Exhibit B

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NORTH CAROLINA
SOUTHERN DIVISION
No. 7:23-CV-897

IN RE:
CAMP LEJEUNE WATER LITIGATION
This Document Relates To:
ALL CASES

VIDEOTAPED & VIDEOCONFERENCED DEPOSITION OF
DR. FRANK J. BOVE

Atlanta, Georgia
Thursday, October 17, 2024

Court Reporter: Michelle M. Boudreaux-Phillips, CCR

October 17, 2024

9:33 a.m.

Videotaped and videoconferenced deposition of DR. FRANK J. BOVE, held at the Centers for Disease Control and Prevention, 1600 Clifton Road NE, Atlanta, Georgia, pursuant to Agreement, before Michelle M. Boudreaux-Phillips, a Certified Court Reporter in the State of Georgia.

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Mike Dowling (via Zoom)
Suzanne Yurk (via Zoom)

Videographer: Safaa Sammander

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THE VIDEOGRAPHER: We are now on the record. My name is Safaa Sammander. I'm the videographer for Golkow Litigation Services.

Today's date is October 17th, 2024. The time is approximately 9:33 a.m. This video deposition is being held in Atlanta, Georgia, in the matter of In Re Camp Lejeune Water Litigation. The deponent is Dr. Frank Bove.

Will counsel please identify yourselves for the record, after which the court reporter will swear in the witness.

MS. GREENWALD: Robin Greenwald for the plaintiffs.

MR. VANSLYKE: Ben VanSlyke for the plaintiffs.

MR. TELAN: Pat Telan for the plaintiffs

MR. LEE: Good morning. Randy Lee for the plaintiffs.

MR. BAIN: Adam Bain for the United States.

MS. PLATT: Elizabeth Platt for the United States.

MS. YUEH: Lena Yueh, representing HHS.

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DR. FRANK J. BOVE,

being first duly sworn, was examined and testified as follows:

EXAMINATION

BY MS. GREENWALD:

Q Good morning, Dr. Bove. My name is Robin Greenwald. I know we met off the record, but I just wanted to introduce myself on the record, and I'm one of the lawyers working on the Camp Lejeune Justice Act litigation on behalf of the plaintiffs, okay?

Can you state your full name for the record, please?

A Frank Joseph Bove.

Q Are you represented by an attorney today?

A No.

Q Did you meet with anyone from the government before your deposition today?

A Yes.

Q And who was that?

A We had a prep meeting yesterday to go over the logistics of this deposition, so there was someone from -- a lawyer from the DOJ, HHS lawyers. And that's basically what was discussed, you know, what kind of objections you might raise, that I have to report truthfully, and so on. So it was just basically going

over what this was going to be.

Q Okay. And who from the Department of Justice did you meet with?

A I don't remember the person's name.

Q No one in the room right now?

A No.

Q Okay. And who from -- you said the other lawyers were from HHS?

A Deborah Tress, Leah Yueh. I think that was it. I think that's -- that's all I can recall in the room. Yeah.

Q Okay. And what type of things did they tell you that you should -- I think you said be prepared to address today. Was that one of the things you said?

A No, no. To answer all questions.

Q Okay.

A Unless there's a -- I forget which type of objective [sic], where -- a privilege objection, I don't have to answer those, but you will -- I will be informed which ones those are. And just going over the procedure.

Q Okay. Did you look at any documents yesterday when you prepared?

A I looked at documents last night when I was home.

Q Okay.

A Just to refresh my memory because I -- I have forgotten a lot since I retired. I put Lejeune out of my mind. So I had to take a quick look at least at some of the studies.

Q All right. Well, you've also done a lot of work on Camp Lejeune, so -- and I'm going to give you copies of everything today.

A That's good.

Q This is not a memory test.

A Good.

Q So maybe -- now that I've done that, let's talk a little bit about depositions. I know you had a meeting yesterday, but maybe we can go over a couple of the rules.

I think you mentioned to me before we started today that you've never had your deposition taken before?

A Right.

Q Okay. So I guess I have the privilege of being the first, and I promise I will make this as painless as possible.

I guess the first thing I would like to tell is if for any reason I ask you a question that doesn't make sense or you don't understand, just please tell me

and I'll rephrase it --

A Right.

Q -- okay? And the other thing I want to mention is this is not a memory test. If you don't remember something, that's fine, and just tell me. Okay?

A Can I ask for a document to help me --

Q Yeah, I was just -- you anticipated my next question. So if you think a document would help you, by all means let me know, and I'll give it to you if I have it. If I don't have it with me, I won't be able to give it to you.

A Okay.

Q Very soon, I'm going to mark many of the studies that we think are relevant to today, and so you'll have those at your disposal to look at as you see fit. Okay?

A Okay.

Q All right. Did you ask at any point of the government to pay for a lawyer to represent you today?

A No.

Q Okay. Are you testifying today as a representative of the United States government?

A No.

Q Okay. And you didn't bring any documents

with you today --

A No.

Q -- did you? Okay.

I forgot to tell you one other rule we have, for the court reporter's sake. So when we start talking, oftentimes we'll anticipate what the question is or what the answer is, and we might talk over each other, and that makes it impossible for the court reporter to get a record. So we should try to wait until I finish the question, and I will do my best to also wait until you finish the answer. Okay?

A Okay.

Q Otherwise, we'll get scolded and rightly so.

Okay. I think I mentioned this already, but if I didn't, important for me to say it. If at any time you need a break, just tell me and we'll take a break. Again, you might want to stretch your legs, get a glass of water, whatever. Please just tell me you want a break, and we will take a break.

A Okay.

(Exhibit 1 marked for identification.)

(Exhibit 2 marked for identification.)

Q (By Ms. Greenwald) So before we get into your work at -- in any detail at the ATSDR by Camp Lejeune, I want to go over your background with

you. So I'm going to show you what's been marked as Exhibit 1 and 2.

One is an email that I believe dates your CV, and -- there's the email.

And then No. -- Exhibit No. 2 is your CV.

(Discussion off the written record.)

Q (By Ms. Greenwald) And here is the CV that was attached to that.

So the email is dated January 2023. Is this your CV in or around January of 2023?

A Yeah. Yeah, I would think so. Yeah.

Q Okay. And so at that time, you were still working at the ATSDR; is that right?

A Right.

Q Okay. And since then, you've left the ATSDR, right?

A Yeah. I left on June 28th. That's the Friday -- the last day of the pay period.

Q Of this year?

A Yeah, this year.

Q Okay. So other than the -- other than the fact that you're now retired from the ATSDR, is this, generally speaking, an up-to-date version of your CV?

A Uh-huh.

Q Is that a yes?

A Yes. I'm sorry.
Q The other thing we have to do -- no, my fault. I didn't say that.
A No, I --
Q They probably told you yesterday.
A Right, right.
Q We have to say "yes" and "no."
A Right.
Q But --
A Sorry.
Q No, no, no, no. It's okay.
All right. So I would like to go through your CV with you, if that's okay, and tell -- let you tell us a little bit about your background.
So you went to The Haverford School in Pennsylvania. That was your high school?
A Yes.
Q I only know that's relevant because of your questions that they interviewed you at some point --
A Oh.
Q -- in 2018, and we'll be going over that, so that's why I wanted to mention that.
A Okay.
Q So that's your alma mater from high school, right?

A Right.
Q Okay. And then you went to University of Pennsylvania, and you majored in political science and philosophy?
A That's right.
Q Okay. And you graduated in May of 1973?
A Yes.
Q Did you go to work straight from there, or did you go straight to graduate school?
A I went straight to graduate -- well, I had a summer job, but I went straight to graduate school.
Q I see you went to graduate school at Boston University, in philosophy, in 1973 --
A Right.
Q -- and spent a couple of years?
A Year and a half -- well, yeah, two years, year and a half.
Q And what was your study there?
A Well, I studied philosophy of science, I studied western philosophy mostly, and some ethics, but that's pretty much --
Q Okay. And you left before getting a graduate degree from there --
A Right.
Q -- is that right?

A Right.
Q Okay. And what did you do when you left Boston University?
A Well, the first thing I did was take a job with an organization called Science for the People, which is where I became exposed to environmental health and occupational health issues and energy issues. And they put out a bimonthly magazine. I worked for them for about two years and -- I was going to say by the date. They disbanded in '89. They've re -- reborn the last few years and produce a bimonthly magazine.
Q Okay.
A So that's -- I worked with them for two years. And then after that, I worked for the Clamshell Alliance, in the Boston office. The Clamshell Alliance was an anti-nuclear, pro renewable energy and energy efficiency organization that was involved with an occupation of the Seabrook nuclear power plant in 1977, which I participated in, and other demonstrations at Seabrook, New Hampshire. And then after --
Q Before -- I'm sorry.
A Yeah.
Q What did you do with Clamshell Alliance? What was your job there?
A I was an organizer.

