UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JAN 31 2011

REPLY TO THE ATTENTION OF:
WQ-16J

Illinois Pollution Control Board, Clerk's Office
James R. Thompson Center, Suite 11-500
100 West Randolph Street
Chicago, Illinois 60601

PC#580

ORIGINAL

Re: R2008-009(B): In The Matter of: Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code 301, 302, 303 and 304

Dear Illinois Pollution Control Board:

U.S. Environmental Protection Agency has reviewed the documents entitled "Clarifications about CHEERS in response to the US EPA's December 27, 2010 filing with the Illinois Pollution Control Board" prepared by Dr. Dorevitch and others on December 30, 2010 (Public Comment #562) and "Responses to Information Requests at October 19 and 20, 2010 Hearings" submitted by the Metropolitan Wastewater Reclamation District on January 3, 2010 (Public Comment #565). Our comments on aspects of those documents are enclosed.

We hope that EPA's comments are useful to the Board in its deliberations with regard to the above referenced matter. Please contact Linda Holst of my staff if you have any questions. She can be reached at (312) 886-6758 or holst.linda@epa.gov.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Marcia Willhite, Illinois Environmental Protection Agency

EPA Comments to Illinois Pollution Control Board Docket R2008-009 (Subdocket B) Regarding Information Provided the Illinois Pollution Control Board in Public Comments 562 and 565

Public Comment 562 entitled "Clarifications about CHEERS in response to the USEPA's December 27, 2010 filing with the Illinois Pollution Control Board"

1. Purpose of Chicago Health Environmental Exposure and Recreation Study (CHEERS)

Excerpt of EPA December 27, 2010 Comment: "… it does not appear that the observed risk levels in CHEERS represent the full or future level of health risk to recreators in the CAWS."

Excerpt of Dorevitch December 30, 2010 Comment: "Speculating about future risk levels was not an objective of the study."

EPA Comment: EPA recognizes the limited scope of the study, and reiterates its December 27, 2010, comment that "CHEERS did not include activities that have been documented within some areas of the CAWS such as swimming, wading, jet skiing, tubing, or waterskiing, where higher levels of water exposure and higher gastrointestinal illness rates are likely…. nor did CHEERS consider that such uses may increase over time."

2. Chicago Area Waterway System (CAWS) vs. General Use Waters (GUW) comparison

A. Excerpt of EPA December 27, 2010 Comment: "…the water[s] in the GUW classification were not meeting applicable water quality standards and microbial indicator concentrations, which suggest that GUW waters are impacted by fecal contamination. As a result, the illness rate in the GUW should not be used as a reference group (unexposed to non-disinfected wastewater) upon which to compare CAWS waters."

Excerpt of Dorevitch December 30, 2010 Comment: "Over the past decade, a consistent body of evidence has made clear that elevated levels of fecal indicator bacteria do not necessarily imply human fecal contamination… Thus, the concern that indicators suggest fecal contamination may be misplaced. Because the recreational activities of CHEERS participants in CAWS and GUW waters are the same, it is entirely reasonable to compare rates of illness in the two settings (point-source dominated vs. not), regardless of concentrations (densities) of *E. coli* and/or enterococci."

EPA Comment: EPA is aware of the literature related to the non-specificity of fecal indicator bacteria. As such, EPA utilized available water quality information reported in the CHEERS study, including fecal indicator bacteria concentrations, virus concentrations, and protozoan pathogen concentrations, all of which suggest that GUW waters suffer from fecal contamination. Specifically, as demonstrated in Table II-18 entitled "Presence of enteric pathogenic viruses detected by qPCR," adenovirus or

enterovirus was detected in between one and six samples for GUW locations (i.e., North Branch Dam, Lake Michigan harbors, Lake Michigan beaches, inland lakes, and rivers). This information on human enteric viruses, in conjunction with elevated levels of fecal bacteria indicators, implies that there is human fecal contamination of the water.

