Exhibit 577

Rebuttal Report by Richard J. Schuhmann, Ph.D.:
Observations regarding the expert reports of Judy S. LaKind, Ph.D.

***In re Camp Lejeune Water Litigation*, No. 7:23-cv-00897, (E.D.N.C.).**

Prepared by

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May 13, 2025

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I. Background.

I was retained by Plaintiffs and asked to review and comment on expert reports issued by Dr. Judy S. LaKind relating to the modeling and calculations associated with the ATSDR SHOWER Model that she performed in a number of reports for the plaintiffs. I was not asked to comment on her other modeling. In addition to reviewing Dr. LaKind's expert reports, I also reviewed discovery documents, documents in my files, and relevant Internet resources; these documents and resources are footnoted throughout this report as they are relied upon. I may review data, documents, and reports as they are provided to me in the future, and I reserve the right to amend and/or revise my observations and opinions based upon this additional information.

II. Qualifications.

I hold a Ph.D. in environmental engineering from the Pennsylvania State University (Penn State), a Master of Science degree in environmental engineering from the University of Houston and a Bachelor of Science degree in geology from the University of New Hampshire. I taught engineering topics (*e.g.*, civil engineering, environmental engineering and engineering design) at Penn State and the Massachusetts Institute of Technology (MIT), which included quantitative risk assessment in the context of environmental engineering at Penn State, and risk perception, risk analysis and risk management in the context of engineering project planning, management and leadership at MIT. I also supervised undergraduate (cross-disciplinary) and graduate (surface water hydrologic modeling) engineering thesis research at both institutions for over sixteen years. These projects included the design and operation of mechanical systems and stormwater modeling at Penn State, as well as a multi-year hydrologic modeling study in eastern Uganda for MIT.

I have more than 30 years of experience as a technical consultant in the assessment and evaluation of environmental and engineered systems including groundwater contamination, ambient air dispersion, and indoor air exposures (*e.g.*, volatile contaminants partitioning to air during showering, soil vapor intrusion, particle infiltration from ambient air) in the United States and overseas. I have managed multi-disciplinary teams of scientists and engineers on large multi-year, multi-media environmental evaluation projects associated with litigation. I have been recognized and testified in state court as an expert in the quantification of industrial emissions and the modeling of their transport and fate in the environment, and recognized by state and federal courts as an expert in quantitative risk assessment. I have specific experience with the CDC-ATSDR SHOWER model,[1] having downloaded V.3.0 in April 2023 and subsequently V.4.0

[1] For general information see ATSDR website, webpage entitled "Estimating Site-Specific Inhalation Exposures" at https://www.atsdr.cdc.gov/pha-guidance/conducting_scientific_evaluations/epcs_and_exposure_calculations/estimating_inhalation_exposures.html (last visited 5/6/25).

when it was released in September 2024.[2] I have also been authorized for access to the restricted Public Health Assessment Site Tool (PHAST)[3] since September 2024.

My curriculum vitae and an abbreviated summary of consulting projects (1993 – 2025) are provided separately.

III. Overview.

Based on my review and analysis of the information provided, I have formed the following opinions with regard to the reports of Dr. LaKind. These opinions are held to a reasonable degree of scientific certainty based on the facts and data available to me at this time.

In her reports, Dr. LaKind purports to use various models to conservatively estimate Plaintiff exposures in the past based upon the contaminant levels estimated by the ATSDR in connection with Camp Lejeune. Thus, for example, for plaintiff Allan Howard, a kidney cancer case, she states: "I use four models to estimate Mr. Howard's past exposures to the Agency for Toxic Substances and Disease Registry's (ATSDR) modeled monthly concentration estimates of PCE, TCE, DCE, VC, and benzene in water at Camp Lejeune: one for the dermal/inhalation routes of exposure, one for the oral route of exposure (water ingestion), one for air concentrations at swimming pools, and one for air concentrations in mess halls."[4]

This report focuses on Dr. LaKind's ATSDR SHOWER modeling analyses related to inhalation exposure concentrations. As discussed below, some important model inputs relied upon by Dr. LaKind are not conservative. I discuss this in connection with two topics discussed below:

Topic 1 - Site-specific flow rates would increase the modeled exposure concentrations. Dr. LaKind wrote that where possible and scientifically supportable she used conservative assumptions for determining model inputs; however, information on site-specific flow rates from Camp Lejeune indicates that her assumptions are not conservative and that using these site-specific flow rates would result in higher exposure concentrations.

