Urban Stormwater Runoff Water Quality Management Issues
and San Joaquin River Nutrient Control Issues

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Regulation of Urban Stormwater Runoff Water Quality Impacts

Recently, several items have been distributed through the SJR TMDL e-mail list concerned with urban stormwater runoff water quality management issues, including a statement regarding the recent decision by the 9th Circuit Court on compliance with water quality standards. There may be some confusion about how urban stormwater runoff water quality impacts are being regulated, especially in light of the recent 9th Circuit Court decision in which the judge ruled that the environmental organizations petition was not appropriate. That petition requested that urban stormwater runoff be regulated the same as domestic and industrial wastewater discharges where this runoff must meet water quality standards in the runoff waters. The background to this situation is that the 1987 Clean Water Act revision required that the US EPA develop an urban stormwater runoff water quality management program. In 1990 the US EPA promulgated this program where during Phase I urban areas with populations greater than 100,000 must obtain NPDES permits governing their stormwater runoff. This fall the US EPA will release its Phase II requirements which will lower the urban population that must meet these requirements.

The Agency requires that pollution caused by NPDES permitted urban area stormwater runoff be controlled to the maximum extent practicable using best management practices (BMPs). Section 502 (19) of the Clean Water Act states *"The term 'pollution' means the man-made or man-induced alteration of chemical, physical, biological, and radiological integrity of water."* Generally this is interpreted to mean that a pollutant is a constituent or condition that impairs the designated beneficial uses of a waterbody.

Controversy has arisen as to whether NPDES permitted urban area stormwater runoff can not cause or contribute to violations of water quality standards, including narrative standards. In January 1998, US EPA Region 9 and headquarters in Washington, D.C., reaffirmed the agency's previous position that ultimately NPDES permitted urban area stormwater runoff must meet water quality standards in the runoff waters. This requirement established a BMP ratcheting down process where urban area stormwater management agencies must work with the water pollution control agencies to develop ever more stringent BMPs to control violations of water quality standards for constituents in NPDES permitted urban area stormwater runoff. Neither the US EPA nor the state or regional water quality control boards established a time table by which the BMP ratcheting down process would achieve compliance with water quality standards for constituents in the stormwater runoff.

A number of environmental groups have indicated that they plan to take legal action to ensure that NPDES urban stormwater runoff permits require the stormwater be managed in such a way to not cause or contribute to violations of water quality standards at the point of discharge to ambient waters. Several environmental groups in Arizona filed a petition designed to review US EPA NPDES permits for five Arizona municipalities, claiming that the US EPA should have required numeric limitations in the permits to ensure compliance with state water quality standards. This appeal was reviewed by the US 9th Circuit Court of Appeals. On September 15, 1999, the 9th Circuit Court denied the petition. A copy of the Court's decision will soon be available from G. Fred Lee's website, www.gfredlee.com, in the Water Quality Stormwater section.

The 9th Circuit Court determined that since the US Congress, in revising the Clean Water Act in 1987, did not mandate that urban stormwater runoff shall be required to meet water quality standards, the US EPA has discretionary power in determining the appropriate degree of management/treatment of urban area stormwater runoff to comply with Clean Water Act requirements. The final two paragraphs of the decision state:

"[8] Although Congress did not require municipal storm-sewer discharges to comply strictly with S 1311 (b)(1)(C), S 1342 (p)(3)(B)(iii) states that "[p]ermits for discharges from municipal storm sewers ...shall require...such other provisions as the Administrator...determines appropriate for the control of such pollutants." (Emphasis added.) That provision gives the EPA discretion to determine what pollution controls are appropriate. As this court stated in NRDC II, "Congress gave the administrator discretion to determine what controls are necessary....NRDC's argument that the EPA rule is inadequate cannot prevail in the face of the clear statutory language." 966 F.2d at 1308."

"[9] Under that discretionary provision, the EPA has the authority to determine that ensuring strict compliance with state water-quality standards is necessary to control pollutants. The EPA also has the authority to require less than strict compliance with state water-quality standards. The EPA has adopted an interim approach, which "uses best management practices (BMPs) in first-round storm water permits...to provide for the attainment of water quality standards." The EPA applied that approach to the permits at issue here. Under 33 U.S.C. S 1342(p)(3)(B)(iii), the EPA's choice to include either management practices or numeric limitations in the permits was within its discretion. See NRDC II, 966 F.2d at 1308 ("Congress did not mandate a minimum standards approach or specify that [the] EPA develop minimal performance requirements."). In the circumstances, the EPA did not act arbitrarily or capriciously by issuing permits to Intervenors."

