North Carolina
Secretaries' Science Advisory Board

Official Recommendation
For the Human Health Risk Assessment for 1,4-Dioxane in Drinking Water Legislative Report

December 3, 2025

Background:

In September 2023, the North Carolina General Assembly directed the North Carolina Department of Environmental Quality (NCDEQ) to prepare a human health risk assessment of 1,4-dioxane in drinking water with empirical support from peer-reviewed scientific studies. During the December 2023 Secretaries' Science Advisory Board (Board) meeting, the Board discussed the difficulty of meeting the legislative timeline, recommending a strategy to meet the requirements in the allotted timeframe. That strategy entailed using the U.S. Environmental Protection Agency's *Framework for Human Health Risk Assessment to Inform Decision Making*, incorporating the most recent 1,4-dioxane systematic reviews and syntheses, and searching for recently published studies that may be relevant to the assessment. In January 2024, NCDEQ followed the Board's suggested strategy and convened a group of experts to begin the assessment. In May 2024, NCDEQ delivered their *1,4-Dioxane in Drinking Water Legislative Report* to the Joint Legislative Commission on Governmental Operations. The request posed by NCDEQ and the Board's summarized response are provided below.

The request posed to the Board by NCDEQ during the April 2, 2025, meeting was to:

Review the May 2024 Human Health Risk Assessment for 1,4-Dioxane in Drinking Water to provide formal feedback regarding whether the approach and findings of the report are scientifically reasonable.

The Board's approach:

The assessment and charge to the Board was provided to all Board members in advance of the April meeting. At that meeting, the Board conducted a review of the methodologies, data, assumptions, and findings of the report. In addition to the opportunity for Board members to provide general feedback, questions posed to guide feedback included the following:

- Are the methods appropriate, and were they described clearly and in sufficient detail to allow for replication?
- Are the data reliable and adequate, clearly described / properly cited and referenced?
    - Is the drinking water exposure pathway well characterized?
    - Are the hazard data clear and adequate, and is the use of a cancer slope factor reasonable?
    - Is the dose-response relationship appropriate and supported by the data?
- Are the conclusions consistent with the evidence, and are they valid and clearly stated?

A synopsis draft of the input received at the April meeting was circulated to Board members for refinement in September 2025. That draft was further discussed at the October 2025 meeting, and a revised draft was circulated for review in early October.

The Board's response:

The Board discussed all categories of the report and considered the methodology to be appropriate, concurring that all steps from EPA's HHRA for Decision-Making Framework were followed. The Board noted that the drinking water exposure characterization applies only to the general population and does not include supplementary information about sensitive subpopulations or any other pathways of exposure (which was appropriate as the legislative request specified drinking water).

Appropriate exposure data sources and quality assurance / quality control measures were used to create a new and valuable synthesis of 1,4-dioxane occurrence across North Carolina. The level of detection for 1,4-dioxane was less than the health screening value, which is advantageous for risk characterization (i.e., results reported as less than detections may be presumed safe, versus uncertain). The statistical summary of the exposure data is reasonable.

The Board notes that the hazard assessment did not include a new systematic review. However, the data sources used to derive the hazard and dose-response portions of the assessment were collected from comprehensive systematic review documents (which underwent peer and public review), including the IRIS assessment which is considered the most health-protective of the toxicity reference values derived since a wide array (multiple species, multiple sites of toxic action) of studies are reviewed during the IRIS process. All formal assessments of 1,4-dioxane produced by a federal agency were included in the effects assessment, and any new peer-reviewed scientific studies published since the last comprehensive report was published were included and reviewed. The hazard assessment presents recent references with differing perspectives regarding the mechanism of action for 1,4-dioxane toxicity and low dose extrapolation. The hazard assessment provides a complete and transparent rationale for selection of a no threshold approach. The assumptions and uncertainties are documented. The hazard assessment used the IRIS assessment's oral cancer slope factor. The IRIS document has extensive documentation on the study selection, model fitting, and uncertainty around this cancer slope factor. The Board calls attention to that discussion moving forward, but they do not question DEQ's use of that cancer slope factor.

The Board acknowledges that the report's employment of margin of exposure as a method of characterizing anticipated risk for carcinogenic substances is reasonable and is a peer-reviewed method consistent with U.S. and international practice. The Board also notes that it is scientifically reasonable to truncate the exposure data non-detects that fall below the health-based screening level and communicate the frequency of detections above the screening level to provide summary statistics of these frequencies.

The Board prioritizes clear information communication, which can be implemented in various ways. The Board finds the graphs and tables in the final report to be appropriate in conveying the geographic extent and magnitude of exposures. The Board encourages making data sources from which the report is derived publicly available.

Overall, the Board recommends that NCDEQ's human health risk assessment, *1,4-Dioxane in Drinking Water Legislative Report*, be among the resources used to inform and support decision-making next steps, as the methods, data, analysis, and conclusions are scientifically reasonable and defensible.

The recordings of the Board discussions of the topic at can be found here: December 2023; April 2025; October 2025; December 2025.

Tom Augspurger, PhD
NC SSAB Chairperson