# Exhibit 334

**EXPERT REPORT OF STEVEN BIRD, MD**
**WITH REGARD TO TRACK ONE PLAINTIFF TERRY DYER**

Dated: February 7, 2025
Corrected: June 11, 2025

**OUTLINE OF TOPICS**

## I. SUMMARY

1. I was asked to review the case of Terry Dyer and evaluate the available facts and information regarding Ms. Dyer's exposures to the relevant chemical contaminants in the water at Camp Lejeune during pertinent times. I have authored this Expert Report in addition to my prior expert reports on general causation regarding bladder cancer and the chemical contaminants at issue and my supplemental report regarding EPA's recent ban of TCE and PCE. My prior reports are incorporated herein by reference.

2. This report contains, cites to, or will be appropriately accompanied by: (i) a complete statement of all opinions I will express and the basis and reasons for them; (ii) the facts or data considered in forming the opinions; (iii) a listing of exhibits used to summarize or support the opinions; (iv) my qualifications and a list of all publications authored in the previous 10 years; (v) a list of all other cases in which, during the previous four years, I have testified as an expert at trial or by deposition; and (vi) a statement of the compensation to be paid for my work in this case.

3. Ms. Dyer was diagnosed with bladder cancer. It is my opinion that, based on a review of her exposure history and circumstances at Camp Lejeune, Ms. Dyer's exposures to the chemical contaminants in the water at Camp Lejeune were above *de minimis* levels and were significant and substantial, including when compared to exposures discussed in one or more relevant scientific studies, as cited previously in my general causation reports.[1]

4. The methodology and basis for the opinions stated herein are not novel and, for the reasons set forth, are generally accepted in the medical and scientific community.

## II. QUALIFICATIONS

5. A copy of my Curriculum Vitae, was provided with my prior expert reports in this matter, as was information including i) my qualifications and a list of all publications I authored in the previous 10 years; ii) a list of all other cases in which, during the previous four years, I have testified as an expert at trial or by deposition; and iii) a statement of the compensation to be paid to myself for my work in this case.

6. I earned my Bachelor of Science degree in biology *cum laude* in 1991 from Yale University, where I was named a Yale University Richter Fellow. I worked in the laboratory of Professor Sidney Altman, Dean of Yale College and winner of the 1989 Nobel Prize in Chemistry. I was awarded my Doctor of Medicine degree by Northwestern University in 1995 and was also elected to the Alpha Omega Alpha national medical honor society (generally awarded to the top 10% of medical students nationally). Following medical school, I gained post-graduate training through residencies with the Naval Hospital San Diego (surgery) and the

[1] My understanding is that one or more other properly qualified medical experts are concurrently providing reports and expert opinions to the effect that, based on a review of Ms. Dyer's personal medical history and other factors, Ms. Dyer's chemical exposures at Camp Lejeune were as likely than not a substantial factor in causing her bladder cancer. I have not sought to review Ms. Dyer's medical records.

University of Massachusetts Medical School (emergency medicine). In addition, I completed a two-year fellowship in medical toxicology at the University of Massachusetts Medical School in 2004.

7. I began my independent clinical career in the Department of Emergency Medicine at the University of Massachusetts Medical School in 2002. I was promoted to Assistant Professor of Emergency Medicine in 2004, to Associate Professor in 2010, and to full Professor in 2016. In addition, I served as Program Director of the Emergency Medicine Residency Program and as Vice Chair of Education for the Department of Emergency Medicine at the University of Massachusetts Medical School from 2011 to 2019. I am currently the Division Chief of Medical Toxicology at the UMass Chan Medical School and UMass Memorial Health. I work as an Attending Emergency Physician at UMass Memorial Medical Center and Clinton Hospital. I am actively involved with numerous professional committees within the UMass Chan Medical School and its Department of Emergency Medicine and Division of Medical Toxicology and in national and international scientific organizations, such as the Society for Academic Emergency Medicine, the American College of Medical Toxicology, and the American College of Emergency Physicians. I served on the Board of Directors of the Society for Academic Emergency Medicine from 2014-2020 and was President of the Society from 2018-2019. Additionally, I was formerly President of the Medical Staff of UMass Memorial Healthcare.

8. During my professional career, I have received several awards, including the Navy and Marine Corp Achievement Medal; the Outstanding Contribution to Medical Toxicology Research by the American College of Medical Toxicology; the Society for Academic Emergency Medicine ("SAEM") Best Resident Basic Science Presentation Award; the SAEM New England Regional Research Directors Excellence in Research Award; the teaching award (twice) from the UMass Emergency Medicine Residency; and a Young Investigator Award from the Society for Academic Emergency Medicine.