Q Organizer. Okay.
A That's pretty much what I did at Science for the People, too, although I helped edit articles in the magazine.
Q All right. And you were going to go to the next job. I'm sorry.
A Right. I worked for the Massachusetts Public Interest Research Group for a year on energy issues. Near the end, they started to do some environmental issues, but mostly it was energy.
Q Okay. And what did you do there? Researcher?
A Research and also, again, organizing. And then -- and then I worked for a Community Action Agency, which is part of the war on poverty that -- during the Johnson era, these agencies were created to work with the communities, in particular to focus on low-income communities. And so there, again, working as an organizer, worked on doing weatherization workshops, giving weatherization kits to low-income community, and then we branched out into utility shutoffs, electric utility in particular, and gas, and also fuel assistance where there were threats to cut fuel assistance, so we were organizing around that, and then public housing and tenant issues as well. So all

of it was focused on low-income community.

Q And how many years did you do that for?

A Let's see. Two years.

Q Two?

A Roughly, yeah.

Q Okay. Again, mostly organizing and then some research?

A That one was mostly -- well, you have to do some research in organizing, but mostly organizing, mostly organizing.

Q And then --

A Then I went to public health school.

Q All right. And what was it that -- was there anything in particular about the positions you held after being at Boston University that drove -- that spoke to you for going to public health school?

A Well, as I said, the Science for the People job, it exposed me to environmental health and occupational health. It got me very interested in that, as well as energy. And I was always interested in social justice issues, going back to my high school days, because of the Civil Rights Movement, Anti-War Movement, and so on during the '60s. So that was my orientation going in.

So when I went to Penn and then when I went

to Boston University, I focused on, as I said, progressive philosophy, if you will, western philosophy, Hegel, Kant, and so on and so forth.

So -- yeah. So I think that what propelled me to public health school was definitely the Science for the People exposure and then being interested in that, and realizing that occupation -- being an organizer as an occupation was going to be difficult. I think I was starting to get tired, burned out, as they say, and that -- and it was time to move on.

Q Okay. I would love to talk to you about your philosophy, but that's not the subject of today.

A Right.

Q So now we have to go into public health, another important topic, of course.

And so you went to Harvard School of Public Health, right?

A Right.

Q And what year did you start there?

A '82. So September '82.

Q And what degrees did you get from the Harvard School of Public Health?

A Well, as you can see from the resume, environmental health science in '84, and then I decided

to continue on.

I had a brief period working for the Tufts University hazardous waste program, but then -- that was pretty much just the summer and part of the fall, and then went back to school and got a doctorate in epidemiology and also in occupational health, although they call it something else. I can't remember what Harvard called the occupational health degree. It's something about physiology or something, but it was occupational health.

Q Uh-huh.

A So that's why I put it that way. And it's an Sc.D. They don't have PhDs for these kinds of degrees, so there's a Doctor of Science.

Q Okay. And what's the -- I'm just curious. Is there a difference between -- I mean, what is the intersection between epidemiology and occupational health? Is there one?

A Oh, yeah.

Q Yeah.

A Yeah. I mean, there's --

Q How would you describe that?

A Well, epidemiology is conducting studies mostly. And occupational health would include occupational -- industrial hygiene. It would include

just being -- just doing exposure assessments at plants.

We went in, for example, to a plant where they were using trichloroethylene, for example, in buckets underneath their workstation, and so -- you know, so we went to plants like that, went to a rubber plant and so on, just to get a feel for the kinds of occupational exposures.

Actually, I had had some experience with occupational exposures in my summer jobs way back in college when I worked at a shipyard in Chester and was exposed to all kinds of solvents and asbestos and lead and so on, while working at a summer job. So I had some previous knowledge of this, although back then I didn't realize how bad things were at that shipyard. I didn't have any idea, in fact. But, yes, that helped me understand what was going on in these plants.

So that's part of what occupational health is, is exposure assessment, making recommendations for more safety at the workplace, alternatives to using toxic chemicals, and so on. So that's -- that's occupational health.

Occupational epi would be doing studies at these plants, so -- let's see if I can -- so my dissertation was looking at neurological symptoms, in

this case, temperature and vibration sensitivity among industrial painters. Solvents have an impact on peripheral neuropathy, and this is an early sign of that, and so -- so that's an example of occupational epi.

Q Okay. And that's basically the -- essentially the field you practiced in for the 37 years since you --

A Well, it was mostly environmental. Most of the studies I've done have been environmental studies. I'm trying to think of which -- if I've done any worker studies since the dissertation. I mean, I look at civilian workers at Camp Lejeune, but that's an environmental exposure. It's not a workplace exposure.

Q Okay. So you're distinguishing between exposures to the environment at large versus exposure to chemicals in a workplace setting?

A Right.

Q Okay.

A So the civilian workers also were exposed to -- were doing some kind of job where they were using solvents or something like that. That would be a workplace exposure. But drinking water exposure, I would characterize as an environmental exposure.

Q Yeah, I was actually noticing, when I was

looking at your CV -- let's jump to that now -- that when you go through the -- wrong document.

I noticed when you were referring to your publications, you have quite a few, but it appeared to me that 12 of them relate to drinking water contamination. Does that sound about right to you?

A Probably, yeah, yeah. Yeah, I did a study in New Jersey looking at birth defects and birth weight and small for gestational age. I worked on a study on leukemia and non-Hodgkin's lymphoma, as well, and drinking water contamination.

New Jersey had a unique drinking water contamination database and also had a cancer registry and a birth defect registry, so that enabled us to do those studies.

I don't know if they were really -- I was hoping they would be replicated in other states, but I don't think they really were.

And then the Camp Lejeune studies were drinking water studies. And I'm trying to think were there others.

Other studies included toxic air emissions from a U.S. Air Force base in Oklahoma which impacted a community right next door, a low-income community, and we looked at birth weight there.

I was involved with the Hanford study looking at iodine-131 emissions in the '40s and pre-term birth. So -- and then I was also involved in a cluster investigation. I was involved with an autism cluster investigation in Brick Township, New Jersey. And in Fallon, Nevada, a childhood leukemia cluster. So I did some of that. But most of the -- mostly I did work at Camp Lejeune, was the lion's share of what I was doing.

Q And that's your time at the ATSDR, right?

A Yeah, all this is at the ATSDR.

Q Okay. Let's talk about your first job after you -- let me step back for a minute.

When you were in graduate school, did you have certain internships, like something at the Massachusetts Cancer Registry?

A Yes.

Q Can you tell us about that?

A Yes. I was asked to investigate the databases that existed in hazardous waste or any other -- and the asbestos information, as well, that we had, and overlay that with diseases, cancers.

And we -- in those days, we didn't have a GIS, so it was physically overlaying a mesothelioma map and -- where the school were [sic] that we knew had

asbestos, and we saw -- we could see a connection, but we didn't do a formal study. But that was the role I had there.

I also did an internship while at school. I can't remember the program. It was part of the Health Policy and Management Program --

Q Right.

A -- looking -- contacting activists across the state who were dealing with toxic waste sites and doing a survey, asking them how helpful was the EPA, how helpful was the Massachusetts environmental agency, what kinds of needs they had, and so on. So that -- I wrote that up as a report. I can't remember the name of the report. That's too far in the past --

Q Okay.

A -- to remember. I didn't put that in here either.

Q I thought it was, "Research at Harvard School of Public Health, Community Health Improvement Program." Is that --

A Yes. That's good.

Q It is -- it is in there, from '82 to '83.

A Oh, it's in there? Okay.

Q Yep.

A Okay.

Q And then there's another one after that says, "Researcher at Tufts University, Department of Community Health." Was that a similar type of internship?

A That was the toxic waste -- they were trying to set up a toxic waste program -- hazardous waste program. And, in fact, they came here to discuss issues with Dr. Kahn, if I remember right, and -- so they were trying to develop this project, and I was helping them do that as a job. And I also was doing some teaching assistance for the medical students in epidemiology.

Q While you were doing your Doctor of Science?

A No. What I was doing that -- that brief period between getting the degree in -- the master's degree in environmental health and going back to school was a little bit more than a four- or five-month period, I think it was. So during that period.

Q Okay. And then the last thing I see on your CV is, "Epidemiologist, Commonwealth of Massachusetts Agent Orange Program."

A Right. That was a brief job as well. I'm trying to remember what I did there. I think it was looking over surveys of veterans who were exposed or at least thought they were, you know, in Vietnam. I can't

recall exactly what that work was --

Q Okay.

A -- but that was -- yeah.

Q All right.

A It's too long ago for me to remember now.

Q So your first job, if I'm correct, after you finished your Doctor of Science, was as a research scientists at the New Jersey Department of Health?

A Yeah, I actually started there before I finished the doctorate.

Q Okay.

A Yeah, so 1986 I started work at New Jersey, finished my doctorate while I was there.

Q All right. And what did you do -- you were there until 1991, so about five years; is that right?

A Yes. Yeah.

Q What kind of work did you do, generally, when you were there?

A Well, I did these drinking water studies I was mentioning --

Q Right.

