E. COLI STREAM STANDARDS; AN UNREALISTIC GOAL?

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ABSTRACT

The Urban South Platte River (USP) runs through the center of metropolitan Denver, Colorado. Since 1998, the watershed has been extensively monitored for E. coli. Comprehensive data from the watershed study will be presented to demonstrate that proposed regulatory limits of 126 cfu/100 ml of sample will be difficult, if not impossible, to attain. Previously unpublished E. coli data from a USGS urbanization impact study in the same geographic area demonstrates similar findings and show that there is also no relationship between the degree of urbanization and E. coli concentrations.

KEYWORDS E. coli, microbiology, watershed, stream standards.

INTRODUCTION

The South Platte River originates high in the Rocky Mountains and exits from the mountainous regions just before the urban Denver metropolitan region. The South Platte River then runs north through the center of metropolitan Denver, Colorado. Near Greely, Colorado, it turns east and eventually becomes part of the Missouri River. Since 1998, the urban Denver watershed has been extensively monitored by the South Platte Coalition for Urban River Evaluation (SPCURE) watershed study group. The stretch of the river researched for this article includes a run of ~50 miles for Chatfield dam south of Denver to near rural Platteville, Colorado. The area of the study is presented in Figures 1a and 1b. In figure 1a the South Platte River in Colorado is shown in blue and the general area of the urban watershed study is shown in the orange ellipse. A more detailed look at the area is presented in Figure 1b; the watershed starts at Chatfield dam and runs north to near Platteville located on the western edge of the Great Plains.

Figure 1a. The general area of interest for the watershed study.

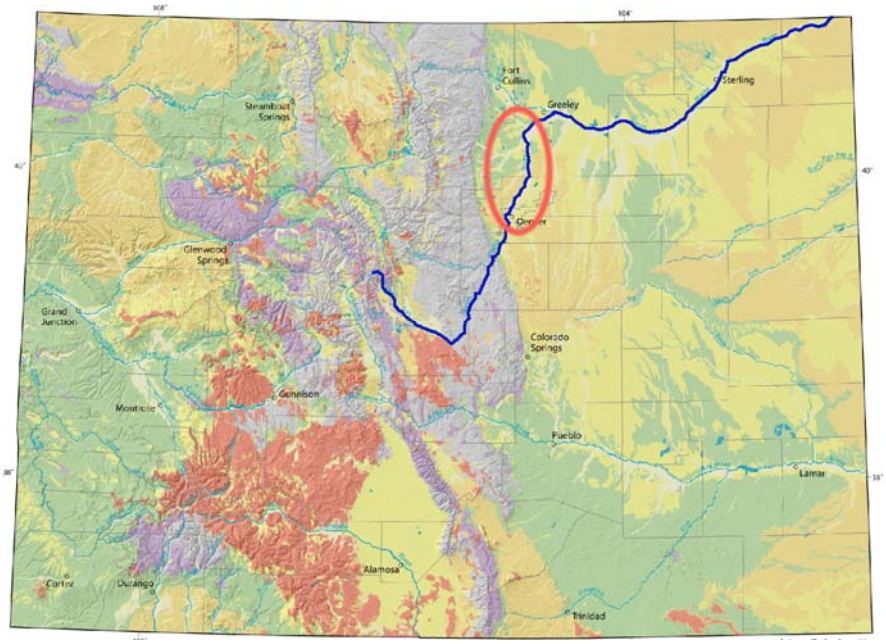
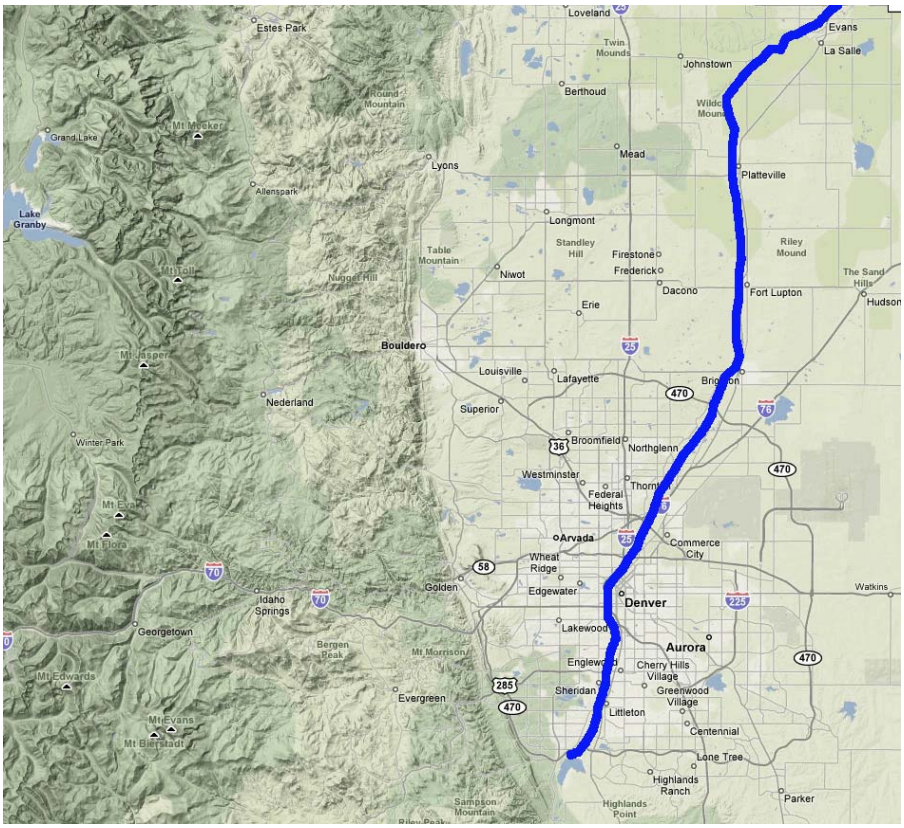