9. I am a reviewer for several scientific journals, including the Journal of Medical Toxicology; Clinical Toxicology; Annals of Emergency Medicine; Academic Emergency Medicine; Toxicology; the New England Journal of Medicine; and JAMA. I currently serve on the Editorial Board of Academic Emergency Medicine and was a founding editorial board member of the Journal of Medical Toxicology. I am certified by the American Board of Emergency Medicine and the American Board of Medical Toxicology. I currently hold a license to practice medicine in Massachusetts. In my practice of emergency medicine and medical toxicology, I evaluate people exposed or potentially exposed to a variety of substances on a daily basis. In my review of this case, I utilized scientifically valid and reliable methods to perform my research, followed by a differential etiology methodology and consideration of the weight of the evidence and the Bradford-Hill viewpoints.

## III. MATERIALS REVIEWED

10. I have been provided with the following case-specific materials, which I have reviewed and have relied upon in formulating my opinions in this case, all of which will be itemized in more detail in the reliance list forthcoming for this report:

a. Plaintiff's deposition and declaration testimony;
b. Plaintiff's Exposure Profile;
c. Information regarding the relevant chemicals, applicable toxicological, medical and epidemiological science;
d. Information regarding ATSDR estimated historically reconstructed water concentrations for relevant chemicals in the Camp Lejeune water;
e. Expert Report of Morris Maslia;
f. Expert Report of Dr. Kelly Reynolds;
g. Expert reports of Kyle Longley; and
h. Materials as were previously listed in connection with my prior general causation reports, submitted in this matter.

11. In addition to the materials provided, I have also reviewed and relied upon the studies and literature cited in this report, all of which are based on scientifically valid principles or are the types of materials I and other physicians and scientific and medical experts normally rely upon to make our opinions in formulating my opinions in this case.

## IV. HISTORICAL EVIDENCE OF LIFE AT CAMP LEJEUNE RELATED TO CIVILIANS

12. In forming my opinions in this case, I have reviewed the expert report and documents cited by Dr. Kyle Longley regarding Camp Lejeune policies and procedures as well as the practices and empirical facts of life at Camp Lejeune which would directly affect the absorption of the water contaminants during the pertinent times generally.

13. Regarding the topic of absorption by ingestion, I note that, according to historical materials produced in the case and ATSDR publications, the use of finished potable water by Marines and civilians in a variety of manners and contexts would obviously lead to ingestion. Dr. Longley noted general historical observations relevant to the likelihood of increased ingestion of contaminated water at Camp Lejeune:

a. The Hadnot Point water distribution system served as the "nervous center" of the base, meaning that any persons visiting, working, or residing across the base, regardless of whether they lived at Hadnot Point, likely had numerous opportunities to ingest contaminated water, whether through recreational, training, or work activities;
b. The military aimed "to keep the Marines on base" and encouraged the use of the base as an all-inclusive, self-sustaining city/county providing all basic needs, to include hospital services, schools, restaurants, gyms, theaters, entertainment, shopping, clubs, sporting competitions, etc., thereby increasing the likelihood of Camp Lejeune inhabitants' frequent and continuous water ingestion from within the Camp Lejeune water treatment systems;
c. While today people rely on bottled water, from the 1950s through the 1980s, people drank tap water from the faucet, using the water to create teas, coffee, or powder drinks such as Kool-Aid.

d. Canteens, water fountains, and water buffalos on base were typically sourced from contaminated water sources;
e. The hot climate of the North Carolina coastline (highs in the 80s and 90s for five months) increased water consumption;

14. Based upon a review of historical and ATSDR publications, residents, workers, and civilians at Camp Lejeune had numerous opportunities to routinely and continuously ingest significant amounts of contaminated water on base.

15. In addition, I note that, according to historical materials produced in the case and ATSDR publications, the use of finished potable water by Marines and others in a variety of manners and contexts would obviously lead to inhalation of the water contaminants.

