissue, then the stormwater dischargers should work with the regulatory agencies to obtain a variance from the worst-case mercury criterion/standard based on the fact that the mercury from a particular source as well as other sources to a particular waterbody is in chemical forms that are not convertible to methylmercury at a sufficient rate to lead to excessive bioaccumulation in fish tissue.

I am part of a CVRWQCB Cache Creek Hg TMDL group that is formulating a TMDL for mercury present in Cache Creek (a tributary of the Yolo Bypass for the Sacramento River system). Thus far, this group is focusing part of its efforts on defining the forms of mercury derived from former mining operations in the Cache Creek watershed that lead to excessive mercury bioaccumulation within Cache Creek and its tributaries fish as well as the Delta and San Francisco Bay. Based on recent meetings of "experts" in this area, it appears that only a small part of the total mercury transported by Cache Creek each year in high winter flows is in a bioavailable form.

In addition to concern about mercury bioaccumulation in fish being potentially adverse to people who eat the fish, there is also concern that mercury bioaccumulation in various forms of aquatic life, including fish and insects, could be adverse to higher trophic level organisms, such as birds, who use the aquatic organisms as food. This is an area of considerable research at this time which could ultimately influence the mercury water quality criterion/standard to even lower levels than those that will be adopted by the US EPA within a year or so. These issues have been reviewed by Dr. Jones-Lee and me in a

report, "Summary of Issues Pertinent to Regulating Bioaccumulatable Chemicals" (1996), available from our web site.

Chromium VI

Chromium VI may become a constituent of concern of urban area and highway stormwater runoff. It has been found to be highly toxic to some common forms of zooplankton that are important sources of larval fish food**.** The critical concentration of chromium VI is about 0.5µg/L. This is a factor of 20 less than the US EPA chronic criterion for chromium VI of 10 µg/L. The US EPA chose not to include the chromium VI zooplankton data to adjust the chromium VI criterion value as part of developing the chromium VI chronic criterion. As discussed herein, there is considerable controversy about the appropriateness of this approach since while chromium VI is not directly toxic to fish at about 1µg/L it is toxic to larval fish food.

The chemistry of chromium VI is such that it does not enter into the types of reactions that tend to detoxify other heavy metals such as precipitation, sorption, and complexation. Finding chromium VI in ambient waters at concentrations above about 0.5µg/L could represent toxic conditions that would be regulated under regional board's Basin Plans toxicity objective. The analytical methods normally used for measuring chromium VI in stormwater runoff and in ambient waters do not have sufficient sensitivity to detect chromium VI at potentially toxic levels. Therefore some of the urban area stormwater runoff toxicity that is being found could be due to chromium VI. Standard Methods includes a method for measuring chromium VI at about 1µg/L. This method should be used in storm water runoff and ambient water monitoring programs to screen for potential chromium VI toxicity.

I have published several papers/reports on the chromium VI regulatory issues including "Chromium Speciation: Key to Reliable Control of Chromium Toxicity to Aquatic Life" that was presented at the American Chemical Society national meeting that was held in spring 1997. I also have a paper in press "Under-Regulation of Chromium in Ambient Waters" that is available in pre-print form. Both of these papers are available from my web site.

Protection of Zooplankton from Aquatic Life Toxicity/Chromium VI and OP Pesticide Toxicity

I have recently become aware that the US EPA, as part of developing its water quality criteria for potentially toxic chemicals, such as chromium VI, does not necessarily include the protection of zooplankton which can be important components of larval fish food in developing the criterion. While zooplankton toxicity data is used as part of the eight family database that is needed to develop a criterion, and it can be included in the four lowest toxicity data sets, zooplankton toxicity is not used to influence the geometric mean of the criterion value. If an important fish species is found to be more sensitive than the formula-calculated criterion values then the toxicity to that fish species becomes the dominant factor in setting the criterion. A similar approach is not used for zooplankton.

This situation leads to one in which the US EPA criteria would not be protective of zooplankton. Also, a criterion value would not conform to protecting aquatic life in accord with the regional boards' Basin Plan objectives.

Several of the state of California regional water quality control boards have Basin Plan objectives which require the protection of zooplankton from aquatic life toxicity. In this respect, for certain chemicals such as chromium VI which is toxic to zooplankton at a factor of 20 or more lower concentration than to fish, it is found that the US EPA criterion is potentially not protective of fish populations by protecting larval fish food resources from aquatic life toxicity.

As part of my discussing the chromium III and chromium VI issue with various individuals within the US EPA, I found that there is considerable disagreement within the Agency about the appropriateness of claiming that fish populations are protected by the chromium VI criterion values when the criterion does not adequately reflect zooplankton toxicity. Based on my experience, if the levels of chromium VI toxicity found by a number of investigators to zooplankton were occurring to fish, the chromium VI criterion would be decreased by at least a factor of 20 or more. This issue of zooplankton toxicity is going to become extremely important in the Central Valley area as well as in Orange County and ultimately throughout the state as part of 303(d) listings of waterbodies where there is organophosphate pesticide toxicity in urban area and agricultural stormwater runoff. The Central Valley Regional Water Quality Control Board's Basin Plan has a water quality objective which prohibits toxicity to zooplankton and other aquatic life. There are exceedances of this objective with every urban area stormwater runoff event, as well as due to airborne transport of agriculturally used diazinon associated with its application as a dormant spray in orchards in the winter. This causes rainfall, fogfall and mist to be highly toxic to certain forms of zooplankton throughout over 200 miles of the Sacramento Valley.