"PETITION DENIED."

While the interpretation of the 9th Circuit Court ruling will evolve, it appears that for now there will be a period of time where conventional, non-structural and structural BMPs, such as detention basins, grassy swales, etc., that obviously will not manage/treat urban area and highway stormwater runoff associated constituents so that they do not cause or contribute to violations of water quality standards at the point of discharge, ultimately the US EPA can implement its previously announced policy of requiring full compliance with water quality standards. The US EPA has not established a period of time for compliance with water quality standards. Unofficially, statements of ten years or so are sometimes made about this period. However, it is likely, through environmental group litigation within five to seven years, when it is clear that the BMPs that have been implemented are not achieving water quality standards in the stormwater runoff, the courts may decide that the current BMP ratcheting down process is not effective in achieving water quality standards and require that more effective BMPs be implemented.

Meanwhile, there is considerable effort underway by various organizations (Association of Metropolitan Sewerage Agencies, National Association of Counties, National Association of Flood and Stormwater Management Agencies, National League of Cities, US Conference of Mayors, and the Water Environment Federation) to have Congress revise the Clean Water Act to clarify the need to comply with water quality standards in urban area stormwater runoff. Ultimately, this issue will likely be decided by Congress as part of the revision of the Clean Water Act.

I have been active with the State Stormwater Quality Task Force over the last half dozen years. This Task Force consists of about 100 individuals who meet every two months to review issues pertinent to regulating urban area stormwater runoff water quality impacts. For the past year and a half I have initially chaired the Stormwater Science Workgroup and now chair the Stormwater Compliance Cost Workgroup. In the fall of 1998 I worked with several other members of the Task Force in developing an assessment of potential water quality standards compliance problems for urban area and highway stormwater runoff. I developed an overview discussion, "Assessment of Potential Urban Area and Highway Stormwater Runoff Water Quality Standards Compliance Problems," Lee(1998), which was issued as a report to the Task Force and was published in the fifth issue of our Stormwater Runoff Water Quality Science/Engineering Newsletter. This and other Newsletter issues are available from our website, www.gfredlee.com.

As discussed in this report, urban area and highway stormwater runoff typically contains a number of heavy metals such as copper, lead, zinc, and occasionally cadmium at concentrations which will cause violations of US EPA worst cased based water quality criteria, and state standards based on these criteria, at the point of discharge. Urban area stormwater runoff also contains excessive concentrations of fecal coliforms which can cause violations of sanitary quality contact recreation standards. Further, urban stormwater runoff contains the organophosphate pesticides diazinon and chlorpyrifos that cause the stormwater runoff to be toxic to *Ceriodaphnia* at the point of discharge.

Control of Algal Nutrients

In those areas where receiving waters for the NPDES permitted urban area stormwater runoff experience excessive algal growths, which either cause dissolved oxygen depletion below water quality standards and/or nuisance growths of algae that impair recreational use of a waterbody, and regulatory agencies have listed the waterbody as an impaired waterbody which placed it on the 303(d) list which results in the development of a total maximum daily load (TMDL) to control nutrient inputs to the waterbody, the urban area stormwater runoff management agency will have to control nitrogen and/or phosphorus in the urban area stormwater runoff in order to comply with the TMDL requirements.

It is important to note that while there are no water quality standards for nitrogen or phosphorus that relate to controlling excessive growths of algae, the US EPA, as part of its Clean Water Action Plan (1998), has announced that it plans to require by 2003 that states adopt nitrogen and phosphorus standards which will be implemented the same as the heavy metal and other standards where an exceedance of these standards will lead to the 303(d) listing and TMDL development. There is considerable controversy about the appropriateness of the US EPA's approach for developing nutrient water quality standards. As discussed by Lee and Jones-Lee (1998a), if the US EPA proceeds as announced in developing numeric water quality standards for nitrogen and phosphorus compounds with respect to excessive fertilization of water bodies, it will almost certainly lead to significant inappropriate regulation of excessive fertilization problems. It has been well demonstrated through numerous studies conducted in the 1960s and 1970s that it is not possible to use nutrient concentrations in discharges to a waterbody to estimate the impacts of the nutrients on the algal related water quality of the waterbody. Site specific evaluations have to be made of nutrient load-eutrophication response relationships to determine the appropriate nutrient load.

