Stormwater Runoff Water Quality Science/Engineering Newsletter

Devoted to Urban Stormwater-Runoff Water Quality Management Issues

* * * * *

Volume 2 Number 2
October 16, 1999

Editor: Anne Jones-Lee, PhD
Contributor to This Issue:
G. Fred Lee, PhD, PE, DEE

* * * * *

Urban Stormwater Runoff Compliance with Water Quality Standards

Preface to Newsletter Volume 2, Number 2

Ninth Circuit Court Ruling on Compliance with Water Quality Standards

This issue of the Newsletter presents a discussion of several areas that are pertinent to regulating urban area and highway stormwater runoff water quality impacts. It includes an overview review of the Ninth Circuit Court ruling regarding the need for the US EPA Region IX to include compliance with numeric water quality standards in municipal stormwater NPDES permits issued to several Arizona cities. The Ninth Circuit Court has recently ruled that the US EPA has discretionary authority to issue municipal stormwater NPDES permits that do not at this time require strict compliance with US EPA numeric water quality standards. This ruling reinforces the current US EPA regulatory approach involving a BMP ratcheting down process to ultimately achieve control of constituents in NPDES permitted urban area and highway stormwater runoff so that stormwater runoff associated constituents do not cause or contribute to violations of water quality standards.

Overview of Approaches for Assessing the Appropriate Degree of Treatment of Urban Stormwater Runoff

The second section of this Newsletter presents an overview outline of an approach that can be used to determine the appropriate degree of stormwater runoff associated constituent control to protect beneficial uses of receiving waters without significant unnecessary expenditures.

Sanitary Quality Issues Associated with Urban Stormwater Runoff

The third section of this Newsletter is concerned with regulating municipal stormwater runoff impacts associated with violations of fecal coliform standards for contact recreation.

These overview outline discussions summarize key issues that stormwater management agencies and regulatory agencies should be reviewing as part of developing technically valid, cost effective stormwater runoff water quality management programs. Additional information on many of these topics is provided in previous Newsletters, as well as in papers and reports on the authors website, www.gfredlee.com.

Review of the Ninth Circuit Court Ruling on Compliance with Water Quality Standards in Urban Area Stormwater Runoff

There is confusion about how urban area stormwater runoff water quality impacts are being regulated, especially in light of the recent Ninth Circuit Court decision in which the Court ruled that the environmental organizations petition to require compliance with numeric water quality standards was not appropriate. That petition requested that urban area 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 is regulated to prevent causing or contributing to violations of water quality standards, including narrative standards.

In January 1998, US EPA Region IX 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 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 California 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 urban stormwater runoff NPDES 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/petition was reviewed by the US Ninth Circuit Court of Appeals. On September 15, 1999, the Ninth 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 Ninth 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 authority 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 theNinth Circuit Court ruling 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."

It is important to note that the Ninth Circuit Court ruling does not restrict the US EPA from implementing the previously announced policy of requiring full compliance with water quality standards. Based on this ruling, it appears that there will be a period of time where conventional, non-structural and structural BMPs, such as detention basins, grassy swales, etc. will be acceptable as "BMP" for NPDES permitted urban area and highway stormwater runoff. It is recognized that these BMPs 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 The Ninth Circuit Court discussed that the environmental groups in their petition did not raise the issue of whether conventional BMPs, such as detention basins, would treat urban stormwater runoff so that the runoff did not cause or contribute to violations of water quality standards. This is an issue that could need to be addressed by the courts in the future.

Ultimately, under the current BMP ratcheting down process, the water quality standards will have to be adjusted from the worst case based approach to consider site specific conditions for how chemical constituents impact aquatic life and other beneficial uses of waterbodies in order to establish appropriate water quality standards for urban area and highway stormwater runoff. The US EPA's guidance, in its Water Quality Standards Handbook, Second Edition (1994), may not provide sufficient adjustment of the standards to eliminate over regulation and unnecessary expenditures for constituent control that can

occur when US EPA water quality criteria are used as water quality standards to regulate urban area and highway stormwater runoff to some waterbodies.

Lee(1998), in, "Assessment of Potential Urban Area and Highway Stormwater Runoff Water Quality Standards Compliance Problems," published in the fifth issue of the Stormwater Runoff Water Quality Science/Engineering Newsletter, discussed potential water quality standards compliance problems for urban area and highway stormwater runoff. As discussed, urban area and highway stormwater runoff typically contains a number of heavy metals such as copper, lead, zinc, and occasionally cadmium, as well as several organics, at concentrations which could 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 on nearby beaches.

Further, as discussed in Volume 2, Number 1 of this Newsletter, urban stormwater runoff in some and possibly many areas contains the organophosphate pesticides diazinon and chlorpyrifos that cause the stormwater runoff to be toxic to *Ceriodaphnia* at the point of discharge. This toxicity is a violation of the narrative water quality standard of no discharge of toxic constituents in toxic amounts. Also, for those situations where the receiving waters for the urban stormwater runoff are classified as 303(d) "impaired" waterbodies and are under a TMDL limitation, urban area and highway stormwater runoff water quality management agencies could find that there is need to control/treat stormwater runoff to reduce the concentrations of certain constituents in the runoff to comply with TMDL requirements.

The Ninth Circuit Court ruling does not change the BMP ratcheting down requirement of ultimately having to meet water quality standards in the runoff waters when the US EPA decides to enforce this requirement. This ruling, however, apparently could relieve the pressure that environmental groups could bring through litigation of shortening the time when water quality standards will have to be achieved in NPDES permitted stormwater runoff. The US EPA has not established the period of time for compliance with water quality standards. Unofficially, statements of ten years or so are sometimes made about this time period. However, it is likely, through environmental group litigation within five to seven years associated with subsequent renewal of NPDES permits, 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 for NPDES regulated urban stormwater runoff.