Furthermore, known point source discharges and combined sewer overflows (CSOs), as well as backflows of water from the CAWS to Lake Michigan, are all potential sources of human fecal contamination to GUW. While it does not appear that the CHEERS study includes specific information as to where GUW users were recruited or where water quality sampling took place within GUW waters, consideration of Figure I-3 entitled "Setting of the CHEERS Study" suggests that the Fox, Du Page, and Des Plaines River sites, as well as the North Branch Dam site, are subject to periodic CSO events (see: http://www.mwrd.org/irj/portal/anonymous/cso or http://map24.epa.gov/emr/) and receive wastewater treatment plant (WWTP) effluent (see http://www.epa.state.il.us/water/permits/waste-water/npdes-statewide.pdf). Furthermore, backflows of CAWS water into Lake Michigan were reported by the Metropolitan Wastewater Reclamation District (see: http://www.mwrd.org/irj/go/km/docs/documents/MWRD/internet/protecting%20the%20environment/Combined%20Sewer%20Overflows/htmls/Reversals.pdf) on three occasions during the CHEERS sampling period. Backflow of water from the CAWS, as a result of storm water and CSO flows, occurred where the North Shore Channel meets Lake Michigan once each year of the study, with the 2008 backflow also occurring where the Chicago and Calumet Rivers meet Lake Michigan. Thus, EPA does not agree with Dr. Dorevitch's assertion that it is "entirely reasonable to compare rates" of illness between CAWS and GUW user groups.

B. **Excerpt of EPA December 27, 2010 Comment**: ...there appears to be minimal reporting of what the relative fecal source attributions were for each day of the epidemiological study."

Excerpt of Dorevitch December 30, 2010 Comment: "CHEERS protocols were developed by adapting the USEPA's National Environmental and Epidemiological Assessment of Recreational Water (NEEAR) study. Neither that study nor, to the best of the research team's knowledge, any other epidemiologic studies, have attributed fecal pollution each day to different sources. It would be greatly appreciated if the USEPA could share with the research team a validated method for the daily source apportionment of fecal indicator bacteria."

EPA Comment: Previous epidemiological studies, including EPA's, have investigated the influence of prior rainfall events, bather densities, etc. (reflecting certain types of fecal source inputs) on illness rates. These studies have used weighted regression analysis to determine each type of fecal indicator (summarized in Wade et al., 2003), time of day of swim (Wade et al., 2006), which is a similar approach that has been used to select periods of specific fecal source or event's contribution such as bather density and preceding rainfall introducing sewage contamination (e.g. Wade et al., 2008 who used principal-components analysis to produce summary components [for beach-goer density,

temperature (water and air), rainfall, wind direction and debris, and wind speed and wave height]) to assess bather risk of gastrointestinal illness. Given the importance of knowing if the study subjects were exposed to sewage-impacted water or not, and available information suggesting that at least some GUW sites may have been subject to CSOs, WWTP, or CAWS backflow based on local knowledge of the Chicago systems studied, further consideration of source attribution and its contribution to illness rates in GUW waters, in a manner similar to the studies referenced above, appears to be warranted. Of particular interest due to the large number of participants, would be further exploration of sources in Inland Lakes.

Furthermore, where the CHEERS study attempts to include source attribution information for GUW waters, the potential influence of CSOs, WWTPs, and CAWS backflows did not appear to be adequately considered. Specifically, the CHEERS study states, "The frequent detection of human viruses above the WRPs and in GUW locations (but not at the North Branch Dam) raises questions about the virus sources. Bathers may be sources at Inland Lake and Lake Michigan locations, where point sources of human wastewater pollution are absent." The authors go on to say, "At the North Branch Dam relatively high concentrations of protozoan pathogens were detected but human enteric viruses were not. This suggests that the protozoan pathogens at this location may have a zoonotic source (i.e., animals living in the forest preserve system)." First, EPA notes that few samples overall were collected for enteric viruses. As such, interpretation of these data, while informative, should be considered in conjunction with all other available data on water quality and possible sources. Second, while the study group's hypothesis that human bathers are a contributing source of human pathogens to Lake Michigan beaches could be true, another source (given the range of pathogens and indicators identified) would appear more likely to be local wastewater inputs, such as periodic backflows from the CAWS into Lake Michigan, as reported for three occasions during the sampling for CHEERS. As for the suggestion that the North Branch Dam is polluted by a zoonotic source, it seems likely that the protozoan pathogens, enteric viruses and fecal indicators were contributed from CSOs of wastewater (of which there are several upstream of the North Branch Dam) or upstream WWTP inputs (at least one WWTP discharges upstream, although it is probably 10 to 20 miles upstream). The lower virus detection rate as compared to that of parasitic protozoa is normal for environmental waters, and in part can be explained for the study sites due to the time prior to CSO input or distance from WWTP that would have lead to a greater decreased in enteric viruses, but left the more robust protozoan oocysts input as a signal of earlier human sewage inputs. Furthermore, cattle (and wildlife) excrete large amounts of *Cryptosporidium* oocysts compared to *Giardia* cysts, and *Giardia* cysts dissipate more rapidly than oocysts in the environment. In contrast sewage has some orders of magnitude more *Giardia* cysts in it than oocysts, so a water with fecal indicators, plus occasional enteric viruses, plus higher counts of *Giardia* cysts than *Cryptosporidium* oocysts (as reported on pages II-81 and II-82) all likely adds up to a sewage-impacted waterway.