A -- looking at birth defects and small for gestational age and pre-term birth and -- and that hadn't been done before. In particular, I was able to link a disinfection byproduct called trihalomethanes

and small for gestational age, neural tube defects, oral clefts. And that was unique and caused a lot of stir because we knew -- or we -- we had some experience with cancer and these contaminants, but no one had looked at birth outcomes before.

And so, as I said, it did raise a lot of interest at EPA. There was a conference I remember the ILSI, I-L-S-I, put on where they sort of questioned me on the study, you know, and I had to defend the study and so on.

So it had that big of an impact. And it also, I think, encouraged the EPA to do some research looking at neural tube defects and the trihalomethanes and the other disinfection byproducts. So that was a good outcome of --

Q That's a great outcome.

A Yeah. So that was the key one. I also, as I said, worked on a leukemia and non-Hodgkin's lymphoma study, again, with drinking water.

Q Do you remember what the chemical was?

A The chemicals in the drinking water that were in the database that was the focus of the study was trichloroethylene, perchloroethylene, vinyl chloride, benzene, and 1,2-dichloroethylene.

Q So similar to the contaminants at

Camp Lejeune?

A Right. But they -- you know, we -- I think that that -- those were the chemicals that people were most concerned about, going back to the 1980s. And trihalomethanes, as I said, they were the other -- that was a different database in New Jersey, but I decided to -- I was asked -- I was tasked by -- actually, it was a cooperative agreement from CDC/ATSDR to look at toxic waste sites and birth defects. I did try to do that, but the data from the remedial investigations from our health surveys were not -- the health assessments were not good enough to do a really good study.

So I focused on the drinking water data that New Jersey had, which was the best in the country. And those were the chemicals -- TCE, PCE, 1,2-dichloroethylene, vinyl chloride -- were the ones that they covered, and then there was a separate database on trihalomethanes.

I decided to include the trihalomethanes in the study, just because it was there, and didn't expect to see anything. And that's the contaminants that had the strongest findings. And so that -- as I point out to people all the time, you never know what you're going to get in a science study, and sometimes the

unexpected happened.

In this case, I had no idea I would see anything with trihalomethanes, and it was there. I did see something with trichloroethylene. I think the problem there was just not enough numbers of people or populations exposed to get a strong finding. And also, birth defects are rare, and so you have small numbers to start with.

So, you know, it was hard to interpret those studies to some extent, but I did see something with trichloroethylene and perchloroethylene and benzene.

Q Okay.

A Yeah.

Q And I think you mentioned this, but I was just going to ask you. I see it in your -- when you were describing your job with New Jersey, that it was a cooperative with the -- cooperative agreement.

Was that the entire time -- it says, "Responsibilities: Co-principal investigator on a 5-year cooperative agreement with ATSDR/CDC."

A That was pretty --

Q Was that the entirety of your job there, or were there other parts of your work with New Jersey?

A That was most. I mean, I think my salary came out of that, pretty much.

Q Okay.

A But I did do a land -- there was this study I was involved with looking at birth outcomes around a landfill that was one of the major landfills in the country called Lipari Landfill. I think -- that was one of the landfills that pushed Lautenberg to push for a superfund, along with Love Canal.

And so we did see small for gestational age in a small ring around the landfill. So, again, that was the first time that that was done. So we were able to do a lot of initial work on these things because of the data we had in New Jersey.

Q Just a couple of other quick questions here. Were you also an adjunct faculty member at Drexel?

A Right. I think I did that only one year --

Q Uh-huh.

A -- teaching medical -- was that the -- yeah, I think that was the medical students.

Q You say --

A Oh, no. I'm sorry. That wasn't medical students. That was graduate students, I think, and --

Q Department of Environmental Engineering?

A Yeah, and I was teaching them epidemiology. And all the -- all the teaching, I'm teaching epidemiology.

Q Okay.

A Okay. So I was -- later, I did a -- taught in India, for example, epidemiology to doctors there. So the doctors I taught, that was at the -- Tufts, right. And the Drexel was the, right, as you said, engineers.

Q Okay. So after your five years at New Jersey Department of Health, you joined the ATSDR; is that right?

A Right.

Q And what position did you join the ATSDR as?

A I started out as a senior epidemiologist and stayed a senior epidemiologist the whole time.

Q So when you left, what, 32 years later -- were you with ATSDR for 32 years?

A Almost 33.

Q Almost 33?

A Yeah.

Q So for 33 years, you were a senior epidemiologist for the ATSDR?

A Right.

Q Well, we thank you for your service.

Okay. So let's just do a little high level now about your time at ATSDR because, obviously, we're going to focus on Camp Lejeune --

A Right.

Q -- at this deposition. I just wanted to get a background in epidemiology first before we dive into some of this --

A Okay.

Q -- information on Camp Lejeune. And I also wanted to mention -- that I forgot at the beginning, is that we're in Phase 1 of the litigation, so the focus is going to be on five diseases today. We're not going to go into birth defects today because it's not part of Phase 1. So it's, just so you know -- I think you might know this already, but just in case, it's kidney cancer, bladder cancer, non-Hodgkin's lymphoma, leukemia, and Parkinson's disease. So that's going to be the focus today, and not even much on that specifically, but I won't be going into birth defects much in detail. While I know you've done a ton of work on that, it won't be today. I just wanted to mention that.

So with that prelude, I wanted to just have you give sort of a high level, as we start out, about your job at the ATSDR over the almost 33 years.

A Okay. It's the Agency for Toxic Substances and Disease Registry. It's part of the Centers for Disease Control.

Initially, I was still finishing up some work on that drinking water study in New Jersey. I did a little bit of additional analyses and wrote a journal article. So that was one thing.

But the main reason -- my main job at the beginning was this hazardous waste workers surveillance project, which entailed surveying hazardous waste workers who were part of the Laborers' International Union of North America, LIUNA, and working with that union to serve hazardous waste workers.

And we did one survey, and then we -- I guess it must have been a year or two later, we did another survey asking about, you know, the job they were doing, also what kinds of exposures they think they had and any -- I'm pretty sure there was some health -- yes, there definitely was some health component, as well, in the surveys.

That didn't -- that wasn't as successful a project. I think partly because when you do a survey, it's very difficult to get a good participation, and I think that that was the major problem. Even though we worked with the union, we didn't get a high percentage of workers participating.

Q Just generally speaking, how would you distinguish a survey that you just mentioned, that type

of study, from the kind of cohort study that I know you've done many of while you're at the ATSDR -- while you were at the ATSDR?

A Well, a survey could be -- you can survey a cohort --

Q Right.

A -- and that's -- a survey is like we did with the birth defect study at Lejeune, where we first try to find out who has a birth defect. There was no birth defect registry. The only way to approach that was to survey the families. And we were lucky to have some information on the birth certificate to help us that way, and there was also some hospital records that helped us identify the people who had been on base and gave birth, and then there was word of mouth. So you had that group of people.

We did a phone survey, which is just asking questions --

Q Right.

A -- you know, did you -- you know, who you are, when were you on the base, and did your child have a cancer or birth defect. Okay? So that's a survey.

And then we surveyed them again, those people who we had medical records on that confirmed that they had the birth defect we were interested in, which was

neural tube defects and oral clefts. We would -- we did a, again, phone interview to get additional information.

So that is a survey, but you could call it a cohort study as well. So any time you use a questionnaire or do interviews, I would call that a survey.

Q Okay.

A And the question is what's the -- you know, one of the questions of a survey is how many people participated, what's the percentage.

Q Right.

A Right.

We did a survey later on trying to survey Marines, Navy personnel, and civilian workers at Camp Lejeune. And, again, we sent -- that was a mail survey, so we sent out a survey to everybody, hundreds of thousands of people. But the participation rate there was around, which you would expect these days, about 30 percent. So that's a survey.

Q Uh-huh.

A You can -- for an occupational study, you would want to use plant records to identify the workers, you would have plant records on what kinds of -- what jobs they had. You had maybe some

information on what chemicals are used in those jobs, so you have -- that's on the exposure side. And you'd either have -- you would have medical records from the plant. Or if you did a cancer incidence study, you might use a cancer registry to help you do that and so on. So that's a different kind of study altogether.

So if you use hard data, let's say, if you're not doing an interview but you're basing it on data that you obtained, maybe you -- you test people. You can test people, like I did in my dissertation, where I tested these painters for vibration and temperature sensitivity, and there were other tests being done at the same time looking at neurobehavioral problems. So that's -- that's a study; that's not a survey.

Q Okay.

A So that's how I distinguish it.

Q That's really helpful.

And is it fair to say that the number of participants you have in a study is relevant to the power of that study, typically?

A Oh, sure.

Q Okay.

A Sure.

Q And so the lower the participants, the weaker the results?

A Well, also you have to worry about bias. It's not just a power issue. You have to worry about selection bias, who -- or volunteer bias, whatever you want to call it, why these people and not others, was it because they were already sick and they wanted to be in this and the people who weren't sick didn't participate. You have to deal with issues like that, and sometimes you don't have information to tease out how bad the bias might be, so...

Q All right. So let me mark your -- some of the studies that you may or may not want to refer to over the course of the deposition today.