An area of concern to some urban stormwater runoff water quality management agencies is compliance with TMDL requirements of achieving water quality standards as a TMDL goal. What the Ninth Circuit Court ruling means to implementation of TMDLs that use as a goal achieving water quality standards in the urban stormwater runoff on the timetable dictated by TMDL requirements remains to be defined. A number of the TMDLs for waterbodies have much shorter time periods for implementation of constituent control to meet water quality standards than the period of time that will likely apply to meeting water quality standards in urban stormwater runoff where there are no TMDL limitations for the constituents of concern in the urban area and highway stormwater runoff.

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, compliance with water quality standards will likely be decided by Congress as part of revising the Clean Water Act. Since the full cost of urban area and highway stormwater runoff compliance with worst case based water quality standards will cost hundreds of billions of dollars across the US, there will be some clarification of water quality standards regulatory requirements for urban area and highway stormwater runoff.

Reference

Lee, G. F., "Assessment of Potential Urban Area and Highway Stormwater Runoff Water Quality Standards Compliance Problems," Report to CA State Storm Water Quality Task Force Stormwater Science Work Group, G. Fred Lee & Associates, El Macero, CA, December (1998) - Available from www.gfredlee.com

Determining the Appropriate Degree of Management/Treatment of Urban Stormwater Runoff

Previous issues of this Newsletter have discussed urban area stormwater runoff potential compliance problems with water quality standards, where stormwater runoff associated constituents may cause no more that one violation of a water quality standard by any amount every three years. Compliance with the current US EPA worst case based water quality standards will mean that urban area and highway stormwater runoff water quality management agencies/the public will be spending hundreds of billions of dollars retrofitting urban areas and highways to collect, store, and treat stormwater runoff using advanced water/wastewater treatment technology.

The current US EPA urban area and highway stormwater runoff NPDES permit program is being implemented through a BMP ratcheting down process that at this time does not have a defined timetable for compliance with water quality standards. Technically valid cost effective compliance with water quality standards in urban area and highway stormwater runoff will require stormwater management agencies, regulatory agencies, and others to work together to:

- Define the real significant water quality use impairments that are caused by stormwater runoff associated constituents that cause or contribute to water quality standards violations and/or use impairments;
- Develop appropriate water quality standards that will protect the beneficial uses of waterbodies without significant unnecessary public and private expenditures for stormwater runoff associated chemical constituent and pathogen indicator organism control;

- Develop management/treatment programs (BMPs) for urban area stormwater runoff associated constituents that cause real water quality/use impairments that will comply with appropriate water quality standards that are affordable by the public.

Recently Dr. G. Fred Lee and Dr. Anne Jones-Lee have presented a paper at the Marine Technology Society National Conference that discusses suggested approaches for appropriate management of wastewater discharges and stormwater runoff from shipyards and drydock facilities. This paper is available from their website, www.gfredlee.com, in the Stormwater Water Quality Impact section. This section of the Newsletter presents an expanded outline of the key issues covered in this paper that are pertinent to appropriately managing urban area and highway stormwater runoff water quality impacts. Additional information on the topics covered is available in papers and reports presented on the authors website. Additional details will be discussed in future newsletters.

Outline of
Assessing the Degree of Appropriate Treatment of
Urban Stormwater Stormwater Runoff

G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
G. Fred Lee and Associates, El Macero, CA

Adapted from
Presentation at Marine Technology Society, Oceans 99 Conference
Seattle, WA September 1999
Available as Preprint at www.gfredlee.com

Definitions

A Lack of Understanding of Basic Regulatory Issues/Definitions Leads to Over-Regulation and Under-Regulation of Wastewater Discharges and Stormwater Runoff-Associated Constituents. (Presented below are terms which are frequently misused in water quality investigations and management.)

Pollution - Clean Water Act - Impairment of Beneficial Uses

Water Quality - Assessed by Impairment of Beneficial Uses

Not a List of Chemical Concentrations

Water Quality Assessment - Evaluation of Beneficial Use Impairment

Cannot Use Exceedance of Water Quality Standard as a Water Quality Assessment

Aquatic Chemistry - Chemical Reactions That Control Chemical Species and Their Impacts

Not a List of Chemical Concentrations which should be called Chemical Characteristics

Administrative Exceedance - Exceedance of a Water Quality Standard without Beneficial Use Impairment

Related to the Overly Protective Nature of US EPA Water Quality Criteria and State Standards

Cause of Aquatic Life Adverse Impacts - Toxic/Available Forms of a Chemical That Are Present for Sufficient Time to Exceed Critical Exposure

Aquatic Life Toxicity - Must Be Assessed Based on Toxicity Measurements

Cannot Be Evaluated Based on Chemical Concentrations in Water or Sediments

Suggested Approach for Managing Urban Area Stormwater Runoff Water Quality Impacts

Urban Area and Highway Stormwater Runoff Contain Elevated Concentrations of Potential Pollutants

- Heavy Metals, Nutrients, Organics and Pathogen Indicator Organisms

Need to Reliably Evaluate Whether Concentrations in Runoff above Water Quality Standards Cause Impairment of the Beneficial Uses of the Receiving Waters for the Runoff

- Requires Site-Specific Evaluation to Avoid Over- and/or Under-Regulation
  - Over-Regulation Associated with Use of Existing Water Quality Standards and Sediment Quality Guidelines
  - Under-Regulation Occurs for Unregulated Chemicals, i.e., Those for which There Are No Water Quality Standards
  - Must Consider both Watercolumn and Sediment Impacts