16. Dr. Longley noted the following historical observations relevant to the likelihood of increased inhalation of contaminated water for a civilian residing at Tarawa Terrace at Camp Lejeune:

*a. Inhalation exposures throughout family housing.*

i. According to historical materials, Camp Lejeune consists of 15 different housing areas, with families living in housing an average of two years.[2] During the 1970s and 1980s, family housing areas were served by three water-distribution systems, all of which used groundwater as the source for drinking water—Hadnot Point, Tarawa Terrace, and Holcomb Boulevard.

ii. Individuals who resided in family housing used water in all of the ways that constituted the necessities of life, to include bathing, showering, hygiene involving sinks and water, flushing, cooking, laundering, cleaning, and other water uses inside the home. The schematics cited by the historian depict small bathroom/shower square footage, with no windows, which can increase inhalation exposure due to lack of ventilation.

iii. Documents cited by Mr. Longley show alleged health problems related to mildew and inadequate ventilation in the Tarawa Terrace neighborhood.

iv. A newspaper article from 1990, showing long-existing ventilation issues in the housing units, noted that many of the Tarawa Terrace residents were getting various ailments from the poor housing conditions in which they lived. "An industrial hygienist who spoke on condition of anonymity said some of the problems in the housing units appear to be what he termed 'sick building syndrome.' He said this condition exists when there is not enough fresh air coming into the house to dispel the carbon dioxide. 'Houses have to breathe,' he said. The hygienist also added that any water damage will foster the growth of mildew and molds and 'you never get rid of it.'"

[2] *See* ATSDR, Report of the Camp Lejeune Water-Modeling Expert Panel, Sec. 1.1, October 2005 (noting that "families live in base housing for an average of 2 years"), https://stacks.cdc.gov/view/cdc/134077 (last visited 11/26/24).

v. Additionally, even when the air conditioning units were functioning, the military would, at times, not allow residents to turn them on in order to curb energy waste. According to a 1982 Utilities and Management Plan, the AC could only run when temperatures exceeded 85 degrees Fahrenheit.

17. Finally, with regard to the exposure pathway of dermal absorption, I note that, according to historical materials produced in the case and ATSDR publications, the use of finished potable water by Marines and others in a variety of manners and contexts would lead to obvious dermal exposure as a VOC mass is absorbed through the skin into the bloodstream from a contacting medium, such as water and water vapor.

18. Dermal exposure opportunities, as identified when discussing inhalation above, include showering, bathing, general hygiene, cooking, laundering, cleaning, training activities using or within contaminated water, recreational swimming, recreational use of water, and other activities where the contacting medium containing a VOC concentration contacts the skin surface.

19. Studies have shown that damaged skin exhibits increased absorption rates for both hydrophilic and lipophilic compounds. [Chiang A. J Appl Toxicol 2012;32:537-63; Nielsen JB. Arch Derm Res 2007;299:423-31; Tsai JC. J Pharm Sci 2001;90:1242-54] Additionally, skin conditions such as eczema can lead to a marked increase in the absorption of solvents such as toluene and xylene. [Hino R. Contact Dermatitis. 2008;58:76-9].

20. The end result of the above descriptions of the routes of exposure to TCE, PCE, benzene, and vinyl chloride via ingestion, inhalation, and/or dermal is that persons present on the base during the contamination periods had the opportunity for significant exposure to, and absorption, of contaminants contained in water and vapor through their routine habits, including but not limited to showering/bathing, cooking, eating, civilian and recreational activities, and sleeping or playing in their homes.

## V. ANALYSIS AND OPINIONS IN THE CASE OF TERRY DYER

21. Based upon the documents and information provided, I note the following exposure history:

22. According to her Exposure Profile and other information as per the reliance list to be forthcoming, Terry Dyer was born in Fayetteville, North Carolina on [redacted], 1956, just under two years before she moved with her family to Camp Lejeune when her father started his new position as principal of Tarawa Terrace II Elementary School, where he remained until becoming principal of Berkely Manor on Mainside at Camp Lejeune. Dyer Dep. 23:1-6, 24:10-23.

23. The military produced four Tarawa Terrace residence housing cards for Ms. Dyer's father – John Fristoe – during the period from August 5, 1958, through January 16, 1973, a period spanning nearly 15 years. See CLJA_Housing-0000165783; CLJA_Housing-0000149771; CLJA_Housing-0000171911; CLJA_Housing-0000175670.

24. During this time, Mrs. Dyer would have been between 2 and 16 years old.

25. During her exposure period, Mrs. Dyer lived in a house in Jacksonville for a year and during that time, she still went on base to go to her friends' houses and participate in all of the ordinary activities that she participated in while living on base, including drinking the water. Dyer Dep. 58:11-21. According to the Exposure Profile for Ms. Dyer, the period of residing off base would have occurred between June 2, 1964, to May 12, 1965.