I am going to mark first as Exhibit 3 your "Evaluation of mortality among Marines and Navy personnel exposed to contaminated drinking water at USMC Base Camp Lejeune: a retrospective cohort study."

A Right.

Q That's No. 3.

A Uh-huh.

(Exhibit 3 marked for identification.)

MS. GREENWALD: No. 4 is going to be the "Mortality study of civilian employees exposed to contaminated drinking water at USMC Base Camp Lejeune: a retrospective cohort study."

(Exhibit 4 marked for identification.)

MS. GREENWALD: The next one is -- 5 is the "ATSDR Assessment of the Evidence for the Drinking Water Contaminants at Camp Lejeune and Specific Cancers and Other Diseases."

THE WITNESS: Right.

MS. GREENWALD: That's a big one.

(Exhibit 5 marked for identification.)

MS. GREENWALD: Exhibit 6 is "Evaluation of mortality among Marines, Navy personnel, and civilian workers exposed to contaminated drinking water at USMC Base Camp Lejeune: a cohort study," of 2024.

THE WITNESS: Right.

MS. GREENWALD: This is the updated one.

THE WITNESS: Right.

(Exhibit 6 marked for identification.)

MS. GREENWALD: And last, but not least, is the cancer incidence study. So this is the "Evaluation of cancer incidence among Marines and Navy personnel and civilian workers exposed to contaminated drinking water at USMC Base Camp Lejeune: a cohort study," and this is also 2024. That's No. 7.

THE WITNESS: Uh-huh.

(Exhibit 7 marked for identification.)

Q (By Ms. Greenwald) I just wanted to give you those so you can have them to refer to at any time you want. Okay?

A Uh-huh.

Q And, again, as I said earlier, anything else you might want to look at, just ask me for it; and if I have it, I'll give it to you.

I just want to ask some preliminary questions. You're the primary author on the documents I just gave you, Exhibit 3 through 7, right?

A Well, the first or second author.

Q Okay.

A But I -- yeah, I directed -- I wrote the protocol for all of them.

Q And that pretty much defines a lot of your life's work at the ATSDR; is that fair?

A Uh-huh.

Q So I want to go over a couple of awards you got relating to some of the work you did. So I want to show you what I'm going to mark as Exhibit 8.

(Exhibit 8 marked for identification.)

Q (By Ms. Greenwald) Do you recall receiving the Ozonoff Award for your studies at Camp Lejeune?

A Yes.
Q So congratulations on this.
Here is the notice that appears on the Boston University School of Public Health.
A Uh-huh.
Q What did you receive that award for?
A Well, I received it for both the research I did at Camp Lejeune up to that point, which was the mortality studies, the birth defect studies, and the birth weight studies, as well as my work with the community assistance panel at Camp Lejeune, working closely with them on a number of issues, trying to work with them to get presumption. I mean, that was something that we were thinking about way back, actually, as the only real solution to this problem. My agency pretty much agreed with that. That wasn't just my opinion. And, you know -- but we didn't know how to get there. So we were hoping the studies might help push that, but we gave as much -- I gave as much information I could on health effects and coached the CAP on that. And so they were able to do the lobbying necessary to actually get that to happen.
So I think that both those things, my work with the CAP and my research, they decided to give me the Unsung Hero Aware. They also knew that I had some

difficulties within the agency at points, and also dealing with the Navy, on getting these studies to happen.

I think the -- the NRC report in 2009 was used, to some extent, by -- well, used by a great extent by the Marine Corps and Navy, and to some extent within my agency, as a reason maybe we shouldn't go any further on these studies.

And in particular, after the mortality studies were done, the next step, which would be a cancer incidence study -- I mean, we did a male breast cancer study, but that was pretty easy to do using VA data, so that wasn't a concern.

The survey, we were forced to do by Congress, and the -- but they did not want internally -- and also, definitely the Navy and Marine Corps were not interested in a cancer incidence study. Everyone thought it was going to be too expensive.

So they knew I was battling on that issue, and I think that was part of the reason for the award.

Q Okay. Can we -- let's -- there was a lot in that answer that I would love to explore with you.

A Okay.

Q I was going to do it later, but let's do it

now.

Let's go to the CAP, and then we'll go to the NRC. So the NRC report is the report in 2009 that evaluated the ATSDR's ability to really do the kind of studies that you wanted to do; is that fair?

A Yes.

Q Okay. There was a lot of controversy about that report, wasn't there?

A Yes.

Q Okay. I have some documents to show you about that, but we'll wait a little bit on that. But I would like to talk to you about the CAP because I know that is an important part of your work at the ATSDR and just generally as an epidemiologist.

So explain a little bit about how that CAP program -- how you were a part of -- that CAP program become [sic] part of the ATSDR generally and specifically for Camp Lejeune.

A Well, I always think that it's important for a community to be involved in the science as much as possible, either giving us direction by telling us what their health concerns are or what other concerns they have or that they want the research to meet. That would include health assessments too. I feel that there should be CAPs for that too, but that hasn't

happened in the agency.

It is time-consuming to develop a CAP, who's going to be on it, who isn't.

I worked on one CAP that was in Cape Cod, Massachusetts, around the -- it used to be Otis Air Force Base. I can't remember what it's called now. That CAP was very controversial. There was a lot of animosity between a few CAP members and the agency, and everybody else, for that matter. And because of my organizing experience, I went there and tried to calm the situation down and work with them more closely to get what they wanted done. And it benefited both -- everybody, I think.

So I was not going to do any work on Camp Lejeune without having a CAP in place. I made that clear to the agency. There was some, again, you know, resistance because it does take work to develop a CAP.

Q So why did you feel that you couldn't and wouldn't do any work at Camp Lejeune without a CAP?

A Because I thought that it was important for the affected community to have some say and input. We did have a meeting that was required by Congress to look at endpoints other than childhood endpoints, so look at adult endpoints. That meeting was in 2005 or

before that. I'm trying to -- I can't remember the exact dates.

At that meeting, I talked to the two co-chairs and said, "If you can do anything, push for a CAP." And they did. And because they pushed and because I was pushing internally, a CAP was formed.

Q And the ATSDR eventually embraced the concept of a CAP, correct?

A Well, they embraced the concept of a CAP before that. It's just that -- you know, we're involved in thousands of sites. You can't set up a CAP on every site, so which ones do you choose, I think that was one problem. And it's difficult, who's going to be on the CAP, who isn't. We had a bad experience with the Cape -- I didn't have a bad experience, but the agency had a bad experience -- so did the health department -- had a bad experience in the Cape Cod CAP, so -- so there's those reasons. So it's not automatic.

But the agency pretty much thought it was important, and they -- you know, they had no problem with the Camp Lejeune CAP once the science panel made that recommendation.

Q Okay.

A It went quickly to set it up.

Q And that was, like, in 2005, right, that the

science panel recommended that?

A Yeah, I think -- yeah, it's in the website. I think it's 2005. And so the CAP must have started in 2006. I think that --

Q I have the document from 2005 here somewhere.

A Yeah, I'm trying to remember exactly, but that's roughly.

Q So can you just say -- so what is a CAP? I mean, if you can describe that in your words what a CAP is.

A Well, it's supposed -- a CAP, a community -- we call it a community assistance panel because it's not an advisory panel --

Q Right.

A -- so it doesn't follow the advisory panel laws or regulations. So it's an assistance panel. It's named that way for that reason.

So there wasn't a need to have a vote on stuff. We did have votes, but just to get a sense for the meeting. But it didn't require those kind of rules, it -- who was on the CAP, in this case -- you know, you do different things in different communities. In this case, there were two groups already formed on Camp Lejeune, either dependents or Marines who were there during the contamination. So we just asked both

groups to nominate four people, I think it was. So that's how we formed the Lejeune CAP. I'm not sure how the other CAPs are formed.

The CAP I helped form at New Hampshire for the Pease PFAS study -- I did work on other things. That's why I'm --

Q I saw that.

A Not just Camp Lejeune.

That one, we asked both -- there were three activists already, and we asked them to nominate other people, we brought scientists in there as well, and formed that CAP a little differently than the Lejeune CAP.

So it really depends on the community, so -- and we use the CAP, if you will, to explain what we are thinking about doing, explain the studies if we are going to do one, and have the CAP -- in an ideal situation, have the CAP have input into how that study is designed or what kinds of endpoints we look at, how, you know -- and in this case, the Camp Lejeune CAP was crucial because -- for science information, because they knew, and the Marine Corps apparently didn't know, where barracks were placed on base, where units were barracked on base. And we relied on CAP members plus people they knew who had that memory, for example.

So there were -- and also, we wouldn't have done, I think, a male breast cancer study because -- wouldn't have even thought of doing it, but we did because the CAP had done its own research, identified a lot of male breast cancer cases, made a big public, you know, media thing about it. And we said yes, good idea, we'll pursue it. At least initially, using VA data, which is limited, we had small numbers, but it was a first look, and we were certainly going to include it in any cancer incidence study or mortality study to the extent we could look at it.