For phosphorus limited water bodies, i.e., where the maximum algal biomass is controlled by the phosphorus input to the waterbody and the associated available phosphorus concentrations within the waterbody, Vollenweider OECD phosphorus load eutrophication response relationships are highly reliable in predicting the amount of planktonic algal chlorophyll, water clarity controlled by algae, and hypolimnetic oxygen depletion rates. These relationships have been described by Jones-Lee and Lee (1986). These relationships evolved out of a 50 million dollar, five year, twenty two country, two hundred waterbody OECD study that was conducted in the 1970s in Western Europe, North America, Japan, and Australia. Similar relationships have not been developed for nitrogen limited waterbodies where algal biomass is controlled by available nitrogen concentrations. Nitrogen limitation in freshwater waterbodies is somewhat unusual. It occurs only in certain areas, such as on the west coast; nitrogen limitation almost never occurs in freshwater waterbodies in the east and mid-west. It is estimated that algal growth is limited by phosphorus in 80-90% of all freshwater waterbodies in the world.

While based on algal stoichiometry (chemical composition), the growth of algae in the San Joaquin River near Stockton appears to be potentially limited by nitrate and ammonia inputs. Based on recent review by Tom King of CVRWQCB, it may be possible to limit algal growth in this system through limiting phosphorus inputs to the waterbody. It is for this reason that I have recently recommended that both nitrogen and phosphorus be considered in urban and agricultural BMP efficacy and cost evaluations. Typically, phosphorus control is much easier/less costly to implement that nitrogen control.

One of the issues that should be considered in a proper evaluation of nutrient loads/ eutrophication response in a waterbody, such as the San Joaquin River Deep Water Channel, is the period of the year when excessive fertility problems cause a water quality use impairment. In the San Joaquin River Deep Water Channel low dissolved oxygen concentrations begin to occur mid-summer and persist through the fall. An issue that needs to be addressed is what role do algae play in contributing to the low DO that occurs in the San Joaquin River Deep Water Channel. While this role is not fully defined there can be little doubt, from the information available, that algae developed both within the Deep Water Channel area and upstream contribute to the low DO problem.

Another issue that has to be addressed for waterbodies, in which the hydraulic residence time (filling time) is greater than one year and principal flow to the waterbody occurs during the time of the year when excessive algal growth is not occurring (i.e., such as in the San Joaquin River Deep Water Channel), is what flows carrying nutrients and/or algae to the waterbody which stimulate algal growth that results in significant oxygen depletion associated with the water quality problem caused by the algae. As discussed in previous correspondence, the stormwater runoff from urban and agricultural land as well as wastewater discharges to the San Joaquin River and its tributaries that occur in late fall, winter, and early spring do not stimulate large amounts of algal growth and do not significantly contribute to the low DO problem that occurs in the San Joaquin River Deep Water Channel. Beginning in late spring/early summer, nutrients added to the San Joaquin River System begin to grow significant algae which, through their death and sedimentation, contribute to the oxygen depletion in the Deep Water Channel. At this time, the coupling between nutrients added to various parts of the San Joaquin River and algal growth and, in turn, algal growth and low DO in the Deep Water Channel are poorly understood. This is one of the primary areas of investigation by the SJR Low DO TMDL Technical Committee.

Excessive growths of algae and their control in waterbodies is an area that Dr. Jones-Lee and I have worked on for the past 40 years. Recently, through the SJR e-mail network, Kevin provided a write-up on a USGS study in Madison, Wisconsin concerned with urban stormwater runoff nutrient issues. I taught at the University of Wisconsin at Madison from 1960 to 1973 where I developed and directed the Water Chemistry Program. In that capacity, my graduate students and I conducted the first work ever done on urban area stormwater runoff nutrient water quality impacts. In that work we developed nutrient export coefficients for urban areas which provide information on the amounts of nitrogen and phosphorus in urban area stormwater runoff. While they were originally developed for the Madison area, they have been evaluated in many other communities and have been found to be reasonably constant independent of location. As discussed in a recent SJR email on nutrient export coefficients, there is need to establish the amounts of nitrogen and phosphorus exported from urban areas in the San Joaquin Valley.

