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Non-primary Water Quality Recommendation for *E. coli* in Recreational Waters

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Executive Summary

The Asheville, NC stretch of the French Broad River (FBR) is an important asset for the city and surrounding communities. In recent years, recreational use of the FBR has increased to include tubing as a favorite pastime for tourists and locals alike. The FBR is known to have historical episodes of fecal matter contamination it was formally placed on North Carolina's Impaired Waters 303(D) list due to exceedance of the state's fecal coliform criteria (Gurney, 2022). To better inform the public about using the FBR to recreate safely, a group of scientists from the North Carolina Department of Environmental Quality (DEQ) has been working to create a real-time model to predict *E. coli* concentrations in the water. This model, available online, will provide real-time conditions of the FBR for anyone to view prior to engaging in primary or non-primary recreational activities.

The North Carolina Department of Health and Human Services (DHHS) has partnered with DEQ to interpret these predictions and provide fresh water recreational guidance values for *E. coli*, which can be applicable to all of North Carolina's recreational water bodies. The Buncombe County Health Department was consulted to aid with signage and written communications about these guidance values. DHHS has concluded that the United States Environmental Protection Agency's (U.S. EPA) 2012 Recreational Water Quality Criteria (RWQC) of 126 CFU/100 mL of *E. coli* for primary contact should be the basis for any public health guidance and communications regarding recreating in surface waters. Additionally, DHHS used recently updated EPA guidance (U.S. EPA, 2022) to calculate a non-primary contact recreational guidance value of 886 CFU/100 mL of *E. coli*. This value would be applicable to activities such as tubing, rowing, kayaking, etc. that do not necessarily involve full contact with the waterbody. These guidance values are not enforceable standards but are intended to inform the public about scenarios where there may be an elevated health risk.

Background

In 2012, the U.S. EPA established a Recreational Water Quality Criteria (RWQC) pertaining to primary contact recreation (U.S. EPA, 2012). The document established a value based on "activities when immersion and ingestion are likely and there is a high degree of bodily contact with the water, such as swimming (U.S. EPA, 2012)." In January 2022 a follow-up document was published to give guidance for

"non-primary contact exposure scenarios" such as boating, canoeing, kayaking, etc (U.S. EPA, 2022). The equation for determining non-primary concentrations were used to calculate a non-primary recreational guidance value for all of North Carolina's recreational water bodies. This value was then shared with DEQ to provide context for values generated from the *E. coli* monitoring model.

Determination of Non-primary Contact Concentration

For calculating a non-primary recreational guidance concentration, DHHS used the equation developed by the USEPA, shown in Figure 1. In this equation, the U.S. EPA's 2012 RWQC of 126 CFU/100 mL of *E. coli* was used to represent the concentration of the Fecal Indicator Bacteria (FIB). Recreational ingestion rates reflecting the upper confidence levels of 140 mL per hour for the primary (swimming) ingestion value, and 19.9 mL per hour for the non-primary (canoeing) ingestion value were selected from the EPA Exposure Factor Handbook (U.S. EPA, 2019). As shown in Equation 1, the ingestion values cancel out units to form a ratio, which is then multiplied by U.S. EPA's 2012 RWQC. The non-primary recreational guidance concentration was calculated to be 886 CFU/100 mL of *E. coli*.

Figure 1: Excerpt from "An Approach for Applying EPA's 2012 Recreational Water Quality Criteria Recommendation to Non-primary Contact Exposure Scenarios" - White Paper – January 2022

$$C^{FIB}_{non-primary} = C^{FIB}_{primary} \times \frac{I_{primary}}{I_{non-primary}}$$

where:

$C^{FIB}_{primary}$ = the concentration of fecal indicator bacteria (FIB) associated with a particular risk of illness during primary contact recreation.

$C^{FIB}_{non-primary}$ = the concentration of FIB in the same ambient water associated with the same risk of illness during non-primary contact recreation.

$I_{primary}$ = the amount of ambient water incidentally ingested during primary contact recreation as described in EPA's 2012 RWQC.

$I_{non-primary}$ = the amount of ambient water incidentally ingested during a specific non-primary contact recreational activity.

Equation 1

$$C^{FIB}_{non-primary} = 126 \text{ CFU/100 mL } X \frac{140\ mL}{19.9\ mL} = 886 \text{ CFU/100 mL}$$

Use of Most Probable Number (MPN) and Colony Forming Units (CFU)

The U.S. EPA established the 2012 RWQC with *E. coli* being one of two Fecal Indicator Bacteria as reference. The values given are in Colony Forming Units per 100 mL (CFU/100 mL) because this is how bacteria are counted in water samples. However, when *E. coli* modeling occurs, samples are not evaluated but instead are estimated based on historical water quality data. The units used in *E. coli*

modeling is Most Probable Number (MPN), a statistical derivation. Literature searches and discussions have not yielded a noticeable difference between the two units, and for the purpose of this project, DHHS has determined the two units to be interchangeable. Hourly values predicted by the model (MPN) will be directly compared to the calculated non-primary contact recreational guidance concentration (CFU/100 mL).

Further Reading

For more information about *E. coli* and its impact to the French Broad River, DEQ developed a FAQ page that addresses many common questions.

References

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