Q Okay. So -- I think, if I understood your answer, so the CAP is sometimes populated by people who have been active, and you ask them to nominate people to be on the CAP; is that right?

A Well, the CAP should be representative -- I mean, the idea is to have it representative of the community and also have -- like I said, in Boston, have the health department involved, any other relevant agency also involved.

So the Camp Lejeune CAP, the relevant parties would have been a representative from the Marine Corps, which they did send for the early days of the CAP. And that was it. There wasn't -- we didn't really have a health department. We were the health department,

so -- so that was a little different.

Other -- there are a few other CAPs that would involve the health department serving the area where the site was.

Q So how many members was the CAP for the Camp Lejeune work?

A It varied. I'm trying -- we had eight at one point. It went back and forth. You know, I'm also confusing it with the Pease CAP. We had a lot more there, so I -- but roughly eight or nine. You could tell from the transcripts.

Q So you had more on the Pease, you said?

A The Pease CAP was much bigger, yes. Yeah. I think because we included the scientists. We didn't really count the scientists. There were two technical people for the CAP, and we asked the CAP to -- well, we helped the CAP come up with who those people were that would be helpful.

Q Okay.

A And at Pease, there were a number of people we wanted, because it was a new substance and new effort, really.

Q Okay. We got on that discussion over your Ozonoff Award. Let me ask you a couple of other background questions before we talk about some of these

studies.

So are you aware -- do you know about the American College of Epidemiology?

A Well, I've heard of them, yeah.

Q You're not a member?

A No.

Q Were you ever a member?

A No.

Q As a government employee, were you allowed to be members of those kind of organizations? I know some government rules have --

A I think we were. I just didn't join.

Q Okay.

A I haven't been -- I don't think I've -- at one point, I think I was a member of the APHA, American Public Health Association, briefly because I had to in order to do a speaking engagement at their convention.

Q Okay.

A But I tried not to be involved in those. My focus was on the work, and so I didn't join any of these organizations.

Q Okay. I want to show you a couple of exhibits that talk about just some of the views of the American College of Epidemiology to see if you agree with them. So 9 is their mission and vision.

(Exhibit 9 marked for identification.)

Q (By Ms. Greenwald) And then I'm just going to go over some -- a couple of the guidelines with you. That will be Exhibit 10.

(Exhibit 10 marked for identification.)

Q (By Ms. Greenwald) And here's the guidelines. I'm just going to ask you if you agree with some of these views of epidemiology generally.

So if you look at the vision on page 2, it says, "We envision a world where the value of epidemiology in public health is universally recognized, driven by a community dedicated to education, innovation, and transformative research."

Would you agree that that's a vision that epidemiologists --

A I think that's a --

Q -- would embrace?

A -- good mission. To me, an epidemiologist needs to be a public health -- have a public health perspective, and that sounds like what they're saying here.

Q Exactly. So I'm going to go to the guidelines, because I think that's probably the most relevant, then, based on what you just said.

A Is that 10?

Q That's Exhibit 11.
A Oh, Exhibit 11.
Q No, 10. I'm sorry.
A Ten. Okay. I was going to say --
Q You're absolutely right.
So if you look at the -- on page 3 of Exhibit 10, at the bottom, under "Core Values, Duties, and Virtues in Epidemiology." Do you see that? It's at the bottom of page 3.
A Well, it's not numbered, so I'm trying --
Q Oh. On the top -- there's no number in the top left?
A Oh, maybe there -- oh, here it is, "Page 3." I'm sorry, I didn't see --
Q Oh, no, no, no.
A Core values.
Q It's because the paper clip is in the way.
A Right. Sorry.
Q It says, "In this section we define and discuss core values, scientific and ethical precepts widely held within the profession, as well as duties and virtues in epidemiology. We also relate core values to the mission of epidemiology: the pursuit of knowledge through scientific research and the improvement of public health through the application of

that knowledge."

So you would agree with that statement --

A Yes.

Q -- right?

A Yes.

Q Okay. And there's a number of those throughout here. I'm going to jump -- I don't want to waste -- I don't want to spend too much time on this so we can make this as short as possible for you.

A Uh-huh.

Q If you can go to page 6, under "Providing Benefits." Do you see that?

A Uh-huh.

Q "Epidemiologists should ensure that the potential benefits of studies to research participants and to society are maximized by, for example, communicating results in a timely fashion. Steps should also be taken to maximize the potential benefits of public health practice activities."

Would you agree with that?

A Yes. And I think that that's why a CAP is important, just for these reasons, to make sure that we can communicate to the community and have the CAP do that for us, and also to make sure that what we're doing is useful to that community.

Q And the timely communication is important as well, right?

A Well, that's what I mean, yeah, yeah.

Q And then apropos to what you're saying, on page 8, 2.8.2 talks about "Involving community representatives in research." And that's, again, something you strongly agree with, right?

A Yes.

Q Okay. So right under that, it says, "2.9 Avoiding Conflicts of Interest and Partiality - Epidemiologists should avoid conflicts of interest and be objective. They should maintain honesty and impartiality in the design, conduct, interpretation, and reporting of research."

You would agree with that --

A Yes.

Q -- also, right?

A Yes. Sure.

Q And they're not inconsistent, correct? Involving the community isn't inconsistent with 2.9, is it?

A Well, it depends on how you define "conflict of interest." My view is that you're supposed to serve the -- especially government workers -- supposed to serve the public.

So working on promoting public health would not be a conflict of interest if you work with the community. That's the whole point of promoting public health, is working with communities to enhance their health. So some people do see that as a conflict. I don't.

Q But -- yeah, I think -- so here -- let me step back and ask it a different way.

A Uh-huh.

Q Your involvement with a CAP in any of your projects, from the time you've been an epidemiologist until the time you retired a couple of months ago, you would never have had that involvement impact the design, conduct, interpretation, and reporting of your research, right?

A No.

Q I'm just trying to save time here, so give me one second.

Okay, so if you go to page 13, the first full -- the second paragraph. I'm sorry.

"The potential benefits of epidemiologic research include providing scientific data that policymakers can use to formulate sound public health policy. The responsibilities of epidemiologists to facilitate the development of health policy include

publishing objective research findings in a form that can be utilized by policymakers. The publication of both positive and negative research findings is important, since it helps to prevent publication bias and allows for additional benefits to be gleaned through meta-analyses."

You would agree with that --

A Yes.

Q -- right?

A Yes.

Q And then I -- we've talked about this a fair amount. 3.8 talks about maintaining public trust. On page 19. I'm sorry. On page 19. And over on page 20, it says, on the first full paragraph, "Maintaining public trust is especially important in planning and carrying out community studies. In identifying public health problems to be studied, and their priority for study, epidemiologists should take into account the perceived importance of the problem to the people living in a community after information about the problem has been provided. However, if epidemiologists perceive that a health problem exists but is being ignored or its existence denied by the community, it may well be appropriate to proceed with a study of a health problem (or an outbreak investigation that must

be initiated without delay to address an urgent public health concern) while simultaneously working with the community to gain their confidence and support."

You would agree with that --

A Yes.

Q -- right?

A Yes.

Q Okay. I think we can put this one aside. Lots more in there, but...

How are you doing? Do you need a break? Are you good?

A Maybe in 15 minutes or so.

Q Okay. Okay.

So I know you were with the ATSDR for about 33 years, right?

A Right.

Q So -- almost. I'm going to show you a couple of documents that the ATSDR says about its mission/vision. So this is No. 11. It's "ATSDR Background and Congressional Mandates." And No. 12 is "ATSDR Mission, Vision, and Impact."

(Exhibit 11 marked for identification.)

(Exhibit 12 marked for identification.)

Q (By Ms. Greenwald) So under "ATSDR Background and Congressional Mandate," it first

describes that Congress created the ATSDR in 1980 "to implement the health-related sections of laws that protect the public from hazardous waste and environmental spills of hazardous substances."
Do you see that?
A Uh-huh. Yes.
Q Would you agree that was part of your mission?
A Yes.
Q And then, that statute is called CERCLA?
A Yes.
Q "CERCLA, commonly known as the 'Superfund' Act, provided the Congressional mandate to remove or clean up abandoned and inactive hazardous waste sites and to provide federal assistance in toxic emergencies. As the lead agency within the Public Health Service for implementing the health-related provisions of CERCLA, ATSDR is charged under the Superfund Act to assess the presence and nature of health hazards at Superfund sites, to help prevent or reduce further exposure and the illnesses that result from such exposures, and to expand the knowledge base about health effects from exposure to hazardous substances."
Do you agree with that?
A Yes.

Q And is that what you did for the 33 years you worked there?

A Yes. In particular, the cooperative agreement back in 19 -- I'm sorry, 1986, when we received it in New Jersey, the health department, and I worked on that cooperative agreement, is trying to meet this mission --

Q I see.

A -- to look at -- because, as I said, they hadn't looked at toxic waste sites and birth outcomes, and that was a key area where they wanted to -- ATSDR wanted to -- and CDC wanted to expand the knowledge base on that.