Suggested Approach

Use **Evaluation Monitoring** Approach

Jones-Lee, A. and Lee, G.F., "Evaluation Monitoring as an Alternative to Conventional Water Quality Monitoring for Water Quality Characterization/Management," Proc. of the NWQMC National Conference *Monitoring: Critical Foundations to Protect Our Waters,* US Environmental Protection Agency, Washington, D.C., pp. 499-512, (1998). Available from www.gfredlee.com

- Focus on Assessing Receiving Water Impacts Rather Than on Chemical Concentrations in Runoff
  - Determine if Exceedance of a Water Quality Standard(s) in Runoff Waters Impairs Beneficial Uses
    - Is the Runoff **Toxic** to Aquatic Life?
      - Use US EPA Standard Three-Species Toxicity Test
    - If **Toxic**, is the Toxicity Adverse to Beneficial Uses of Receiving Waters?
      - Evaluate Whether the Numbers and Types of Desirable Aquatic Life Altered by Toxicity?
    - Does the Runoff Contain Hazardous **Bioaccumulatable** Chemicals?
      - Do Edible Organisms in Receiving Waters Contain Excessive Hazardous Chemicals That Are Present in the Runoff?

Do Not Assume That All Chemicals of a Certain Type from All Sources Are in Toxic/Bioaccumulatable Available Forms

- Use Site Specific Toxicity Identification Evaluations (TIEs) and/or Organism Uptake Studies

Does the Runoff Contain Particulate Forms of Chemicals That Are Potentially Hazardous in Receiving Water Sediments?

- Do the Sediments near the Point of Runoff Contain Elevated Concentrations of Potentially Toxic/Bioaccumulatable Chemicals That Are Present in the Runoff?

Use Watershed-Based Stakeholder-Developed Consensus Approach

Dischargers Should Work with Regulatory Agencies and Others as Appropriate in Developing, Conducting, and Evaluating Current Water Quality - Beneficial Use Impacts of Existing Runoff

If Real, Significant Water Quality Problems Are Found That Are Appropriately Related to the Runoff:

- Evaluate the Cost of Controlling the Constituents in the Runoff Causing the Use-Impairment
- Evaluate the Improvement in the Beneficial Uses of the Receiving Waters Through Control of the Constituent(s) Responsible for Use Impairment

If Exceedance of Water Quality Standards in Runoff Occurs That Is Not Associated with a Significant Adverse Impact on Beneficial Uses, Work with Regulatory Agencies and Others to Address the **Administrative** Exceedance of the Water Quality Standard

Adjust the Water Quality Standard for Site-Specific Conditions in Accord with US EPA Water Quality Standards Handbook

If This Approach Does Not Eliminate Administrative Exceedance, Work with Regulatory Agencies, Federal and State Legislatures to Change Regulatory Approach to modify US EPA **Independent Application Policy**

Search for Undetected/New Water Quality Problems Due to Runoff Associated Constituents

Adopt Proactive Approach to Work with Regulatory Agencies and Others in Detecting Subtle and/or New Water Quality Problems

Proactive Approach Needed to Gain Acceptance of Regulatory Approach for Discharge/Runoff That Is Based on Best Professional Judgment Rather Than Worst Case Based Water Quality Criteria

Best Professional Judgment - Regulatory Approach

Current US EPA Regulatory Approach Does Not Properly Incorporate Current Science/Engineering into Management of Water Quality

Focuses on Managing Chemical Concentrations Rather Than on Chemical Impacts - Cannot Translate Chemical Concentrations to Water Quality - Use Impairment Impacts

Need to Adopt an Expert Panel-Developed, Non-Numeric Best Professional Judgment Weight-of-Evidence Approach for Managing Subtle Water Quality Impacts Based on an Integrated Use of:

- Aquatic Life Toxicity/Bioaccumulation
- Altered Aquatic Organism Assemblage Information
- Chemical Information on the Chemicals Responsible for Toxicity/Bioaccumulation and Altered Aquatic Organism Assemblages

Do Not Use Total Concentration of Chemicals

Must Use TIEs to Establish Cause of Use-Impairment

Use Public, Interactive Peer Review to Resolve Disputes among “Experts” on Technical Issues

Managing Contaminated Sediments

Contaminated Sediments - Elevated Concentrations of Potentially Toxic/Bioaccumulatable Chemicals-Next “Superfund” - “Aquafund”

Technically Invalid Approaches Used to Evaluate Water Quality Significance of Chemical Constituents in Aquatic Sediments

Long and Morgan, MacDonald, and US EPA So-Called "Sediment Quality Guidelines" Not Reliable for Evaluating Toxicity of Chemical Constituents in Aquatic Sediments

Based on Total Concentration of Chemicals - Well-Known There Is No Relationship between the Total Concentration of a Chemical in Sediments and its Impact on Aquatic Life/Water Quality

To Assess Whether a Chemical in Sediments Is Toxic, Must Conduct Toxicity Tests with a Suite of Sensitive Organisms Using Several Appropriate Reference Sediments

Properly Interpret Results in Terms of Waterbody Beneficial Use Impairment - Are the Organism Assemblages in "Toxic" Sediments Significantly Altered Due to a Suspected Toxicant?