Figure 1b. A more detailed map of the area of interest.

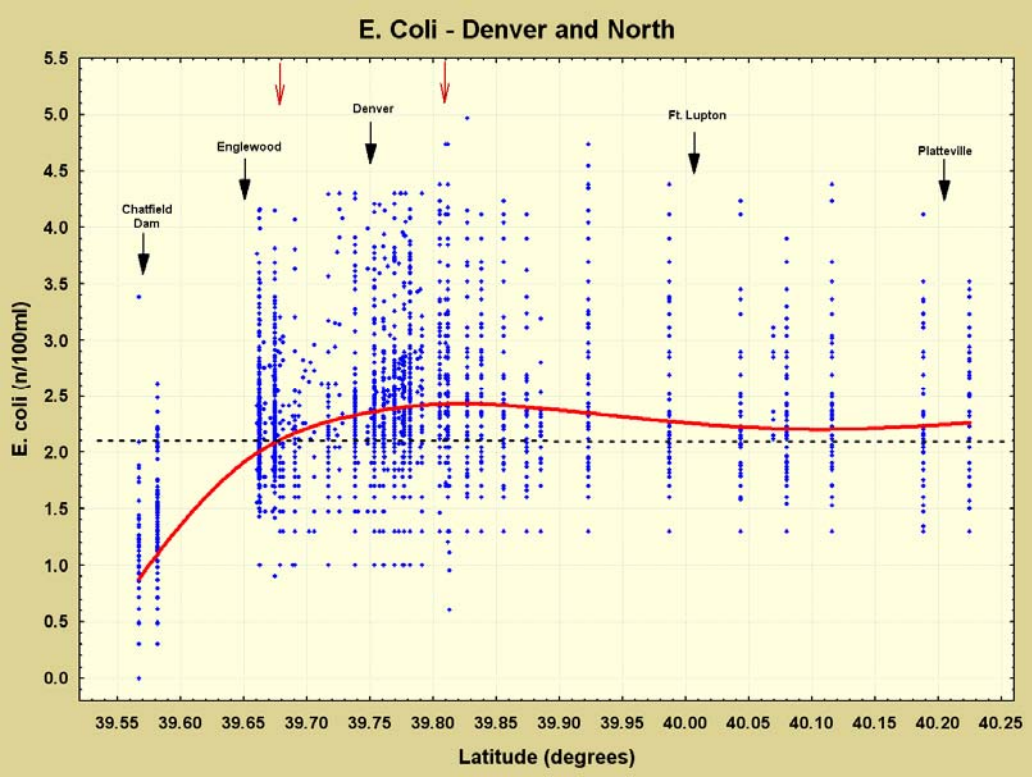


One of the variables measured during the period since the watershed projects inception has been E. coli. Under USEPA direction, the State of Colorado has been requiring increased monitoring for E. coli by various utilities in anticipation of protective stream limits for E. coli (126 cfu/100ml of sample). The use of an E. coli standard seems to be based on the premise that E. coli are an accurate predictor of human fecal contamination. A literature review by SPCURE indicates that there are considerably more sources than humans, including pets, wildlife (mammalian and non-mammalian), and even fish. Further contributing to the problem is the observation that recent advances in E. coli methods may have produced higher than expected values because of increased sensitivity compared to previous methods.

RESULTS

E. coli samples and analyses have been conducted by SPCURE members since 1998. The results of all the SPCURE participants are presented in figure 2. Since the South Platte River runs consistently northward and sample sites were referenced by geographical coordinates, river distance, south to north, is presented in degrees latitude. E. coli measurements are presented as Log_{10} values (1.0 = 10, 2.0 = 100, 3.0 = 1000, etc.); the black dotted line indicates the proposed E. coli stream limit of 126 cfu/100ml. The location of various cities and towns along the river is presented in the upper part of the graph. The two red arrows indicate the location of two wastewater treatment facilities that discharge into the river at rates of 30 and 200 mgd, respectively. The red line running through the data points is a least square model fit to the data.

Figure 2. E. coli Data for Urban South Platte.