Topic 2 - Alternative reasonable conceptual models of the distribution (*i.e.*, timing) of modeled showers at communal facilities would increase exposure concentrations. Dr. LaKind developed a barracks showering conceptual model that assumed a single peak period for shower use with showers then spread (*i.e.*, distributed) throughout the entire 24-hour period of the day/night; however, other, arguably more reasonable, conceptual models would result in higher exposure concentrations.

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[2] Note: V.4.0.1 was released November 19, 2024 as an update.

[3] *See generally* Burk T, Mellard D, Ulirsch GV, Li Z (2022). Public Health Assessment Site Tool and Affiliated Applications: A Key Resource for Evaluating the Health Impact of Community Exposure to Hazardous Chemicals. J Environ Health. 2022 Nov. 85(4):40-42 (describing that ATSDR conducts public health assessments (PHAs) to investigate exposure to environmental contaminants, evaluate potential health effects, and develop action plans; to improve quality and consistency of PHA work, ATSDR developed PHAST).

[4] LaKind report for Howard dated 4/8/25, p. 10.

IV. Discussion.

A. The ATSDR SHOWER model.

Dr. LaKind employed the CDC-ATSDR Shower and Household Water-use Exposure (SHOWER) model V.4.0.1, which "allows health assessors to rapidly evaluate inhalation and dermal exposures to volatile contaminants from various indoor water sources. Using only the name of a contaminant, its concentration in water, and basic simulation parameters, health assessors can quickly determine daily air concentrations, dermal doses, and, if appropriate, inhalation doses for exposed persons".[5]

The technical document supporting the SHOWER model V.4 has not yet been released and a rigorous description of its mechanics is outside the scope of this report. Of value, however, in understanding the fundamental first principles of how the SHOWER model functions is a brief review of the fundamental model used by ATSDR in the 2017 PHA to estimate concentrations of contaminants in air resulting from showering, developed by Andelman (1990):[6]

$$C_{a,MAX} = \frac{(C_w f F_w t_d)}{V_a}$$

where
$C_{a,MAX}$ = maximum concentration of contaminant in air at the end of shower time (t_d)
C_w = concentration of contaminant in water (ug/L)
f = fractional volatilization (dimensionless)
F_w = volumetric flow rate of shower water (L/min)
t_d = time to end of shower (min)
V_a = volume of shower compartment (L)

From the equation above it can be seen that the exposure concentration ($C_{a,MAX}$) is in part a function of the mass emission rate (m_{dot}) into the compartment:

$$m_{dot} = (C_w f F_w)$$

where
m_{dot} = mass emission rate (ug/min)

The concentration of contaminants (C_w) in the water (*i.e.,* monthly concentrations developed by ATSDR) and the fractional volatilization (f) of contaminants from water (*i.e.*, the physical partitioning property that is chemical-specific) are both "fixed" values (*i.e.*, pre-determined). The shower flow rate(s) (F_w), however, is contextual to the exposure scenario (*e.g.*, residential vs.

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[5] ATSDR (2025). Agency for Toxic Substances and Disease Registry Shower and Household Water-use Exposure (SHOWER) Model Version 4.0 User's Guide, Release Date: September 25, 2024, Last Update: January 31, 2025.
[6] Andelman, J.B. (1990). Total exposure to volatile organic compounds in potable water. In: Ram, N.M., Christman, R.F., Cantor, K.P., editors. Significance and treatment of volatile organic compounds in water supplies. Chelsea, Michigan: Lewis Publishers, p. 485-504 (equation on page 499).

barracks; Hadnot Point vs. Tarawa Terrace) and involves additional investigation and thought by the user of the model.