One of the issues that has to be considered in some parts of Stockton, which is different than many areas, is that there is a summer dry weather flow nutrient contribution to local water bodies. This summer dry weather flow is derived from urban fugitive irrigation water, as well as potentially high ground water infiltration into the storm sewer system. It potentially could contribute significant amounts of nutrients which would tend to stimulate excessive growths of algae during the critical period of the year. This is an area that needs investigation in Stockton and the other communities whose stormwater system discharges to the San Joaquin River or its tributaries.

Potential Impact of Safe Drinking Water Act Requirements

Another factor that could readily influence the need to control nutrients in the San Joaquin River watershed is the current effort at source control for domestic water supplies as part of the Safe Drinking Water Act. Water utilities are facing the problem of managing trihalomethane (THM) precursors. Excessive algal growth in a water supply source leads, under certain conditions, to increased THMs being produced in domestic water supplies. This has already been experienced in the City of Los Angeles water supplies that use Delta water as a source. THMs are of concern because they include a variety of chlorinated organics, like chloroform, which are regulated as carcinogens. In order to reduce the amount of THMs being formed, the sources of THM precursors, which are primarily dissolved organic carbon, are being investigated and likely will have to come under control. This issue is being addressed in the Sacramento River watershed as part of potential problems for the Delta and down-Delta water supply users. Ultimately it will need to be addressed in the San Joaquin River system. For additional information, consult the discussion on nutrient algae water quality issues papers that I have developed for the Sacramento River watershed. These are available in the Sacramento River Watershed section of my website.

In addition to focusing on nutrient control, there will be need to control dissolved organic carbon (DOC) sources as well. Agricultural stormwater runoff and irrigation return flows, as well as urban stormwater runoff and domestic wastewaters, are all sources of DOC that may ultimately, through the Safe Drinking Water Act, be required to be controlled at the source. Within a few years there could readily be a TMDL on DOC in the Delta which would require control of DOC input from upstream sources, including algae that under certain conditions could lead to DOC formation. Several years ago I developed an invited review paper on these issues for the University of California Water Resources Center annual conference. This paper, "Regulating Drinking Water Quality at the Source", discusses the relationship between algae and DOC as it may impact water supplies raw water quality is available from my website.

Excessive Fertilization of Delta Waters

The concentration of nutrients within the Delta are such that these waters would support excessive growths of algae. However, because of short residence time and color which restricts the light penetration, excessive algal growths are generally not a problem within the Delta. However, floating macrophytes, water hyacinths, are a severe problem that interfere with recreational use of the Delta. They may also be contributing to the DOC in Delta waters. The Department of Water Resources practices an extensive water hyacinths spraying program within the Delta. This program has recently come under scrutiny by the DeltaKeeper for failing to obtain a permit. The presence of water hyacinths within the Delta and the excessive growths of algae in water utilities water supply reservoirs that use Delta water as a source could become the basis for limiting algal nutrient inputs to the Delta from the San Joaquin and Sacramento Rivers as part of implementing US EPA water quality nutrient criteria.

Generally, from an ecological-fisheries production perspective, it is said that fish production within the Delta is limited by inadequate primary and secondary production. The problem seems to be related in part to consumption of algae by non-native clams that cover parts of the Delta channels. Lee and Jones-Lee (1991) demonstrated a direct relationship between nutrient loads to waterbodies and fish production. Restricting nutrient inputs to the Delta will likely further impair fisheries production within the Delta.

Summary

In summary, in addition to controlling nutrient inputs to the San Joaquin River as part of complying with the TMDL to prevent dissolved oxygen in the Deep Water Channel from decreasing below 6 mg/L from September 1st through November 30th and 5 mg/L from December 1st through August 31st as part of complying with CVRWQCB Basin Plan requirements, there are several other evolving regulatory requirements such as the US EPA's aquatic plant nutrient criteria that are being developed, as well as the Safe Drinking Water Act requirements for control of DOC that will likely influence allowed discharges of nutrients and DOC to the San Joaquin River system from agricultural and urban areas, as well as domestic and industrial wastewater discharges. As part of planning and implementing the TMDL requirements that evolve out of the low DO TMDL, it will be important to consider the potential impact of these additional regulatory requirements that will certainly come into play in ultimately controlling the nutrient inputs to the San Joaquin River. While the low DO TMDL nutrient control programs should focus on those nutrients that impact the low DO that occurs during the summer and fall, it is possible that the other regulatory requirements could broaden the period of time needed to control nutrient inputs to the Delta because of the impacts of these nutrients on downstream water supplies.

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

Fred

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