This 303(d) listing of these waterbodies has already led to a TMDL to be developed by the Santa Ana Regional Water Quality Control Board and will lead to a TMDL development by the Central Valley Regional Water Quality Control Board associated with diazinon and chlorpyrifos zooplankton toxicity. How this situation ultimately plays out will be important in determining how regulatory agencies ultimately address the urban area and highway stormwater runoff toxicity problem.. This problem cannot be addressed through conventional stormwater BMPs since the toxic component will pass through these conventional BMPs with little or no removal.

It should be noted that domestic wastewater treatment plants are having to eliminate diazinon and chlorpyrifos toxicity in their wastewater discharges in order to produce a non-toxic effluent at the point of discharge. There are situations where POTW managers have had to control toxicity to zooplankton due to these chemicals in their wastewater discharges, yet the discharge goes into a stream which is highly toxic during stormwater runoff events due to the same chemicals. There is a significant inconsistency in the approach used by the US EPA in regulating aquatic life toxicity due to these chemicals that ultimately will need to be resolved. If any of the Task Force members wish

additional information on the inconsistent approach being used with regard to regulating zooplankton toxicity in domestic wastewater discharges versus stormwater runoff, please contact me. I have a several page letter dated December 22, 1997 from R. Perciasepe which discusses these issues which I can make available to those who are interested. Basically this letter discusses the current regulatory framework that leads to the inconsistent approach that is being used to regulate zooplankton toxicity in domestic wastewater discharges versus stormwater runoff.

Lead

The Department of Toxics Substances Control (DTSC) has recently proposed to decrease the concentration of lead in wastes such as the sediment associated with urban area and highway stormwater runoff to become classified as a hazardous waste from 1000 mg/Kg to 700 mg/Kg. Under the proposed approach, soils or sediments that become wastes will have to be handled as a special waste under DTSC's hazardous waste classification procedure. This procedure could allow special wastes to be deposited into a municipal landfill as opposed to a hazardous waste landfill if the municipal waste owner/operator obtains new waste discharge requirements from a regional board so that it could take such "hazardous" waste. Under the current approach, soils with lead above 1000mg/Kg are a hazardous waste that must be managed in a hazardous waste landfill. With the new proposed approach, soils or sediments with lead above 700 mg/Kg would be a hazardous waste in a special waste category. The adoption of this proposed critical value of lead in soils/sediments could become significant to many urban area and highway stormwater runoff water quality managers through having to manage, as a hazardous waste, sediments that have accumulated in stormwater conveyance structures and in BMPs with lead concentrations above 700 mg/Kg.

The technical basis for lowering the hazardous waste classification concentration from 1000 to 700 mg/Kg is based on the potential impact of lead in soils above this concentration representing a threat to earthworms. I am in the process of reviewing this matter and will provide additional information on it when my review is completed. My preliminary findings are that the technical basis for DTSC's proposed lowering of the hazardous waste classification critical concentration of lead from 1000 to 700 mg/Kg is not based on a valid assessment of the potential for lead in soils to be adverse to earthworms. To my knowledge, this is the first time that any agency has proposed to protect soil organisms from toxicity due to chemical constituents. Since many soils in urban areas and near highways have lead above 700 mg/Kg with no apparent impacts on soil organisms, it is likely that the tests that were used to show that earthworms were affected by lead in soils above 700 mg/Kg where toxic available forms of lead were added to a synthetic soil under laboratory conditions, do not reflect the bioavailable forms of lead that are typically present in urban area and near highway soils. Further the US EPA is not requiring the Superfund sites to clean up lead-containing soils to this level in order to protect earthworms who might inhabit the soils after the site has been remediated.

Conclusions

I hope my discussion of these issues provides the Task Force with some insight into the variety of factors that influence the development of water quality criteria and state standards based on these criteria. While the numeric criteria/standard values are treated by the regulatory agencies as highly precise absolute standards where an exceedance that occurs more than once every three years represents an impairment of beneficial uses of the waterbody, it is well known by those who understand how these criteria/standards are developed and implemented that a variety of factors influence the relationship between the numeric standard value and real water quality use impairments that are not incorporated into the current regulatory approaches. Significant exceedance of water quality criteria/standards can readily occur without adverse impacts to the beneficial uses of waterbodies. Further, adverse impacts to beneficial uses can occur without exceeding water quality standards for both regulated and unregulated constituents. It is for this reason that the chemically-based approach of focusing on chemical concentrations and loads must be abandoned in favor of a chemical impact approach focusing on toxicity, excessive bioaccumulation and other use impairments of waterbodies.

If there are questions about these comments, please contact me.

Fred

Reference as:"Lee, G.F., 'Comments on Selected Issues that Influence the Application of Water Quality Standards to Urban Area and Highway Stormwater Runoff Water Quality Management,' Submitted to D. Brent and R. Boon, State Stormwater Quality Task Force, Sacramento, CA April (1998)."