The SHOWER model requires the user to either select a default exposure scenario or create a custom scenario using user-defined assumptions and/or site-specific parameters, including shower flow rate (F_w). Dr. LaKind asserts that she used conservative assumptions for determining model inputs and subsequently the results of her evaluation are conservative:

> "It is important to note that, where possible and scientifically supportable, conservative assumptions were used for determining model inputs. Conservative assumptions are those that tend to produce higher estimates of exposure. They are used to avoid underestimating exposures. In other words, conservative assumptions produce "a[n] estimate that tends to err on the side of caution or gives a 'worst case scenario'" and are "[o]ften used in risk assessment to ensure that as much risk as possible is taken into account."[7]
>
> "…I have chosen to utilize values and assumptions for the exposure assessment in this Report that would tend to overestimate exposure (i.e., provide conservative exposure estimates)."[8]

Although in many cases Dr. LaKind did employ conservative input parameters, in some cases it appears she did not. The following observations focus on: (1) flow rate input(s) (*e.g.*, including shower head flow rate, F_w) in residences and bachelor housing and (2) the distribution (*i.e.*, timing) of multiple showers in a barracks facility across a 24-hour period, which relates to the length of time in which emissions are constrained, and thereby affects the exposure concentration.

B. Observations reviewing LaKind reports.

Given the scope of this review, the focus will be on the parameters of (1) flow rates and (2) the distribution (*i.e.*, timing) of modeled showers in a communal facility (*i.e.,* barracks), both of which affect the exposure concentration of contaminants in air.

1. Flow rates.

The water flow rates assigned to shower heads, toilets, and sinks for bachelor and family housing in Dr. LaKind's SHOWER modeling analyses do not appear to be conservative for Camp Lejeune, as they are lower than the site-specific water flow rates reported in the 1999 Marine Corps Base Camp Lejeune and Marine Corps Air Station, New River Water Conservation Analysis report[9].

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[7] LaKind Expert Report relating to Mr. Howard, 04/08/25, page 12.
[8] LaKind Expert Report relating to Mr. Howard, 04/08/25, page 18.
[9] Note: LaKind's assigned shower head and toilet flow rate were not lower than those reported for Berkeley Manor, however, it does not appear that any of the Plaintiffs resided at Berkeley Manor.

Higher water flow rates (in particular, higher shower head flow rates) tend to lead to higher exposure concentrations. The tables below are illustrative of how site-specific flow rate inputs affect the modeling, resulting in "more conservative" results (*i.e.*, higher exposure concentrations) than those obtained by Dr. LaKind.

Table 1 below shows the appliance flow rates used as inputs by Dr. LaKind and site-specific flow rates from discovery documents[10]. As shown in Table 1, all the reported site-specific flow rates are higher than the flow rates applied in Dr. LaKind's SHOWER modeling analyses except for the shower and toilet flow rates at Berkeley Manor (however, it does not appear that any of the Plaintiffs resided in the Berkeley Manor neighborhood).

Table 1. Appliance Water Flow Rates[11]

		Site-Specific[a]							
		Bachelor Housing	Family Housing						
Appliance/Fixture	LaKind[b]	Hadnot Point French Creek Camp Johnson Naval Hospital MCBCL Paradise Pt	Paradise Point	Berkeley Manor	Watkin Village	Tarawa Terrace	Midway Park	Knox Mobile Home Park	Hospital Point
Shower heads (L/min)	7.6	17.0	9.5	7.6	9.5	9.5	9.1	11.4	13.2
Faucets[c] (L/min)	3.34	13.2	12.5	9.5	12.5	10.6	10.6	11.4	11.4
Toilet volume per flush (L/flush)	8.7	17.0	17.2	6.1	17.0	15.5	11.2	15.1	15.1

a. Average flow rates reported in ECG (1999). Marine Corps Base Camp Lejeune and Marie Corps Air Station, New River Water Conservation Analysis

b. Flow rates shown in Attachment 1 of Dr. LaKind's Expert Reports, 04/08/25

c. Dr. LaKind's flow rates for communal and residential faucets are 3.34 L/min and 3.347 L/min, respectively (Attachment 1 of Dr LaKind's Expert Reports, 04/08/25)

To visualize how many times greater the reported site-specific flow rates are compared to Dr. LaKind's input values, ratios of the site-specific flows rates to Dr. LaKind's flow rates are provided in Table 2, below (*i.e.*, the site-specific flow rates were divided by Dr. LaKind's flow rates, and the resulting values presented in Table 2). As can be seen in Table 2, all the ratios are greater than 1.0, except for the shower heads and toilets at Berkeley Manor (however, it does not appear that any of the Plaintiffs resided at Berkeley Manor). Given that the mass emission rate of a contaminants from water passing through an appliance (*e.g.*, shower head) is proportional to the water flow rate associated with that appliance, higher water flow rates tend to lead to higher exposure concentrations.