Must Due Site-Specific TIEs to Identify Toxicant(s)

Stormwater Runoff BMP Selection and Evaluation

Current US EPA Stormwater Runoff Water Quality Management Program Requires That Ultimately Stormwater Runoff Associated Constituents Shall Not Cause or Contribute to Violations of Water Quality Standards in Runoff Waters

Timetable for Implementation Not Established

Will Likely Be Determined by Environmental Group Litigation

Currently Using a BMP Ratcheting-Down Process for Exceedances of a Water Quality Standard in Stormwater Runoff

Stormwater Manager Must Work with the Regulatory Agency in Developing BMPs to Eliminate the Exceedance

Will Cost the US Public Hundreds of Billions of Dollars

US EPA Water Quality Criteria/State Standards Tend to Over-Regulate Stormwater Runoff Associated Constituents

Many Stormwater Runoff Water Quality Standards Violations Represent **Administrative** Exceedance of Water Quality Standards

- Stormwater Runoff Constituents Often in Non-Toxic, Non-Available Forms
- Short-Term Exposure Compared to Critical Exposure Needed to Be Adverse to Aquatic Life

Conventional "BMP" Such as Detention Basins and Grassy Swales Will Not Treat Stormwater Runoff to Achieve Water Quality Standards

BMP Selection Should Be Based on Site Specific Evaluation for Controlling Chemical Constituents in the Stormwater Runoff That Are Significantly Impacting the Beneficial Uses of Receiving Waters

Use **Evaluation Monitoring** Procedures

BMP Efficacy Evaluation Should Be Based on Evaluating the Improvement in the Beneficial Uses of the Receiving Waters for the Stormwater Runoff

Measurement of Percent Reduction of a Chemical Constituent across a BMP Not a Reliable Evaluation of BMP Efficacy - Leads to Erroneous Conclusions on BMP Effectiveness

Conclusions

Current Regulatory Approach for Urban Area and Highway Stormwater Runoff Tends to Over-Regulate Runoff Water Quality Impacts

Can Cause Significant Unnecessary Expenditures for Chemical Constituent Control

Should Focus on Assessing and Managing Chemical Impacts of Runoff Rather than Chemical Concentrations/Loads

Chemical Concentration-Based Regulatory Approach, While Bureaucratically Simple to Administer, Often Leads to Technically Invalid Approaches for Assessing and Managing Water Quality Impacts from Urban Area Stormwater Runoff

Should Use an Evaluation Monitoring Approach to Determine Real, Significant Water Quality Use-Impairments Caused by Runoff to Develop Runoff Management Program That Will Protect the Beneficial Uses of Receiving Waters without Significant Unnecessary Expenditures for Chemical Constituent Control

For Further Information Consult Papers and Reports on Dr. G. Fred Lee's Website, www.gfredlee.com.

Suggested Approach for Development of Urban Area and Highway Stormwater Runoff Sanitary Quality Impact Management

G. Fred Lee, PhD, PE, DEE, and Anne Jones-Lee, PhD

Nature of Problem

Urban area streets and highway stormwater runoff contains elevated concentrations of fecal coliforms and total coliforms that can cause exceedance of sanitary quality standards for contact recreation, shellfish harvesting, and domestic water supplies.

Concentration of total and fecal coliforms in urban area and highway stormwater runoff causes violation of fecal coliform standards at the point of discharge to ambient waters.

Source of fecal coliforms is domestic and wild animal wastes, and in addition for urban areas, leaks, breaks and plugging of sanitary sewerage systems that result in the discharge of human fecal waste to stormwater conveyance systems.

Source of high concentrations of fecal coliforms in highway stormwater runoff at the edge of the pavement is not defined - needs study.

Human fecal waste is one of the most hazardous materials known.

More people die per year in the US from ingestion of human fecal waste in food and water than from all chemicals combined.

Contact recreating (swimming) in water that contains human fecal wastes, drinking water contaminated by human fecal wastes and consuming shellfish that has been contaminated by human fecal waste causes illness and death.

US Public Health Service Centers for Disease Control (CDC) estimates that 1,000 people per year die in the US due to consumption of fecal contaminated domestic water supplies that are treated to meet current drinking water fecal coliform standards.

CDC has recently estimated that over 9.2 million cases of illness occur in the US each year due to ingestion of fecal contaminated seafood.

Regulatory Issues

It has been well known since the 1940s that fecal coliforms are not reliable indicators of protozoan caused human enteric diseases.

Known since the 1970s that fecal coliforms are not reliable indicators of human enteric viral diseases and viral and bacterial caused eye, ear, nose, respiratory and skin diseases.

Known since the 1980s through the US EPA studies that fecal coliform concentrations do not correlate with swimmers' enteric illness.

Fecal coliforms are also derived from domestic and wild animals and birds

Enterococcus and *E. coli* concentrations correlated with enteric illness - diarrhea, upset stomach, vomiting.

Santa Monica Bay dry weather storm drain studies showed a correlation of illness with total/fecal coliform ratio.

Not a valid regulatory parameter for contact recreation. Should not have been included in AB411 regulatory requirements. Neither total coliform or fecal coliforms are valid sanitary quality indicators - a ratio does not improve reliability of relationship to the sanitary quality of contact recreation waters.

Santa Monica Bay studies are not valid assessment of urban stormwater runoff impacts on beach sanitary quality.

Study of stormwater sewer that is likely to be receiving sanitary wastes through illegal connections, leaky sanitary sewerage systems, etc.

Importance of controlling human fecal wastes in urban stormwater runoff that can impact contact recreation areas, domestic water supplies, and shellfish beds.

US EPA developed more reliable sanitary quality indicators in the 1980s

Used passive implementation where new pathogen indicators were made available for use by the states.

Not adopted by many states. Continue to use unreliable fecal coliform indicators.

Environmental Group activities brought national attention to the sanitary quality problems of US beaches

Caused US EPA in 1998 to develop and begin to implement the Beaches Program to improve the sanitary quality of US contact recreation waters.