Q So you were at the forefront of a lot of these issues?

A Yes.

Q Then the last paragraph says, "With the passage of the Superfund Amendments and Reauthorization Act of 1986 (SARA), ATSDR received additional responsibilities in environmental public health. This act broadened ATSDR's responsibilities in the areas of public health assessments, establishment and maintenance of toxicologic databases, information dissemination, and medical education."

Was that also part of what you did in your

years at ATSDR?

A Well, I did not work on public health assessments directly. Sometimes I was asked to help with some of the information going into them, but -- and I was -- again, with toxicology -- and we had a tox profile program -- that, I helped on occasion. I actually wish I had been able to help more because I think that the epidemiologic information in the tox profiles could have been enhanced if I had had more of a role there. But I was very busy doing other work, and I think that was part of the problem. But, yeah, I mean, that's what we were supposed to do --

Q Okay.

A -- as an agency.

Q And then if you go to Exhibit 13 --

A Or 12?

Q Twelve. I'm sorry.

A It's okay.

Q It's 12. I had a different order in my notes.

A Right.

Q The vision: "Most trusted agency protecting American communities from environmental health threats through application of state-of-the-art science."

Is that what you practiced during your years?

A I did, yes. Yeah.
Q And that was important to you to fulfill that vision?
A Yes.
Q And the mission: "ATSDR protects communities from harmful health effects related to exposure to natural and man-made hazardous substances. We do this by responding to environmental health emergencies; investigating emerging environmental health threats; conducting research on the health impacts of hazardous waste sites; and building capabilities of and providing actionable guidance to state and local health partners."
Is that also part of the mission you feel you fulfilled all those years?
A Yes. Yes.
Q And then there's a number of core values. I won't read them, but they are Accountability, Collaboration, Innovation, Equity, Integrity, and Respect.
And if you could just read those to yourself, if you don't know them, or you can read them out loud, whatever. But do you agree that those are core values that you followed and believed in for the 30 -- almost 33 years --

A Yes.
Q -- you worked --
A Yes.
Q Okay. And then "ATSDR Priorities," the bottom of the list, it says, "In addition to the goals and objectives outlined in the strategic plan, NCEH/ATSDR aims to focus on four topical priority areas: asthma, children's health, safe drinking water, and innovative laboratory methods." Do you see that?
A Uh-huh. Yes.
Q And safe drinking water, we talked about earlier, has been a big part of your work with the ATSDR, right?
A Yes.
Q And that was central to the issues in Camp Lejeune, right?
A Yes.
Q Okay. So you're sometimes referred to as an advocate, right? You know that, right?
A Yes.
Q Okay. I applaud that term, and I want to go over a little bit about what I believe you define as an advocate, but I don't want to put words in your mouth.
So I'm going to show you an email that is one of your self-appraisals. It appears to be from 2008,

which -- first is the email, just to give you a time frame, and then the self-appraisal. So the email will be Exhibit 13, and then the self-appraisal will be 14.

(Exhibit 13 marked for identification.)

(Exhibit 14 marked for identification.)

Q (By Ms. Greenwald) Here's the email that gives it a time frame, and here's the self-appraisal. Here's your self-appraisal, which is 14.

This appears to be a 2008 self-appraisal. Does that seem right?

A I guess. I'm trying to figure out why this was -- why I did it and what the point was.

Q I mean, I can help tell you why I think it's the right one. In the bottom right-hand corner, see it's got some funny numbers? Those are Bates numbers. And it says 10891.

A Uh-huh.

Q And then the next one is 10892. So that means they were produced to us together.

A Uh-huh.

Q And that's why I believe it's a 2008 --

A No, that wasn't the --

Q I'm sorry.

A I wasn't sure why I was asked to do this. I guess that's what -- at the time. I'm trying to

remember. But anyway...

Q Yeah, I was wondering about that because that's the only one we found. It doesn't mean there aren't others, but I -- you don't remember doing this on an annual basis?

A Yeah. Right. Okay. It's part of the performance called PMAS, performance -- yeah. Every -- yeah, you're supposed to do a self-appraisal both at the six-month period and at the end of the year to help your supervisor decide what -- how you performed that year. So that's -- so, yes, this happened every year then. Okay. That's -- thanks for reminding me.

Q No, it's okay.

Under "Advocacy" on page -- the second page, which ends in Bates 10893 --

A Yes.

Q -- can you read the -- since it's your words, can you read the paragraph under "Efficacy," the first paragraph?

A "Worked very closely with those affected by exposures to contaminated drinking water at Camp Lejeune, including daily phone conversations and emails, CAP meetings, and informal meetings. Provided informational materials on the risks of exposures to the contaminants, as well as general materials on the

toxicology of the contaminants, epidemiologic study designs, genetics (for example, gene-environment interactions involving the contaminants), and water modeling issues."

Q Okay. And then beyond that, you talk about a couple of other pieces of work you were doing at that time, right?

A Right.

Q Is that one of the ways in which you define "advocacy"?

A Yeah. That's one of the ways, yeah.

Q Okay. And we talked earlier about your interview in May 2018 by your alma mater called Fords in Four. Do you remember that?

A Yes.

Q Okay. So we have that interview. This will be Exhibit 15.

(Exhibit 15 marked for identification.)

THE WITNESS: So you also have a picture of my daughter and I that's a part of that, or no?

MS. GREENWALD: I don't.

(Discussion off the written record.)

Q (By Ms. Greenwald) Here's Exhibit 15.

A That went -- the picture went with this

thing.

Q Oh, okay. We don't have it with the picture. I'm sorry.

Okay, this appears to be from May of 2018?

A I think so.

Q It says, "Fords in" -- under "Bove," it says, "Frank Bove, 69, senior epidemiologist." Do you see that in the upper left? Did I give you the right document?

A You probably did, but --

Q I don't know -- let me just look at that and find out.

A I'm trying to see where --

Q I have a different version.

A Oh, okay.

Q Okay, so mine looks a little different. So yours is part of an email. Okay, never mind. Yours is part of an email. I'm just going to go straight to this -- well, you -- do you remember being interviewed by your undergraduate alma mater about this?

A Yes.

Q Did you know about this Fords in Four before you were --

A No.

Q -- contacted?

A No.
Q Okay.
A I've had very little contact with the school.
Q Do you know about this program, or is it just out of the blue they called you?
A Out of the blue. I think they saw the Unsung Hero Award, the Ozonoff Award, that prompted them.
Q Okay. So on page -- well, now I don't know how to do this. Let's see. Question 3. Unless I have a different version, Question 3.
A "What have you done since Haverford," is that the --
Q It says, "What do you do on a day-to-day basis as a senior epidemiologist? How would you explain your work to others?" That should be Question 3. Is it?
A It's --
Q All right, so I have a different version.
A You have a different version.
Q I apologize. I'm going to do this -- let me -- I'm going to let you keep that, and I will do this after our break, because my version is not the same as yours. Sorry about that. So we'll go back to that.
One more document, or do you want to take a

break?

A One more document.

Q Okay. So I'm going to show you what I'm going to mark as, now, Exhibit 16. This one will be the same.

(Exhibit 16 marked for identification.)

Q (By Ms. Greenwald) Do you recognize this PowerPoint?

A Yes.

Q And did you prepare it?

A Yes.

Q Do you remember when? I don't see a date on it.

A This looks similar to a TED Talk I did at CDC, but I don't remember the date.

Q Did you do a TED Talk on Camp Lejeune?

A Camp Lejeune was part of it, but I was talking more -- yeah, Camp Lejeune was definitely a part of it, I used that as an example, but I think I used other examples too. I talked about the issues around how to interpret studies, in particular statistical hypothesis testing and so on. So I talked about that in here and then did so in the TEDMED.

So the TEDMED, I had to do without looking at anything, but pretty much what I see in here is what I

presented.

Q Okay. Do you remember about when that was?

A Is it in my resume?

Q I didn't see it. So if it was there, I missed it, so -- it's okay.

A Okay.

Q It doesn't matter.

A I can't remember exactly when.

Q Okay. If you go to the -- so these aren't numbered. We're going to use the Bates numbers --

A This is before the pandemic, let's put it that way.

Q Okay. All right.

A So it's probably sometime 2014 to 2017, around that middle --

Q Okay. That's always helpful. That's what we all use now, sadly, for our time frame.

A Yeah, yeah.

Q So I'm going to use the numbers on the bottom right-hand corner because this isn't numbered.

A Okay.

Q So go to the second slide, which is Bates 121759.

A "Main Points."

Q "Main Points." The second one is, "To be

responsible to the needs and concerns of communities, public health practice should adopt aspects of the precautionary principle."

What is that? Can you describe what the precautionary principle means to you?

A Yeah, well, I think it gives us -- there must be a slide in here that actually -- yes.

Q There is?

A Sixty-three.

Q Okay. Let's jump to 63.

A And those are the, as I have there, central tenets of the precautionary principle.

Q Uh-huh.