26. Ms. Dyer attended school at TTII (Tarawa Terrace II) Elementary School, Brewster Junior High School, and Camp Lejeune High School. Dyer Dep. 48:17-18, 116:7. In her free time she swam in the Camp Lejeune swimming pools; ate at different places around base, such as Hardees and a hamburger joint at the PX; participated in summer recreation, a program through which some youths at Camp Lejeune took buses around base to participate in activities such as basket weaving and archery; went roller skating and shopping at Tarawa Terrace; and went to Onslow Beach for what she called "Teen Club." Dyer Dep.87:6-88:12. When Ms. Dyer was younger, the day-care and night-care center at Tarawa Terrace would babysit her while her parents were out. Dyer Dep. 87:8-12.

27. In total, it is estimated that Ms. Dyer had **5,264 days** of exposure to contaminated water at Camp Lejeune and that she was exposed to two contaminated water sources during that time: Hadnot Point and Tarawa Terrace, as she resided and played in Tarawa Terrace and also utilized the base water for schooling, dining, and recreational activities, both with her parents and independently.

28. I have reviewed ATSDR historical reconstruction modeling estimating certain monthly average contaminant levels in the water distribution systems affecting the Plaintiff, including Hadnot Point and Tarawa Terrace. In that regard, below are cropped excerpts from the ATSDR report entitled Analyses and Historical Reconstruction of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water Within the Service Areas of the Hadnot Point and Holcomb Boulevard Water Treatment Plants and Vicinities, U.S. Marine Corps Base Camp Lejeune, North Carolina, Chapter A: Summary and Findings (March 2013);[3] and Simulated Concentration of Tetrachloroethylene (PCE) in Finished Water at the Water Treatment Plant, Tarawa Terrace, U.S. Marine Corps Base Camp Lejeune, North Carolina:[4] Due to the longevity of Ms. Dyer's residence on base, these tables are incorporated by reference.

29. I have further reviewed the exposure assessment of Plaintiff as prepared by Dr. Kelly Reynolds as part of her expert report which includes the following information on levels of contaminant exposures. Due to the longevity of Ms. Dyer's residence on base, these tables are incorporated by reference.

30. Using this exposure assessment, Ms. Dyer met or exceeded the levels that I discussed in my prior report on general causation as being hazardous to human health and generally capable of causing cancer, including bladder cancer, in exposed individuals. See in this regard my prior expert report and its citations to publications, including but not limited to Aschengrau 1993 and ATSDR 2018.

[3] https://www.atsdr.cdc.gov/camp-lejeune/media/pdfs/2024/10/chapter_A_hadnotpoint_1.pdf
[4] https://www.atsdr.cdc.gov/camp-lejeune/media/pdfs/AppI5.pdf

31. Subject to the qualifications included in my general causation report for bladder cancer, below are the amounts of the Camp Lejeune water contaminants that have been shown to cause bladder cancer. It is my opinion to a reasonable degree of medical, scientific, and toxicological certainty that any individual with exposure to any one of these chemicals at the level (or higher than the levels) identified below, as likely as not, was at an increased risk of bladder cancer. The exposure quantities, to reiterate, should not be interpreted as floors below which cancer does not occur:

a. **Cumulative exposure to 27-44 mg of PCE**: 1. Aschengrau A, Ozonoff D, Paulu C, et al. Cancer risk and tetrachloroethylene-contaminated drinking water in Massachusetts. *Arch Environ Health*. 1993;48(5):284-292.

b. **Cumulative exposure to less than 110 ppb-months of TCE**: Agency for Toxic Substances and Disease Registry (ATSDR). *Morbidity Study of Former Marines, Employees, and Dependents Potentially Exposed to Contaminated Drinking Water at U.S. Marine Corps Base Camp Lejeune*. April 2018.

c. **Cumulative exposure to less than 36 ppb-months of PCE**: ATSDR, 2018.

d. **Cumulative exposure to 110 – 11,030 ppb-months of TCE**: ATSDR, 2018.

e. **Cumulative exposure to 36 - 711 ppb-months of PCE**: ATSDR, 2018.

f. **Cumulative exposure greater than 11,030 ppb-months of TCE**: ATSDR, 2018.

g. **Cumulative exposure greater than 711 ppb-months of PCE**: ATSDR, 2018.