US EPA Action Plan for Beaches and Recreational Waters EPA/600/R-98/079 March 1999 available from www.epa.gov/ORD/publications

TMDL for fecal coliforms is forcing development of fecal coliform control in urban area and highway stormwater runoff well ahead of the development and implementation of the US EPA Beaches Program schedule.

Requires development of fecal coliform control programs even though well known to be an invalid indicator of sanitary quality.

No doubt that urban area stormwater runoff that contains human fecal waste is a threat to cause disease in swimmers, shellfish consumers that inadequately cook the shellfish, and inadequately treated domestic water supplies.

Meeting fecal coliform standards is not protective of human health

Treated water supplies that meet standards can have enteric viral diseases and protozoan cyst diseases caused by *Cryptosporidium* and *giardia*.

Suggested Approach for Managing Sanitary Quality of Urban Stormwater Runoff

Overall Objective: Control the concentration of *E. coli* and enterococcus in stormwater runoff to meet US EPA guidance for contact recreation at the point of discharge to ambient waters.

Allow natural die off and dilution where it is adequately demonstrated that contact recreation and domestic water supplies are protected.

Focus urban stormwater runoff sanitary quality management on *E. coli* and fecal enterocci.

Include fecal and total coliforms only to the extent necessary to comply with current regulatory requirements until indicator organisms are changed.

US EPA to require that all states use *E. coli* and enterococcus as sanitary quality indicators by 2002.

Urban stormwater runoff water quality management agencies should work with local domestic sewerage system management agencies to establish control of human wastes in storm sewer collection and conveyance systems.

Establish an ongoing comprehensive stormwater runoff inspection program to control human waste inputs to storm sewer systems.

Support research on:

- Developing appropriate viral and protozoan cyst indicator organism analytical methodology
- Studies to define the public health threat of fecal coliforms, enterococci, and *E. coli* and *Cryptosporidium* for contact recreation.

Basis for Comments

The summary comments presented herein are based on 45 years of periodic work on sanitary quality investigation/management issues for contact recreation, domestic water supplies, and reclaimed domestic wastewater reuse. The comments also include an assessment of the information obtained from the US EPA Beaches Conference that was held in San Diego in late August 1999. This background includes formal training as an undergraduate and graduate student in public health and repeated activities in public health. This experience includes San Jose, California area contact recreation in a private resort swimming area, work on swimming pool water quality at several locations, advising Lubbock, Texas' Parks Department on sanitary quality of the chain of lakes impacted by urban area stormwater runoff, Madison, Wisconsin contact recreation in the Madison

Lakes, advising New Jersey Medical Society on New Jersey Shore contact recreation studies, advising Newport Beach, California on Upper Newport Bay sanitary quality.

Presented below are four abstracts of presentations that were made at the US EPA West Coast Regional Beach Conference that was held August 31-September 1, 1999 in San Diego California. These abstracts provide additional information on the issues summarized in outline form in this discussion. This conference is part of an effort by the US EPA to educate professionals and others on sanitary quality issues associated with contact recreation in waters that contain human and/or animal wastes.

The Relationship of Microbial Measurement of Beach Water Quality to Human Health

Alfred P. Dufour
US Environmental Protection Agency, National Exposure Research Laboratory
26 West Martin Luther King Drive, Cincinnati, OH 45268
Phone: (513) 569-7303 email: dufour.alfred@epa.gov

The bacterial indicator concept has been used for over one hundred years and is today a key element in maintaining the quality of recreational waters. Early use of bacterial indicators was not risk based. The presence of bacterial indicators signaled the presence of fecal material and this alone was considered hazardous enough to disqualify the use of the contaminated water. In the late 1940*s indicator bacteria were used quantitatively to measure the quality of recreational water and this data was used to determine if the water quality was related to health effects associated with swimming activity. Health effects were found to be related to contaminated recreational water. These findings were extended and refined by U.S. EPA studies in the 1970*s on the relationship between water quality and swimming-associated health effects. These data were used by the U.S. EPA to develop guidelines for maintaining the quality of recreational water. The findings of the EPA studies have been confirmed in studies around the world and lend credence to the approach used in the United States to protect the health of swimmers.

The establishment of a risk-based approach to protecting the health of swimmers has not, however, solved all of the issues related to maintaining high quality recreational waters. The U.S. EPA* s Action Plan for Beaches and Recreational Water has discussed a number of these issues, many of which are related to indicator bacteria. Three of these issues, which frequently raise questions from water resource managers, involve indicator bacteria. All currently recommended indicator bacteria demonstrate the presence of fecal material from warmblooded animals without distinguishing whether the source is human or animal. Research findings regarding health effects associated with non-point source of pollution, i.e., animal or bird contamination of water, are equivocal. Data from past research will be used to further define this issue. Another issue which frequently raises questions is whether the risk of swimming in waters that receive discharges from a combined sewer overflow (CSO) is the same as that encountered in waters affected by treated wastewater from a point source. Health data associated with exposure to CSO discharges that affect recreational waters is not available. However, it is possible to speculate on the risk due to this type of exposure using microbial data from the analysis of wastewaters that pass through sewage treatment plants and data from studies on storm water runoff. The last issue to be discussed in this presentation will address the question

of new indicators for measuring recreational water quality and whether a new indicator can be substituted for a standard indicator without establishing its* relationship to health effects. This is especially important because of the rapid proliferation of new technologies for measuring the quality of surface waters. The foregoing issues will be discussed with regard to currently used indicator bacteria, fecal coliforms, *E. coli* and enterococci.