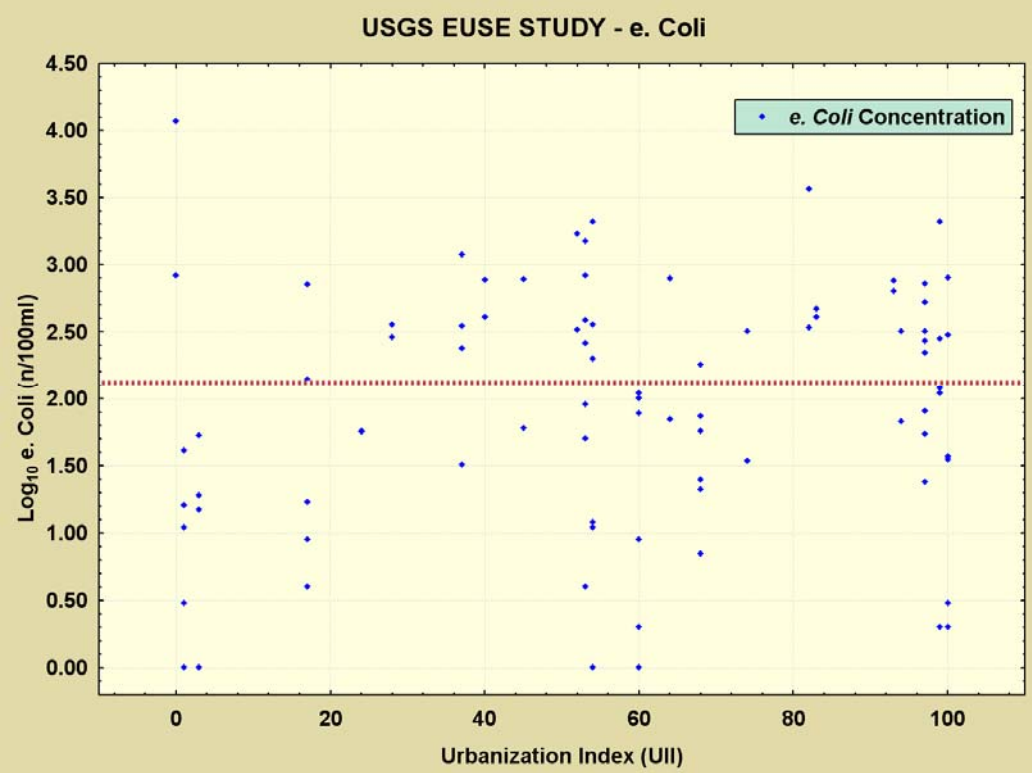


DISCUSSION AND CONCLUSIONS

While it seems to be common knowledge that natural E. coli levels in streams and rivers can exceed stream limits of 126 cfu/100ml, a large study like that of the Denver urban watershed has not been previously presented. The portion of the river investigated included water below a reservoir, a river surrounded by suburbs, a river running through a metropolitan city, a river running through an industrial area and finally a long run through grass and farm lands. In figure 2 it is readily apparent that no matter where you examine E. coli in the urban South Platte (except in near proximity to a reservoir) (1) E. coli levels are extremely variable, (2) E. coli levels average the same regardless of location and (3) on average, and are often above, the proposed stream standard. There is also a seasonal variation in the data with lower values typically being observed in the winter and higher values in the summer. It is also observed that side streams have higher average values than the South Platte River itself. E. coli in sediments are currently being studied and appear to follow similar seasonal and spatial trends in the water body being studied.

A study to determine urban impact on the Colorado and Wyoming Front Range was conducted by USGS in 2002-2003. While E. coli data was collected, it was not presented in the original report (Sprague 2006). The author graciously shared the data with this author and it is presented in Figure 3. The area of the study included the Front Range from south of Denver into South-central Wyoming. The calculated degree of urbanization is presented on the x axis with a high number indicating a high degree of urbanization. This data the mirrors and supports conclusions made from the SPCURE watershed study data and also indicates that there is no relationship between urbanization and measured E. coli concentrations (at least in the arid area east of the Rocky Mountain region).

Figure 3. E. coli from USGS ESUE Regional Study, Rocky Mountain Front Range.



It would appear that normal E. coli concentrations observed in urban and more "natural" waters consistently and frequently exceed proposed stream standards. If that is the case:

A. Should a more reasonable stream standard for E. coli (or other indicator microorganisms) be developed?
B. Should BMPs be considered the best methods to assure protection from human transmitted infection?
C. Should natural streams be subject to intrusive remediation efforts to met proposed stream/safety standards?
D. Should better methods be developed to identify and quantify specific human pathogens?

REFERENCES

Sprague, Lori A, et. al. 2006. *Effects of Urbanization on Stream Ecosystems in the South Platte River B Basin, Colorado and Wyoming.* U.S. Geological Survey, Scientific Investigations Report 2006-5101-A. U.S. Geological Survey, Reston, Virginia.