**h. 1098 ppb-months of TCE: Bove FJ. Cancer Incidence among Marines and Navy Personnel and Civilian Workers Exposed to Industrial Solvents in Drinking Water at US Marine Corps Base Camp Lejeune: A Cohort Study. Environ Health Perspect 2024b;132;10.**

**i. 45 ppb-months of PCE: Bove 2024b Cancer Incidence Study**

**j. 15 ppb-months of benzene: Bove 2024b Cancer Incidence Study**

**k. 66 ppb-months of vinyl chloride: Bove 2024b Cancer Incidence Study**

**l. 285 ppb-months of TVOC (Tarawa Terrace) or 1,224 ppb-months of TVOC (Hadnot Point): Bove 2024b Cancer Incidence Study**

32. Additionally, Dr. Reynolds estimated Ms. Dyer's cumulative ingestion of VOCs as follows:

**Chart 1: 1L** **Chart 2: ATSDR** **Chart 3: ATSDR** **Chart 4: ATSDR**

| | | | RME | CTE | RME; deposition ingestion age 6+ |
|---|---|---|---|---|---|
| | Cumulative ug/l-M | Cumulative consumption (total ug= days*concentration per L) | Cumulative consumption (total ug= days*concentration per ATSDR exposure assumptions) | Cumulative consumption (total ug= days*concentration per deposition/FM exposure assumptions) | Cumulative consumption (total ug= days*concentration per deposition/FM exposure assumptions) |
| **Hadnot Point** | | | | | |
| **TCE** | 3,608 | 26,042 | 40,097 | 13,871 | 93,536 |
| **PCE** | - | - | 14,049 | 4,772 | 35,403 |
| | | | | | |
| **VC** | 10 | 66 | - | - | - |
| **BZ** | 161 | 1,157 | 40,097 | 13,871 | 93,536 |
| | | | | | |
| **Tarawa Terrace** | | | | | |
| **TCE** | 317 | 7,258 | 3,783 | 3,783 | 24,544 |
| **PCE (TechFlowMP Model)** | 7,518 | 172,268 | 90,529 | 90,529 | 595,062 |
| **PCE (MT3DMS Model)** | 9,236 | 211,660 | 110,277 | 110,277 | 715,375 |
| **VC** | 612 | 14,050 | 6,948 | 6,948 | 41,177 |
| **BZ** | - | - | - | - | - |
| | | | | | |
| **Totals HP & TT** | | | | | |
| **TCE** | 3,925 | 33,300 | 50,956 | 17,655 | 118,080 |
| **PCE (TechFlowMP Model)** | 7,518 | 172,268 | 274,503 | 95,301 | 630,465 |
| **PCE (MT3DMS** | 9,236 | 211,660 | 330,565 | 115,049 | 750,778 |

| Model) | | | | | |
|---|---|---|---|---|---|
| **VC** | 622 | 14,116 | 19,632 | 6,948 | 41,177 |
| **BZ** | 161 | 1,157 | 40,097 | 13,871 | 93,536 |

33. Notably, Dr. Reynolds calculated an estimated mass ingestion dose of PCE delivered to Ms. Dyer at Camp Lejeune including a range of **95.301 to 630.465 mg**. (See her report).

34. Ms. Dyer's range of exposure to PCE exceeds the 90th percentile exposure group in Dr. Aschengrau's Cape Cod PCE-contaminated water epidemiology study which showed a 303% increase[5] for the development of bladder cancer and was adjusted for confounding factors such as smoking and family history. Of note, the cumulative delivered dose in the Cape Cod study was computed in terms of mass of PCE that entered a given house as a solute in drinking water over a specific amount of time. The water modeling did not attempt to compute the actual delivered dose of PCE received by the individuals under the study. For this reason, the estimated dose to any household member was estimated to be less than the cumulative amount of contaminants delivered to the household. Therefore, any individual household member in the 90th percentile of dose was likely receiving less than 27.1 to 44.1 mg, or 27,100 to 44,100 µg, respectively.