Risk Assessment Methodologies for Recreational Water

Stephen Schaub
US Environmental Protection Agency Office of Science and Technology
401 M Street, SW, Washington, DC 20460
Phone: (202) 260-7591 email: schaub.stephen@epa.gov

The current recreational water quality criteria are considered risk based in that they were established after studies demonstrated a relationship of the magnitude of fecal indicator organism levels (enterococci and *E. coli)* and relative incidence of disease in persons swimming at contaminated beaches. Improvements in indicators and additional health studies may allow further refinements or new criteria to protect the health of persons swimming in our Nation*s waters. To maximize our ability to provide risk based criteria or to determine the safety of beach waters, improved risk assessment approaches should be applied. These should consider the unique features of microbial pathogens in water that lead to human exposure and also the unique features associated with human infection and disease.

A framework has been developed for conducting pathogen risk assessments for water media and various types of exposure settings. The framework follows a classic risk assessment approach in that there is a Problem Formulation stage, an Analysis stage, and finally a Risk Characterization stage which provide the risk manager or user with answers to problems identified during problem formation. One of the key features of the pathogen risk assessment is that iterative loops are considered important throughout the process, both to obtain the appropriate problem formulation and to properly assess the factors used for the analysis.

The analysis phase is broken down into two major divisions: Characterization of Exposure and Characterization of Human Health Effects. There are a number of tools and methods to use in data collection for the two major divisions of the analysis phase. For Characterization of Exposure the process is broken down into 4 blocks of data collection and analysis: Pathogen Characterization; Exposure Analysis; Pathogen Occurrence and finally Exposure Profile (a synthesis of findings and associated uncertainties observed with the first 3 groups). Under the Characterization of Human Health Effects division there are also 4 blocks for analysis: Host Characterization; Dose Response Analysis; Health Effects; and again, a synthesis of findings and uncertainty in the Host Pathogen Profile.

The final step, Risk Characterization, is an exercise of evaluating all of the exposure and host-pathogen profile data inputs along with the uncertainty, estimates, modeling, etc. that were used during the analysis phase. The estimates of risk take into account the quality and variability of the data, uncertainty of the information, lack of data, etc., and can apply a sensitivity analysis to provide the risk manager with a sense of what the risk assessment will allow him to do in his management decisions.

Risk assessment is a very iterative process and improved analysis tools and improved data will significantly improve subsequent Risk Characterization outputs especially for recreational waters where there is sparse data on pathogen occurrence, exposure assessment and health effects.

Southern California Bight 1998 Regional Monitoring Program: Summer Shoreline Microbiology

Noble, R.T.[1,2] J.H. Dorsey[3], M.K. Leecaster[1], M. Mazur[4], C.D. McGee[5], D. Moore[6], V. Orozco-Borbon[7], D. Reid[8], K. Schiff[1], P.M. Vanik[9], and S.B. Weisberg[1]
(alphabeticalorder)
[1]Southern California Coastal Water Research Project; [2]Wrigley Institute for Environmental Studies, University of Southern California; [3]City of Los Angeles, Stormwater Management Division; [4]Orange County Environmental Health Division; [5]Orange County Sanitation District (Presenting Author); [6]Orange County Public Health Laboratory: [7]Instituto de Investigaciones Oceanologicas, Universidad Autonoma de Baja California; [8]Santa Barbara County Public Health Department; [9]City of San Diego Metropolitan Wastewater Department

More than 80,000 shoreline bacteriological samples are collected annually in southern California, representing roughly one-half of the total bacteriological monitoring conducted in the United States. Despite this impressive amount of monitoring, these data are difficult to integrate for the purpose of making a regional assessment of water quality. Integration is difficult because the data are collected by 22 different organizations with different sampling strategies and different data management systems. Additionally, because the sample locations are assigned to focus on known “problem areas” or to comply with a specific monitoring objective, the strategy does not allow for an assessment of typical regional shoreline microbiological water quality. To overcome these limitations, all of the organizations that perform routine monitoring in the Southern California Bight (SCB) conducted an integrated survey during the summer of 1998 that assessed the overall microbiological water quality of the southern California shoreline. The primary goals of the survey were:

- to determine the percent of shoreline mile-days in the SCB that exceeded bacterial indicator thresholds during August of 1998;
- to compare the response among three bacterial indicators commonly used in California; and
- to determine how well these bacterial indicator measures correlated with detection of human enteric virus genetic material.

Samples were collected on a weekly basis at 307 sites between Point Conception, California, and Punta Banda, Mexico, beginning August 1, 1998, and continuing for five weeks. Sampling sites were selected using a stratified random design. Strata included high- and low-use sandy beaches, high- and low-use rocky shoreline, ephemeral freshwater outlets and perennial freshwater outlets. Samples were collected according to standardized protocols. Total and fecal coliform were measured in all samples. Enterococci were measured in approximately 70 percent of the samples. Molecular analyses to detect the presence of human enteric virus genetic material were performed on samples collected from 15 randomly selected perennial freshwater outlets. Analysis for

the presence of this genetic material was used as a tool to detect human fecal contamination in the coastal zone. It was not intended to be used to infer health risk.

Prior to starting the project, the 22 participating laboratories conducted intercalibration studies to assess data comparability. Thirteen common samples were analyzed by each laboratory to define variability among laboratories, within laboratories, and among methods. Three quantitative analytical methods, multiple tube fermentation (MTF), membrane filtration (MF), and chromogenic substrate tests in a most probable number format were compared for total coliform, fecal coliform (or *E. coli),* and enterococci. The average difference among methods was less than 6 percent. The average difference among laboratories was less than 2 percent. The greatest source of variability was among replicates within individual laboratories. The intercalibration exercises demonstrated that a multi-laboratory, performance-based approach was acceptable for implementing this regional study.