[10] Dishwasher and washing machine flow rates were not evaluated in this scoping analysis.

[11] Site-Specific average flow rates reported in: ECG (1999). Marine Corps Base Camp Lejeune and Marine Corps Air Station, New River Water Conservation Analysis. December 1999.

Table 2. Ratios of site-specific flow rates to Dr. LaKind's model input flow rates

Appliance/Fixture	Ratio of site-specific flow rates to LaKind's							
	Bachelor Housing	Family Housing						
	Hadnot Point French Creek Camp Johnson Naval Hospital MCBCL Paradise Pt	Paradise Point	Berkeley Manor	Watkin Village	Tarawa Terrace	Midway Park	Knox Mobile Home Park	Hospital Point
Shower heads	2.2	1.2	1.0	1.2	1.2	1.2	1.5	1.7
Faucets	4.0	3.7	2.8	3.7	3.2	3.2	3.4	3.4
Toilet volume per flush	2.0	2.0	0.7	2.0	1.8	1.3	1.7	1.7

As an example, when bachelor housing site-specific appliance flow rates are incorporated into Dr. LaKind's communal SHOWER modeling analysis of Mr. Howard, it can be seen in Table 3 that the resulting average daily TCE exposure concentrations are more than double those output by Dr. LaKind.

Table 3. CTE and RME daily exposure concentrations for all persons using the communal bachelor housing facility at Hadnot Point, Camp Lejeune (September 1977 – February 1979): TCE (example: Howard)

Exposure Type	Avg Daily TCE Exposure Concentration (ug/m^3)		Ratio of "site-specific" to "LaKind"
	LaKind[a]	LaKind with site-specific water flow rates for bachelor housing[b]	
CTE	10	23	2.3
RME	23	50	2.2

a. LaKind Expert Report relating to Howard, 04/08/25, page 39; and associated LaKind Attachment 1 relating to Howard, page 39 of 60.

b. Attachment 1 of this report relating to Howard, p. 3 of 15.

Similarly, when Tarawa Terrace site-specific flow rates are incorporated into Dr. LaKind's residential SHOWER modeling analysis of Mr. Downs, it can be seen in Table 4 that the resulting average daily PCE exposure concentrations increase and are 1.3 to 1.4 time higher than those output by Dr. LaKind.

Table 4. Average daily exposure concentrations in a residence at Tarawa Terrace, Camp Lejeune (February 1960 – September 1961): PCE (example: Downs)

Exposure Type	Average Daily PCE Exposure Concentration (ug/m³)		Ratio of "site-specific" to "LaKind"
	LaKind[a]	LaKind with site-specific water flow rates for Tarawa Terrace family housing[b]	
7 min shower	9.4	13	1.4
20 min shower	37	48	1.3

a. LaKind Expert Report relating to Downs, 04/08/25, page 42; and associated LaKind Attachment 1 relating to Downs, pp. 18 and 63 of 120.

b. Attachment 1 of this report relating to Downs, pp. 3 and 18 of 30.

2. Distribution (*i.e.*, timing) of modeled showers at a communal facility (*i.e.,* barracks).

Dr. LaKind writes, regarding a barracks communal facility conceptual model:[12]

> "Peak shower times: The SHOWER model includes two scenarios regarding timing of shower use: (i) people in the barracks use the facility at a constant rate over the course of the day, or (ii) there are one or more peak times for shower use. It is not unreasonable to assume that early morning might be a peak time for shower/bathroom usage. The assumption of a 1-hr morning or evening peak period for bathroom/shower usage yields more conservative (higher) results compared to a constant usage scenario (see results for a hypothetical scenario in Table 3). The daily exposure concentrations are the same regardless of whether the peak occurred in the morning or evening. For this Report, <u>I assumed that the facility used by Mr. Howard experienced a peak usage period from 6:00-7:00 am</u>."