35. Further, in the Aschengrau study, actual water sampling obtained from each town showed the following measurements and means of PCE, which are comparable to that in the Camp Lejeune cohort:

| | **Mean** | **Lowest measured** | **Highest measured** | **75th Percentile** |
|---|---|---|---|---|
| **Barnstable** | **ND** | **ND** | **ND** | **ND** |
| **Bourne** | **57 µg/L** | **ND** | **540 µg/L** | **26 µg/L** |
| **Falmouth** | **47 µg/L** | **ND** | **75 µg/L** | **62 µg/L** |
| **Sandwich** | **36 µg/L** | **ND** | **92 µg/L** | **59 µg/L** |
| **Mashpee** | *Not sampled* | *Not sampled* | *Not sampled* | *Not sampled* |

36. When comparing Ms. Dyer's levels of PCE to the Aschengrau study, she was exposed to an amount of exposure that is considered substantial since it is known to be hazardous to human health. In addition, this only addresses one chemical (PCE) and does not consider the additive (and perhaps synergistic) effect of combining ingestion of TCE, VC, and benzene with what is already known to be a hazardous level of PCE. As I stated in my general causation report, while it is frequently assumed that the toxic effects of solvents are additive, the chemicals

[5] Bladder Cancer. 39% increased risk of bladder cancer that was dose-related with 303% increase among 90th percentile of exposure; Adjusted relative risks among ever exposed subjects: 1.39 (95% cl=.067-2.91); Adjusted relative risks among 90th percentile of exposure: 4.03 (95% CL = .65-25.10) (303% increase).

may also interact synergistically or antagonistically." [Bruckner JV. Toxic effects of solvents and vapors. In Casarett and Doull's Toxicology: The Basic Science of Poisons, 9th Ed., Chapter 24 (Toxic Effects of Solvents and Vapors), p. 2 of 157].

37. Further, when absorbed VOCs from inhalation and dermal exposures are considered (see below), Ms. Dyer would have absorbed a significantly greater amount of the VOCs than from ingestion alone.

38. Based on the above, as well as the totality of my prior reports and reviewed materials, it is my opinion, to a reasonable degree of medical, scientific, and toxicological certainty, that Ms. Dyer was exposed to the relevant chemicals at Camp Lejeune at levels individually or collectively known to be hazardous to human health that were capable of causing humans to develop cancer in general and bladder cancer in particular and that placed Plaintiff Terry Dyer at an increased risk of developing bladder cancer.

39. When determining whether a person's exposure to a toxic chemical, mixture, or stew of such chemicals is substantial versus *de minimis* in nature, it is important to consider the amount of the exposure, the duration of the exposure, the frequency of the exposure, and the intensity of the exposure. Here, a review of the available facts and information concerning Ms. Dyer's ingestion, inhalation, and dermal exposure to the contaminated water at Camp Lejeune reflects that it constituted a substantial exposure capable of causing bladder cancer, consistent with the analysis and conclusions in my general causation report.

40. As additional biographical information, according to Ms. Dyer's deposition and declaration testimony, on a typical day at Camp Lejeune, Ms. Dyer drank "tons" of water at Camp Lejeune and states that "we didn't have water bottles back then"—water was from the tap or from a water fountain. Dyer Dep. 152:2-5; 156:9. Her mother made sweet tea and Kool-Aid with the water, and her family "lived on tea and water." Dyer Dep. 156:9-13. She had about ten glasses of water and at least two cups of tea a day. Dyer Dep. 156:18-20, 157:25-158:2. Ms. Dyer attended school at TTII (Tarawa Terrace II) Elementary School, Brewster Junior High School, and Camp Lejeune High School and drank water from the fountains there during the day. Dyer Dep. 48:17-18, 116:7; Dyer Declaration para. 16.

41. Even while briefly living off-base in Jacksonville, Ms. Dyer still went on base to go to her friends' houses and participate in all of the ordinary activities that she participated in while living on base, including drinking the water. Dyer Dep. 58:11-21.

42. I have considered and analyzed qualitative and quantitative factors, including a mass ingestion dose, contributing to Ms. Dyer's ingestion exposure at Camp Lejeune. I opine that Ms. Dyer was exposed to substantial levels of PCE, TCE, VC and benzene via her ingestion of toxic chemicals at Camp Lejeune.

43. In addition to ingestion exposure, Ms. Dyer also would have had inhalation and dermal exposures to the water contaminants. When absorbed VOCs from inhalation and dermal exposures are considered (see below), Ms. Dyer would have absorbed a significantly greater amount of the VOCs than from ingestion alone.

44. Ms. Dyer took baths at night with no window, an overhead fan only occasionally on, and a door that was open when she was a small child but closed as she got older. Dyer Dep. 152:23, 159:9-23. As a child she took these 15-to-20-minute baths every day. Dyer Declaration para. 16. As a teenager, she continued to take these 15-to-20-minute baths three times a week and additionally took ten-minute showers every morning. Dyer Declaration para. 6. She additionally took five-minute showers every day in school after gym class. Dyer Declaration para. 6.