C. **Excerpt of EPA December 27, 2010 Comment:** "Since there was a 20% chance of making such a false-negative error, and both the CAWS and GUW appear to be polluted

with sewage, it is not surprising that the study did not detect a different level of health effect between the CAWS and GUW groups."

Excerpt of Dorevitch December 30, 2010 Comment: "The study clearly had enough statistical power to identify these differences in risk. In the case of the CAWS vs. GUW comparison, there was no suggestion of difference that appeared different but failed to reach statistical significance."

EPA Comment: The point being raised by EPA is that given the suggested sewage impact within both CAWS and GUW sites and given that a large number of epidemiological studies previously undertaken on sewage-impacted waters found about 11 illness per 1000 recreators in freshwaters, the fact that similar levels of illness were reported for both groups of recreational sites in the CHEERS study is not, in retrospect, unexpected. Thus, the results seem consistent with sewage-impact at both sites.

D. **Excerpt of EPA's December 27, 2010 Comment:** "... there are many differences between the population of CAWS and GUW users... that limit the usefulness of the comparisons between the CAWS and GUW groups."

Excerpt of Dorevitch December 30, 2010 Comment: "Comparisons of the illness rates between the CAWS and GUW groups were adjusted for the following 22 potential differences, as listed in Table V-42 of the August 31, 2010 CHEERS Final Report... The CHEERS peer review panel was familiar with the details for adjusting for potential confounders and they were comfortable with the analyses and findings."

EPA Comment: Given the weight of evidence for sewage impact into GUW sites, the 22 potential differences studied were not useful. Rather, basic environmental health data on fecal sewage as raised above should have been better studied and incorporated into the CHEERS study final report. As noted in Appendix D, a peer review commenter raised a similar issue with regard to the lack of difference between CAWS and GUW illness rates.

3. **Stool Sample Analysis**

Excerpt of EPA's December 27, 2010 Comment: "While EPA is aware that etiologic agents have been identified in other studies... the stool sample design chosen for CHEERS was very likely not to identify an etiologic agent."

Excerpt of Dorevitch December 30, 2010 Comment: "The team of infectious disease physicians, microbiologists, infectious disease epidemiologists, and other members of the research team were in agreement regarding the methods for obtaining stool samples, testing them, and the battery of specific analyses that the samples underwent. The peer reviewers did not indicate concerns regarding faulty designs or methods. We are aware of no epidemiologic study of this scale that tested stool samples for a more comprehensive array of bacterial, viral, and protozoan pathogens... The basis for EPA's concern regarding "stool sample design" was not stated. It would be helpful to the research team to understand this concern."