Dr. LaKind assumed a single peak showering time with off-peak showers spread throughout the day/night:[13]

> "Many plaintiffs recalled that while there may have been peak shower times, the barracks showers were often used throughout the day. The SHOWER model accounts for this. As described in the model, when assuming a peak period for shower use (as was done in this Report), while modeled people arrive more often during the peak than during the rest of the barrack's operating hours, the rate of arrival increases linearly up until the peak time, stays constant during the peak period, and then decreases linearly afterwards."

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[12] LaKind report relating to Mr. Howard, 04/08/25, pages 34-35.

[13] LaKind report relating to Mr. Howard, 04/08/25, page 35.

Given a group of 72 Marines (*i.e.*, the number of marines Dr. LaKind assigned to the communal facility used by Howard), Dr. LaKind's assumption results in an average of: ~17 Marines regularly showering between 00:00-06:00 (hours during which some sleep may occur), ~6 Marines regularly showering during the designated "peak" 1-hour time period (06:00-07:00), and ~49 Marines regularly showering between 07:00-00:00, with ~35 of those Marines regularly showering between 09:00-17:00 (*i.e.*, almost 50% of the Marines are "scheduled" to shower during the "work day"). Given the unknowns, this is certainly one way of conceptualizing the group showering behavior; however, it is not a conservative assumption if most showers are in fact not regularly occurring during work hours (or commonly occurring during sleeping hours), but instead are concentrated within a discrete period or within discrete periods of the day (*e.g.*, in the morning and in the evening). For example, if an alternative conceptual model is chosen, such that there are two discrete showering periods analyzed for a day, one in the morning and one in the evening, with the showers "closed" during working hours when Marines are mostly working and "closed" during sleeping hours when Marines are mostly sleeping, then the resulting concentrations of contaminants in air within the barracks showers would be greater than those observed with Dr. LaKind's conceptual model (*i.e.*, the total mass emission of contaminants is constrained to briefer showering periods resulting in increased exposure concentrations during those time periods). In other words, higher exposure concentrations result if the timing of the modeled showers are concentrated within a discrete period (or discrete periods) of the day instead of being spread/distributed across an entire 24-hour day.

Conclusion.

Dr. LaKind endeavored to use conservative assumptions in her modeling to create quantitative exposure modeling applicable to the plaintiffs; however, she failed to use conservative assumptions as it relates to site specific water flow rates and in her estimation of the timing of communal showering. As an example, just modifying the nonconservative flow rate assumptions in Dr. LaKind's analysis more than doubles the inhalation exposure concentrations for Mr. Howard.

As a result, Dr. LaKind's quantitative SHOWER modeling regarding shower outputs is unreliable for the affected plaintiffs as a conservative assessment.

References.

Andelman, J.B. (1990). Total exposure to volatile organic compounds in potable water. In: Ram, N.M., Christman, R.F., Cantor, K.P., editors. Significance and treatment of volatile organic compounds in water supplies. Chelsea, Michigan: Lewis Publishers, p. 485-504

ATSDR (2025). Agency for Toxic Substances and Disease Registry Shower and Household Water-use Exposure (SHOWER) Model Version 4.0 User's Guide, Release Date: September 25, 2024, Last Update: January 31, 2025. https://www.atsdr.cdc.gov/pha-guidance/resources/SHOWER-Model-Users-Guide-508.pdf

Burk T, Mellard D, Ulirsch GV, Li Z (2022). Public Health Assessment Site Tool and Affiliated Applications: A Key Resource for Evaluating the Health Impact of Community Exposure to Hazardous Chemicals. J Environ Health. 2022 Nov. 85(4):40-42 https://www.neha.org/Images/resources/85.4.JEH-November-2022-Issue.pdf

ECG, Inc. (1999). Marine Corps Base Camp Lejeune and Marine Corps Air Station, New River Water Conservation Analysis. December 1999.

LaKind (2025). Expert Report of Judy S. LaKind, Ph.D. In the Matter of Downs, v. United States with associated Attachment 1 relating to Downs. April 8, 2025

LaKind (2025). Expert Report of Judy S. LaKind, Ph.D. In the Matter of Howard, v. United States with associated Attachment 1 relating to Howard. April 8, 2025