45. Ms. Dyer brushed her teeth for a couple of minutes before her shower each morning and a couple of minutes before her shower each night. Dyer Declaration para. 7.

46. Ms. Dyer remembers mold and mildew while living at Tarawa Terrace in the kitchens and bathrooms and steam accumulating in the bathrooms while the showers were in use. Dyer Declaration para. 8, 9.

47. Ms. Dyer also used the water in her home in Tarawa Terrace for cooking, washing animals, watering the lawn, washing fruits and vegetables, and hand washing the dishes because they did not have a dishwasher. Dyer Dep. 157:7-11, 160:6-10. She cooked with her father, frequently making spaghetti on the weekends, and helped with laundry and steaming her clothes multiple times during the week. Dyer Declaration para. 11. Starting around eight or nine years old, Ms. Dyer would start helping with mopping the floors, cleaning the bathrooms, and handwashing the dishes. Dyer Declaration para. 12.

48. During the school day, Ms. Dyer ate lunch in the school cafeteria every day. Dyer Declaration para. 16.

49. It is important to note that Ms. Dyer was exposed as a child, which is a vulnerable population.

50. Children are highly susceptible and vulnerable to chemical toxins. Children have disproportionately greater exposures to toxins: per body weight, children drink more water, eat more, and breathe more than adults. Children in the first six months of life drink seven times as much water as the average adult (Ershow AG. Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources. Life Sciences Research Office, 1989), while one- to five-year-old children eat three to four times more food (Nationwide Food Consumption Survey. Continuing Survey of Food Intakes of Individuals: Women 19–50 Years and Their Children 1–5 Years, 4 Days, 1985. Nutrition Monitoring Division, Human Nutrition Information Service, 1987). The air intake of a resting infant is twice that of an adult.

51. The metabolic pathways of children, especially in the first months after birth, are immature and markedly different than those of adolescents and adults. Children's ability to metabolize and excrete many toxins differs from that of adults, leaving them less well able to deal with chemical toxins (Rane A. Pediatr Clin N Am 1972;19:37–49). Children undergo rapid growth and development, and their developmental processes are easily disrupted. Organ systems in infants and children undergo very rapid changes in the first months and years after birth. These developing systems are very delicate and are not well able to repair damage that may be

caused by environmental and other toxins. Thus, if an infant's cells are damaged or destroyed by chemicals or if improper developmental signals are sent to the developing organs, there is high risk that the resulting dysfunction will be permanent and irreversible. Because children have more future years of life than most adults, they have more time to develop chronic diseases triggered by early exposures. Many diseases that are caused by toxins require decades to develop. Many of those diseases, including cancer, are now thought to arise through a series of stages that require years or even decades to evolve from earliest initiation to actual manifestation of disease.

52. Ms. Dyer was exposed to inhalation of VOCs throughout the day in a variety of settings. While it is difficult to quantify all these inhalation exposures, the dose from inhalation routes is - as likely as not - comparable or greater than the dose from the ingestion route. For example, an internal dose via inhalation of TCE during a 10-minute shower is comparable to an internal dose via the ingestion of two liters of TCE-contaminated drinking water.[6] Andelman has estimated that the daily indoor inhalation exposure associated with contaminants originating in tap water may be as much as six times higher than ingestion exposure" [*Journal of the Air and Waste Management Association*, Volume 46, pages 830-837, 1996]. An article by Giardino and Wireman stated that "many scientists have shown that inhaling volatile organic chemicals (VOCs), such as benzene-contaminated water during showering, results in larger lifetime exposures than ingesting or dermally absorbing the VOCs from similarly contaminated water" [*Journal of Hazardous Materials*, Volume 62, pages 35-40, 1998]. McKone conducted a detailed analysis of household exposure to VOCs due to contaminated tap water and concluded that "indoor inhalation exposures attributable to a contaminated tap water can be between 1.5 and 6.0 … times the exposure attributable to the consumption of 2 L/day tap water by a 70-kg adult" [*Environmental Science and Technology*, Volume 21, pages 1194-1201, 1987]. In fact, the ATSDR also concluded the dose from the inhalation and dermal routes may be as high as the dose from the ingestion route.[7]

53. The end result of the above descriptions of the routes of exposure to TCE, PCE, benzene, and vinyl chloride via ingestion, inhalation, and/or dermal is that Ms. Dyer was exposed, during childhood, to a substantial amount of known carcinogens at Camp Lejeune through exposure to, and absorption of, contaminants contained in water through her routine habits including but not limited to showering/bathing, cooking, eating, and recreational and educational activities.