A I mean, heeding early warnings is, in general, what the precautionary principle means. But unpacking that, you have, "Take preventive action in the face of uncertainty." So you don't wait until all the bodies are in front of you. If you have some information to act, you act. You may -- and there's always uncertainty anyway. So that's the first one.

The key one -- a key one is shifting the burden of proof from those who are upset or concerned about a project to those who are advocating for a project. For example, if someone wanted to put an incinerator in your community, they have to show that

it's safe. You don't have to show that it's dangerous.

Q And why is that important?

A Because it's stacked the other way. It's stacked the other way. In almost all situations, the polluter or proposed -- whatever it is that has that potential to pollute doesn't have to prove -- doesn't have to prove that it's safe. The advocates, people of the community, has to -- is given -- usually has the burden of proof to -- and so that's trying to redress that.

These are -- by the way, the precautionary principle is something that was adopted in the European Union. This is not, you know -- and so it's, you know --

Q Right.

A It's not something --

Q It's a well-accepted principle?

A Yeah. It's not --

MR. BAIN: Objection.

THE WITNESS: Yeah, I mean, we haven't accepted it -- the EPA has discussed it, and I would say what the FDA does is sort of precautionary, testing drugs before they're put to use. So there are aspects of this already, but not the whole -- not in this

country.

Q (By Ms. Greenwald) So can we stay on your point about for a minute about shifting the burden, sometimes referred to "as level the playing field." But whatever word we use, is that not because the proponent of an action that could cause harm or a facility or an entity that's already caused harm has most of the facts, and the community being impacted is really without a lot of the facts?

A That's part of it.

MR. BAIN: Object to form.

You can answer. Go ahead.

THE WITNESS: That's part of it, lack of information, because some of -- the company may say it's proprietary, for example.

But there's also another issue, which is, as I said, the burden of proof is on the community oftentimes, in many instances.

So anyway -- so that's a part of it, just to make -- "level the playing field" is not a bad description of that. And then look for alternatives too. And a key one for me is increase public participation in decision-making. That's the whole point of having a CAP or some kind of entity, that the

community has input into your work.

Q (By Ms. Greenwald) So if we can go to the slide -- a couple back -- that ends in 61. The bottom bullet point in red says, "Advocate for public health - an obligation to act," as one of the primary duties of public health practitioners, right? And would you consider that a primary duty for epidemiologists --

A Yes.

Q -- as well?

A Yes. That's controversial. There are epidemiologists who say that you should not do any of this work or that your science should be pure and not have any -- or not have direct policy implications, or at least epidemiologists shouldn't be involved in that effort.

So, I mean, I'm thinking of Kenneth Rothman, for example, who has made that case over the years. But I disagree with that. I think that epidemiologists should play a role. We know something; we should play a role in the policymaking. And in the case of information we have on the dangers of a substance or dangers of an exposure, we should act.

Q So I notice on the bottom of that slide, you have some notes, and it says -- the last is, "They

think" -- "they," I assume that's people who don't agree with you -- "They think you cannot be both a scientist and an advocate/activist." Do you see that?

A Yes, I see that.

Q You believe those are compatible, don't you?

A Yes, absolutely.

Q Okay. So if you go to slide 66, did you use the Woburn example as an example of why advocacy and public participation advances science and knowledge?

A This is the Long Island breast cancer work, where they had a map of where the breast cancers were, also any information they had on environmental exposures, and they put it together, the community put it together. And that impacted the research that was done, I guess, by NCI. I'm trying to remember who did all the research. I think NCI was involved. I don't remember if CDC was involved as well, doing -- looking at Long Island breast cancer and doing a sequence of -- and, of course, the health department -- the New York health department was involved.

It was -- a lot of the work was instigated by the community's work itself. And that was true of Woburn. The families, in particular one family whose son had -- I think it was a son -- had leukemia, went around and identified many of the cases.

That was also the case in Brick Township. One family who had two children with autism identified most of the cases in the community before health people showed up, so that's -- that was an important -- that's citizen science of a sort.

Q Okay.

A Yeah.

Q On page 69, you refer -- and also on page 70 -- I think they're similar -- a couple of slides here talk about the difference between false positives and false negatives and why -- sort of your views on the importance -- or the -- let me ask this question right.

What are your views on the significance of false positives -- the lack of concern of false positives versus the risk of false negatives?

A Well, what -- the way statistical testing is set up is a problem because they use -- arbitrarily use a .05 as an error rate for a false positive. And they oftentimes, for no good reason, set .20 for a false negative.

And so -- and my view is that they either should be equal, so both should be .05 or .20, or there should be some cost analysis done as to what is the cost of a false positive and what is the cost of a

false negative, who bears those costs, right, and all that should be put into -- if you're going to use this method, that's -- you should do that. But no one does that, and so that's part of the reason I am opposed to using significance testing. There's a whole list of reasons why I'm opposed, and a lot of -- most of those reasons, if not all of them, are in American Statistical Association articles that were written in 2016 and 2019 and where the American Statistical Association, the head of it, in one paper in 2019 said basically don't use it, simply said don't use significance testing, and I agree with that.

Q Is there a shift right now in statistical significance dialogue among scientists and biostatisticians now on this issue?

A This issue is at least a hundred years old. I, in fact, found something in the 1800s where there was something like a dispute about this, so it goes way back.

I know that Sander Greenland, who is a well-known theoretician in epidemiology, and two researchers put out a call for how many people -- how many researchers agree with their position not to use significance testing. And they initially got something like 7- or 800 researchers saying, "We agree with you."

But I would say at this point, it's still very much a controversy. The journalists and the researchers still use it. And I've had to battle both journalists and within the agency around this issue over the years, trying to, you know, go through why it's not a good approach, what the deficiencies are, trying to promote a different approach, which, again, some of these well-known theoreticians are pushing as well.

Q I want to ask you about -- on page -- on slide 74 -- not your cartoon, although I like your cartoon a lot -- you write here, "Even when an association between exposure and disease is observed, the agency may claim that the finding does not constitute 'definitive' or 'conclusive' proof of causality." And this is the sentence I want to focus on, "But this is misleading because no study, by itself, can provide 'conclusive proof.'"

So that goes both ways, right? So no one positive study, in the absence of everything else, and no one negative study, in the absence of positive information, can really answer a question on its own, right?

A Right. Because most research, if not all research, there is a background that promoted that

research in the first place. There's some information, animal data, maybe -- in the case of vinyl chloride and angiosarcoma of the liver, you know, reports that there were too many cases, because you didn't expect any, in a plant, so, you know, then you do a study.

So it's -- the study is built on previous information and subsequent information. So in trying to determine what the evidence -- how strong the evidence is -- because in science, you hate to use the term "proof," but how strong the evidence is, you have to bring all that together.

So even for smoking and lung cancer, you know, the epidemiologic studies done in the '50s were helpful, you know, but there was also other information. And together, with animal data and with what they knew, they made a convincing case. They still don't know the mechanism, though, and that would make it even more convincing, and that's, you know -- so I'm just -- so that's what I mean here, is that a lot of times -- and when I say "agency" here, I'm not talking about ATSDR specifically.

Q Right.

A I actually think more about health departments more often and cluster investigations where they say, "Well, it's not statistically significant;

there's no problem here." And that's happened at Woburn too. The way they -- they analyzed the wrong outcome in particular on -- in that situation.

But again, you know, even if it's not statistically significant or -- you know, you have another information. Maybe workers who work with the substance have had that disease or something like that. So you need to bring in what they call our priors, our background information, and inform the current study.

And that's what we did at Lejeune too. I mean, the outcomes we focused on -- starting with the birth defect study, we looked at outcomes that I found in the New Jersey study and also the Woburn study and, actually, the other New Jersey cancer study. So those informed the Lejeune study there, the birth outcomes and the birth defect cancer study.

The mortality study, occupational studies really pushed that, because there was some evidence already about trichloroethylene and kidney cancer, for example.

Q And just one more thing and then break time, because I know I've gone past the 15 minutes.

The second [sic] sentence there says, "Nevertheless, a study can provide important evidence for a causal association that, linked with evidence

from other research, can be scientifically convincing."

A Right. Yes.

Q So that's the flip side of what we just talked about --

A Yes.

Q -- right?

A Yes.

Q Okay, you want to take a break?

A Sure.

THE VIDEOGRAPHER: Okay. The time is 11:02 a.m. Going off the video record.

(Recess taken.)

THE VIDEOGRAPHER: We are back on the record. The time is 11:16 a.m.

Q (By Ms. Greenwald) Okay. Let's move to some of the work you did at Camp Lejeune.

A Okay.

Q But before we do that, I want to ask you a little bit about the peer-review process at the ATSDR for published papers, basically any paper that you worked on when you were there. I'll mark this as Exhibit 17, in case you want this for reference. You don't have to read it. I just wanted to [indiscernible] need it for reference.

(Exhibit 17 marked for identification.)

Q (By Ms. Greenwald) So can you explain the peer-review process to us, please?