Overall, microbiological water quality along the southern California shoreline was good during the study period with more than 95 percent of the shoreline mile-days meeting all present and proposed California bacterial indicator standards. In 98 percent of the cases where a standard was exceeded, it was exceeded for only one bacterial indicator, while all other bacterial indicators at the same site and at the same time were below thresholds. Less than 0.2 percent of the shoreline mile-days exceeded thresholds for all indicators measured at the site.

Freshwater outlets failed to meet bacterial indicator standards in almost 60 percent of the samples, the worst of all strata. Most of the standard failures near freshwater outlets were for multiple indicators and occurred repetitively throughout the five-week study period. Molecular tests demonstrated the presence of human enteric virus genetic material in 7 of the 15 freshwater outlets with 73 percent of these detections coinciding with levels of fecal coliform that exceeded bacterial indicator thresholds.

The probability of exceeding a bacterial indicator threshold differed substantially among indicators. Of the samples that exceeded a bacterial standard, and for which all three indicators were measured, only 13 percent failed for all three indicators, 34 percent failed for two indicators, and 54 percent failed for one indicator. Thresholds for fecal coliform were exceeded at twice the rate of total coliform and enterococci failed at three times the rate of total coliform. Less than one-half of the enterococci thresholds failures paired with threshold failures by another indicator, while nearly 90 percent of the total and fecal coliform threshold failures were partnered with failures of another indicator.

This cooperative study is the first to compare the relative quality of Mexican and United States beaches using similar site selection approaches and coordinated quality assurance methods. Although nearly 75 percent of the beach samples in Mexico met California*s bacteriological water quality standards, the standards were exceeded five times more often on Mexican than on United States beaches. Mexican freshwater outlets were just as likely to exceed a bacteriological water quality standard as those in the United States.

California's Regulations and Guidance for Beaches and Recreational Waters

Steven Book
Division of Drinking Water and Environmental Management
California Department of Health Services
Phone: (916) 322-1553 email: sbook@dwemb.dhs.cahwnet

The Department of Health Services (DHS) recently expanded its regulations for public beaches and ocean water-contact sports areas in response to requirements of Health and Safety Code § 115880, Assembly Bill (AB) 411, Statutes of 1997, Chapter 765. The regulations (in Title 17 of the California Code of Regulations) consist of §7956 (new), §7958 (amended), §7961 (new) and §7962 (new), which became effective July 26, 1999. Other regulations, §7957, §7959, and §7960, were unchanged. The regulations are reproduced below.

7956. Storm Drain. "Storm drain" means a conveyance through which water flows onto or adjacent to a public beach and includes rivers, creeks, and streams, whether in natural or in man- made channels.

7957. Physical Standard. No sewage, sludge, grease, or other physical evidence of sewage discharge shall be visible at any time on any public beaches or water-contact sports areas.

7958. Bacteriological Standards. (a) The minimum protective bacteriological standards for waters adjacent to public beaches and public water-contact sports areas shall be as follows:

(1) Based on a single sample, the density of bacteria in water from each sampling station at a public beach or public water contact sports area shall not exceed:

(A) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or

(B) 10,000 total coliform bacteria per 100 milliliters; or

(C) 400 fecal coliform bacteria per 100 milliliters; or

(D) 104 enterococcus bacteria per 100 milliliters.

(2) Based on the mean of the logarithms of the results of at least five weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station at a public beach or public water contact sports area, shall not exceed:

(A) 1,000 total coliform bacteria per 100 milliliters; or

(B) 200 fecal coliform bacteria per 100 milliliters; or

(C) 35 enterococcus bacteria per 100 milliliters.

(b) Water samples shall be submitted for bacteriological analyses to a laboratory certified by the Environmental Laboratory Accreditation Program, California Department of Health Services in microbiology for methods for the analysis of the sample type.

7959. Bacteriological Sampling.

(a) In order to determine that the bacteriological standards specified in Section 7958 above are being met in a water-contact sports area designated by a Regional Water Quality Control Board in waters affected by a waste discharge, water samples shall be collected at such sampling stations and at such frequencies as may be specified by said board in its waste discharge requirements.

(b) In waters of a public beach or water-contact sports area that has not been so designated by a Regional Water Quality Control Board, water samples shall be collected at such frequencies as may be determined by the local health officer or Department. Local health officers shall be responsible for the proper collection and analysis of water samples in such areas.

7960. Corrective Action.

(a) When a public beach or public water-contact sports area fails to meet any of the standards as set forth in Section 7957 or 7958 above, the local health officer or the Department, after taking into consideration the causes therefore, may at his or its discretion close, post with warning signs, or otherwise restrict use of said public beach or public water-contact sports area, until such time as corrective action has been taken and the standards as set forth in 7957 and 7958 above are met.

7961. Public Beaches Visited by More than 50,000 People Annually and Adjacent to Storm Drains.

(a) Waters adjacent to a public beach shall be tested for bacteria identified in Section 7958 on at least a weekly basis from April 1 to October 31, inclusive, if the beach is

(1) Visited by more than 50,000 people annually, and

(2) Located adjacent to a storm drain that flows in the summer.

(b) Water samples shall be taken from locations that include areas affected by storm drains. Samples shall be taken in ankle- to knee-deep water, approximately 4 to 24 inches below the water surface.

(c) When testing reveals that the waters adjacent to a public beach fail to meet any of the standards set forth in Section 7958(a)(1), the local health officer shall post the beach pursuant to Health and Safety Code Section 115915, and shall use the standards of Sections 7958(a)(1) and (2) in determining the necessity to restrict the use of or close the public beach or portion thereof.