54. Ms. Dyer was exposed to PCE, TCE, VC, and benzene with such daily and/or weekly consistency and intensity, there was likely little to no recovery period from the VOCs in her body throughout her entire duration at Camp Lejeune.

55. For PCE, the ATSDR (2019a) has stated the following: "When tetrachloroethylene is found in water, it can enter your body when you drink or touch the water or when you breathe in steam from the water. Most of the tetrachloroethylene that you breathe in or drink will move from your stomach or lungs into your bloodstream. If you have tetrachloroethylene in your blood, you will breathe most of it out very quickly. A small amount

[6] Weisel CP. and Jo WK. Environ Health Perspect 1996;104:48-51.
[7] 2014 ATSDR

of tetrachloroethylene in your blood may get changed into other chemicals that leave your body in urine. It takes about 3 days for half of the tetrachloroethylene in your body to be eliminated."

56. For TCE, the ATSDR (2019b) has stated the following: "When trichloroethylene is found in water, it can enter your body when you drink or touch the water or when you breathe in steam from the water. Most of the trichloroethylene that you breathe in or drink will move from your stomach or lungs into your bloodstream. Once in your blood, your liver changes much of the trichloroethylene into other chemicals. When the body absorbs more trichloroethylene than it can break down quickly, some of the trichloroethylene or its breakdown products can be stored in body fat for a brief period. However, once absorption ceases, trichloroethylene and its breakdown products quickly leave the fat. You will quickly breathe out much of the trichloroethylene that reaches your bloodstream; most of the trichloroethylene breakdown products leave your body in the urine within a day."

57. For VC, the ATSDR (2006) has stated the following: "Most of the vinyl chloride is gone from your body a day after you breathe or swallow it."

58. For benzene, the ATSDR (2007) has stated the following: "When you are exposed to benzene in food or drink, most of the benzene you take in by mouth passes through the lining of your gastrointestinal tract and enters your bloodstream. Once in the bloodstream, benzene travels throughout your body and can be temporarily stored in the bone marrow and fat. Benzene is converted to products, called metabolites, in the liver and bone marrow. Some of the harmful effects of benzene exposure are caused by these metabolites. Most of the metabolites of benzene leave the body in the urine within 48 hours after exposure."

59. Considering all four VOCs would stay absorbed in the body for a minimum of 24 hours, this duration of exposure for the Plaintiff was substantial considering there was never a period of time in which the VOCs and their metabolites would not have been coming into contact with her body. The VOCs will be absorbed in the body with the constant daily (perhaps hourly) chronic exposure to the VOCs. Under the circumstances, it was more likely than not that Ms. Dyer was chronically exposed to the VOCs the entire time she was at Camp Lejeune. In Ms. Dyer's case, the duration of exposure would be **5,264 days** of chronic exposure to the VOCs in her body. This was a substantial duration to be exposed to known carcinogens.

60. In conclusion, my opinion is that Ms. Dyer was exposed to levels of carcinogens that are known to be hazardous to human health, including bladder cancer and, as a result, developed an increased risk of developing bladder cancer. Ms. Dyer was exposed to a substantial amount of contaminants during her time at Camp Lejeune that are carcinogens, and her exposure to the chemical contaminants was at levels that can generally cause cancer, including bladder cancer.

61. Based on the foregoing, and for the reasons stated above, it is my opinion to a reasonable degree of medical, scientific, and toxicological certainty that the exposures to the chemical contaminants that Ms. Dyer had at the base went well above normal background levels of exposure and that such cumulative exposure from the chemicals was at a substantial level that

is generally capable of causing the development of cancer and of bladder cancer. These exposures were significant and were not minimal or insignificant.

62. The opinions I have reached are based on my review of the evidence of exposure in this case, the medical and scientific literature cited herein concerning chemical characteristics, science, exposure and disease, available epidemiologic, toxicological and other studies and science, and my knowledge, skill, experience and training as a physician, toxicologist, and expert who has worked with chemical exposures and diseases for many years. All statements made herein are made with a reasonable degree of medical, scientific, and toxicological certainty.

DATED: February 7, 2025
Corrected: June 11, 2025

Steven Bird, M.D.