EPA Comment: EPA's comment appears to have been misunderstood. While the array of tests was good, too few samples were collected given the rate of infection and the likelihood of stool detection from such samples when compared to the expected background in the unexposed community. For example, the rate of shigatoxin in stools for people in Chicago or North America in general, is likely to be very low. Next, the likelihood of shigatoxin-producing *E. coli* in sewage (let alone surviving in the recreational waters) is likely to be very low. So, it appears that a very large number of samples (likely much larger than the number collected in this study) would be necessary to expect to see any shigatoxin-positive stools via the secondary-contact exposures studied in CHEERS. On the other hand, *Norovirus* infection is very common in the general community, so you may expect to see on average between 1-10% of stools positive in the community (depending on seasonal infections). As such, detecting a 1.2 to 1.3% increase in positive stool sample results due recreational exposure (as suggested as the maximum GI illness rate in the CHEERS study) over the background detection rate in stool samples, assuming all GI came from *Norovirus,* would take a large number of stool samples to have any statistical power, and even more samples would be necessary if *Norovirus* was not responsible for all GI illness. Since the CHEERS study identified no stool samples positive for *Norovirus* from either water recreation or unexposed groups, one would expect that it is extremely unlikely for the design to be able to link water recreation to increased incidence of pathogens in the stool of recreators. Furthermore, the peer reviewers expressed serious concerns about the stool analyses, as reported in Appendix D, which should be given adequate weight in evaluating these results. Specifically, a peer reviewer summarized that, "The stool results are at best inconclusive and should not be discussed in detail or in the executive summary. Due to non-compliance, differences in compliance across groups, days between illness and stool collection, low recovery rates and failure to sample asymptomatic people, the results have no bearing on risk determination or evaluation."

4. Uncertainty with Illness Rates

Excerpt of EPA December 27, 2010 Comment: "EPA is uncertain as to why there is an apparently the highest gastrointestinal illness rate for fishers/boaters, given that water exposure (of which they would be assumed to be the lowest) seems to link clearly to illness."

Excerpt of Dorevitch December 30, 2010 Comment: "The research team shares EPA's uncertainty regarding the cause(s) of the relatively high rates of acute gastrointestinal illness among fishers and motor boaters. It should be noted that these findings were not limited to individual recruitment locations, dates of enrollment or study group (CAWS and GUW)... It is plausible that pathogens are transferred from fish (and/or bait) to the hands and then ingested by fishers. This is thought to account for the elevated rate of gastrointestinal illness among fishers. In the case of motor boaters, the cause of symptoms is less clear. An activity that often takes place on boats is the consumption of food and alcohol. It is possible that food borne illness, alcohol-related gastrointestinal symptoms, and sea-sickness account for at least some of the elevate risk of illness among boaters."

EPA Comment: EPA believes that more work would need to be done before conclusions can be confidently drawn as to why fishers and boaters have a higher rate of gastrointestinal illness.

Public Comment 565 entitled "Responses to Information Requests at October 19 and 20, 2010 Hearings"

District Comment: In Public Comment #565, the Metropolitan Water Reclamation District (the District) provided cost estimates of retrofitting three facilities with nutrient removal technologies.

EPA Comment: In 2008, the U.S. Environmental Protection Agency Office of Wastewater Management published the *Municipal Nutrient Removal Technologies Reference Document,* which can be found at http://water.epa.gov/scitech/wastetech/upload/mnrt-volume1.pdf . The EPA document includes a detailed description of the various municipal nutrient removal processes used at WWTPs to meet various nutrient discharge levels. The document includes detailed performance and cost data using 2007 currency values for nine case studies from plants around the country and one in Canada that have successfully met their permit requirements. It also includes an executive summary that summarizes nutrient removal levels achievable by various technologies, including those that reduce effluent to 3 milligrams per liter (mg/l) of total nitrogen and 0.1 mg/l of total phosphorus.

The District provided a number of different estimates for nutrient removal, all of which appear to be substantially higher than any of the costs per unit of wastewater treated described in the ten case studies. We believe that the Board should take the EPA document into account; to the extent it is evaluating the potential costs of nutrient control in this subdocket.

References

Wade, T.J., Pai, N., Eisenberg, J.N., Colford, J.M., Jr., 2003. Do U.S. Environmental Protection Agency water quality guidelines for recreational waters prevent gastrointestinal illness? A systematic review and meta-analysis. Environmental Health Perspectives 111, 1102-1109.

Wade, T.J., Calderon, R.L., Sams, E., Beach, M., Brenner, K.P., Williams, A.H., Dufour, A.P., 2006. Rapidly measured indicators of recreational water quality are predictive of swimming-associated gastrointestinal illness. Environmental Health Perspectives 114, 24-28.

Wade, T.J., Calderon, R.L., Brenner, K.P., Sams, E., Beach, M.J., Haugland, R., Wymer, L., Dufour, A.P., 2008. High sensitivity of children to swimming-associated gastrointestinal illness: Results using a rapid assay of recreational water quality. Epidemiology (Cambridge, Mass 19, 375-383.