(d) In the event of a known release of untreated sewage into waters adjacent to a public beach, the local health officer shall:

(1) Immediately post and close the beach or a portion thereof, or otherwise restrict its use until the source of the sewage release is eliminated;

(2) Sample the affected waters; and

(3) Continue closure or restriction of the beach or a portion thereof and posting the beach until testing results establish that the standards of Sections 7958(a)(1) are satisfied.

7962. Duties Imposed on a Local Public Officer or Agency.

(a) Pursuant to Health and Safety Code Sections 115880(h), 115885(g), and 115915(c), any duty imposed upon a local public officer or agency by Section 7961 shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, as determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with performance of these duties.

DHS also prepared draft guidance documents for local health departments seeking to improve their programs for both saltwater and freshwater beaches and recreational waters. These guidance documents are available from the DHS Web site.
For more information: *http://www.dhs.ca.gov/ps/ddwem/beachesindex.htm*

California's Regulations and Guidance for Beaches and Recreational Waters

Steven Book, Ph.D., sbook@dhs.ca.gov
CA Dept. of Health Services, Division of Drinking Water & Environmental Management

August 31, 1999

Procedures for closing and posting public beaches that are adjacent to storm drains that flow during the summer visited by 50,000 visitors

coastal (not within San Francisco Bay)

Implementation not required if legislature does not provide adequate funding in the annual budget. (~ $1 million is in annual budget)

STANDARDS FOR MICROBIOLOGICAL INDICATORS

The most recent single measurement is to be used for determining the need for beach posting.

Total coliform bacteria: 1,000 per 100 milliliters, if the fecal/total ratio exceeds 0.1

Total coliform bacteria: 10,000 per 100 milliliters

Fecal coliform bacteria: 400 per 100 milliliters

Enterococcus bacteria: 104 per 100 milliliters

The 30-day average of measurements of the level (the log mean of the results of 5 weekly samples) is to be used by the local health officer along with the single sample standards to determine if closing and/or other restrictions are appropriate.

Total coliform bacteria: 1,000 per 100 milliliters

Fecal coliform bacteria: 200 per 100 milliliters

Enterococcus bacteria: 35 per 100 milliliters

LOCATIONS, FREQUENCY, & DEPTH OF SAMPLE COLLECTION

For AB 411 public beaches	C At least weekly sampling from April 1 to October 31 C Sampling is to include waters affected by storm drains C Samples to be taken in ankle- to knee-deep water, approx. 4 to 24 in. below the water surface
For other beaches	C At the discretion of the local health officer

DEFINITIONS

Storm drain (Regulation): A conveyance through which water flows onto or adjacent to a public beach, and includes rivers, creeks, and streams, whether in natural or in man-made channels.

Posting: Signs at an area of a public beach that inform the public of contamination of recreational water and the risk of possible illness (AB411).

Posting may be

(1) temporary, when a single standard is exceeded for a short period, or

(2) more permanent, where monitoring indicates regular or sporadic contamination (e.g., storm drain), or where contamination sources are identifiable and can be explained (e.g., storm drain water, or residential marine mammals or seabirds) (Guidance).

Posting is required at public beaches subject to AB411 whenever standards for microbiological indicator organisms are exceeded.

Closure (Guidance): Signs that inform the public that the beach area is closed to swimming and water contact. They should indicate the nature of the concern (e.g., sewage spill), and should, by language, color, and design, enable differentiation from advisories provided by posting.

Closure is envisioned to occur when health risks are considered greater than those associated with posting, as with sewage spills or at areas at which monitoring results show that multiple indicator organism standards are exceeded, for both single sample and 30-day average values.

Closure is required by AB 411 when an untreated sewage release is known to have reached recreational waters at a public beach.

BEACH IS REQUIRED TO BE CLOSED...

- with a known release of untreated sewage (AB 411)
- otherwise at the discretion of the local health officer

BEACH IS REQUIRED TO BE POSTED WITH WARNING SIGNS...

- whenever an applicable standard is exceeded (AB 411)
- otherwise at the discretion of the local health officer

SAMPLE LANGUAGE FOR SIGNS (Guidance)

WARNING! UNTREATED SEWAGE SPILL BEACH CLOSED	WARNING! STORM DRAIN WATER MAY CAUSE ILLNESS NO SWIMMING IN STORM DRAIN WATER

OTHER MEANS OF PUBLIC INFORMATION

- Telephone Hotline (required by AB 411)
- Press Release (Guidance)
- Electronic Access (e.g., Internet or local television) (Guidance)

FUTURE ACTIVITIES

Fresh water beaches and certain other beaches

Reporting of beach closures/postings (SWRCB)

For more information regarding regulations implementing AB 411 and guidance documents for salt & fresh water beaches, see:

http://www.dhs.ca.gov/ps/ddwem/beaches/beachesindex.htm

References on Beach Sanitary Quality Issues

Cabelli, V.J., A.P. Dufour, L.J. McCabe, and M.A. Levin, “Swimming-Associated Gastroenteritis and Water Quality”. American Journal of Epidemiology 115:606-616 (1982.)

Haile, R.W., J.S. Witte, M. Gold, R. Cressey, C. McGee, R.C. Millikan, A. Glasser, N. Harawa, C. Ervin, P. Harmon, J. Harper, J. Dermand, J. Alamillo, K. Barrett, M. Nides, and G-Y. Wang, “The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff”. Epidemiology. 10:355-363,(1999).

Seyfried, D.L., R.S. Tobin, W.E. Brown, and P.F. Ness, “A Prospective Study of Swimming-Related Illness. II. Morbidity and the Microbiological Quality of Water”. American Journal of Public Health 75:1071-1075 (1985).