A Well, it has -- we're required by the CERCLA or SARA -- I can't remember which -- to peer-review all our studies. And that would sometimes include peer-reviewing the protocol, as well as the report on the study or the article.

So we have -- so it goes through an independent peer-review process. We usually pick three -- either the science office at ATSDR asks us to recommend people, or if we don't have any -- for some reason, we don't have any ideas, they pick the people. Their decision is the final decision, though. They may disagree with your representations and pick three people.

But usually, they pick at least one -- for the epi studies, one epidemiology [sic], at least one statistician, sometimes two epidemiologists and a statistician. It varies. It depends on the study too.

So -- so, yeah, so every -- for example, the cancer incidence study, we had not only a peer review, but there was a meeting to discuss the protocol, to go over it with a group of scientists in the room. And then -- and then they had a chance to go back and then provide additional comments to the initial protocol.

So that was -- so -- that and the -- I don't think the mortality studies went through that rigorous a situation, that was kind of rare, but we all -- all the studies have to go through a peer-review process set up by the Office of Science at ATSDR. And then when it goes to a journal, it goes through another peer-review process.

Q So I want to ask you about this -- where you say sometimes the protocol itself goes through peer review. So that's before you actually write the study, that's when you come up with the protocol, and before you even start doing the work on the study, you have to -- you go through peer review on just how it's going to be done?

A Yes.

Q And you said that was done for the cancer incidence study?

A Yes, we had -- as I said, we had a meeting of -- I don't know how many -- six, seven, eight people, experts in epidemiology, in cancer registries. We had at least one person who was a part of the National Association of -- the North American Association of Central Cancer Registries, NAACCR, and also researchers who had done other cancer incidence studies themselves.

So we had a room full of these people, and went back and forth as to whether the protocol was the proper approach. Some people thought there was another approach that might be useful. We had that debate. But the protocol pretty much was accepted pretty much the way it was. So that reassured us and it was -- that was important for the -- they felt that way.

The mortality studies were more -- were simpler. They really were -- you know, mortality studies are standard pretty much in the occupational field, occupational health field. So I don't think that was -- I don't remember the protocol there, going through the, kind of, committee meeting like that. It may have been peer-reviewed, I can't remember, the earlier mortality study. But the study itself was -- I mean, the report was peer-reviewed, the --

Q Right.

A Yeah. Whether the protocol was, I can't remember. But the protocol for the cancer incidence, and I think also for the current mortality study, was also evaluated. So -- and for the assessment of the evidence, there was a peer review early on, and that's a whole -- there's a whole story behind that one. And then --

Q We'll get to it.

A -- there was a peer review once the report -- a draft was written. So there was two peer reviews there. And those were the only two peer reviews for that because that was not submitted to a journal.

Q Okay. So let me ask you a couple of follow-up questions to your answer.

So I think you mentioned -- and if I got it down wrong, please correct me. I think you said that the protocol for mortality studies are more standard in the occupational field than the cancer incidence study would have been. Did I get that right?

A Yeah.

Q So what does that mean, "more standard"?

A Well, first of all, the data is easier to obtain. The National Death Index is available. There's no such thing as a national cancer incidence database where you have personal identifying information linked to it.

So that's a major difference right there. There are very few studies done on cancer incidence because they're difficult to do, and -- whereas mortality studies, you have -- if you can identify the cohort, you have some identifier, like social security number would be important to have, then you can match it to the National Death Index, get causes of death,

specific causes of death, and do a study.

I mean, it's not that simple, but -- but at least there's that database. Otherwise, as I said, for cancer incidence, you either have to go to a cancer registry or a group of cancer registries like the -- NIOSH did a study of firefighters, and I think they used 10 cancer registries that were around the firefighters that -- the cities, the three cities, I think, they have.

So there are cancer incidence studies, but they're difficult to conduct for that reason.

Q I see.

A But there's no national registry.

Q And so -- so talking about mortality studies, the death --

A National Death Index.

Q National Death Index. That just refers to the cause of death on a death certificate, right?

A Right.

Q Okay. So if someone -- I know you -- I think it's in one of your papers or somewhere, I saw a comment that if someone had cancer, but they were killed in a car accident, the cause of death would be the car accident, not cancer?

A It would be missed, yeah.

Q Okay.

A That's a limitation of mortality studies, is that you'd rather have -- for cancer or for Parkinson's or any of the diseases, you'd rather have incidence data than mortality data. But all else fails, you have mortality data.

Q Okay. And so -- so you mentioned that the cancer incidence study went through a peer review for the protocol.

A Yes.

Q Was that the kind of peer review that you talked about where you recommended a few people, and then other people recommended people, and those people were brought together and looked at the protocol?

A I think I was the one who recommended all those people because I knew who had done studies on cancer incidence --

Q Okay.

A -- and who was -- who worked for a registry that was -- you know, we asked a couple of registry people on one, you know, so I -- if I recall, I did -- I picked those people for the most part. And I think that's because the Office of Science deferred to me because I was the internal expert on this.

Q Uh-huh.

A And that's, you know -- but as I said, they often asked us for recommendations. And most of the time, I would say, they used our recommendations, maybe add one person or -- oftentimes, some of the people we recommend can't do it.

Q Okay.

A People are busy, so --

Q And when you -- I'm sorry. I didn't mean to cut you off

A So they pick somebody if we're having trouble getting people. And that's happened on occasion.

Q Okay. When you send a paper in to a journal for peer review, those are -- are those blind, or do you also recommend --

A No, no, no. The journal -- the journal picks them.

Q Right.

A I noticed Environmental Health Perspectives said, "Do you have some people in mind?" So they actually do that, but that may be -- that's new for me. I don't recall that in any of the other journals, so -- I was never asked. That was the first time I was asked by a journal. Whether they actually picked those people, I have no idea.

Some journals will let you know who the

reviewers are, and some won't. It's up to, actually, sometimes the interviewer, does the reviewer want you to know.

Q Okay. So when you're talking about doing a study, like a mortality study or a cancer incidence study, which I understand is a more complex, robust type of study based on --

(Interruption in the proceedings.)

Q (By Ms. Greenwald) Apologies, Dr. Bove, for that little interlude.

Are there, sort of, key components that one would look for in a high-quality study of either mortality and/or cancer incidence that would be, like, common to these type of studies, or do you have to look at them separately? Is there a commonality between them as far as what would be a high-quality study? And maybe I should go over some of the ideas I have, and maybe that would be easier for you.

A Well, I mean, a high-quality study would have a good exposure assessment. And also, good outcome data that's verified, that would be good.

The problem with a survey, for example, is oftentimes we don't verify the outcomes that are reported to us. But if you have -- but the occupational studies, some use a job exposure matrix,

depending on the study. Some use plant-specific, which is better than a generic job exposure matrix, which would cover various occupations and various plants that use the chemicals. That's a little less accurate to some extent.

So the better the exposure assessment, the better the study, in particular if you have -- if you take body sample -- fluid samples or, you know, you take some kind of sampling that enhances the exposure assessment. So that's one side. The other side is to have verified outcome data --

Q Okay.

A -- cancer registry data, National Death Index, or some medical records to do that.

So those are -- now, some people say, well, if you don't look at smoking, you know, you don't ask for smoking, that's a detriment to your study, for example, if you're doing a cancer or any smoking-related diseases.

However, you can -- you can deal with that problem to a great extent by determining whether other diseases that are smoking-related, but not related to the exposure you're interested in, are elevated or not.

If you don't see -- for example, in the work we did in the cancer incidence study and the mortality

study, chronic obstructive pulmonary disease, it's not related to any of these chemicals in the drinking water, at least as far as we know, but it is smoking-related.

So if you don't see an increase in COPD in one group versus another, there probably isn't much of a smoking difference. Between the two, there's not much of a smoking difference. There's really no problem with confounding or very minimal confounding.

So even if you don't get smoking information, you can tease out how bad the bias might be and in what direction.

So I don't -- so to me, a good -- high-quality study, sure, if they get smoking information and it's good information, that's fine. But a high-quality study doesn't necessarily have to have smoking information.

Q Okay.

A The main thing is to have a good assessment, exposure assessment, good outcome assessment, and interpret it properly -- that's another problem -- and minimize as many of the biases as you can. For occupational studies, a healthy worker; for veteran studies, a healthy veteran effect. You have to keep those biases in mind. Selection bias could be a

problem because you've lost people to follow-up, for example.

So, you know, if you minimize these biases, that would be a high-quality study.

And high-quality studies are -- you know, when NCI does a study or NIOSH, they're usually high quality.

Q Uh-huh.

A And IARC, when they do a study, usually high quality.

Q So can I go through some of the factors that -- I'm going to ask you, for example, if these are factors or components that you would say are present in the studies that you did for Camp Lejeune --

A Uh-huh.

Q -- that you have in front of you right there.

A Uh-huh.

Q So the cohort size, is that something you would consider the larger the cohort size, the stronger the study?

A Yes, as long as it doesn't impact your exposure assessment. If you --

Q What do you mean by that?

A In other words, if you -- if you include more people, oftentimes -- sometimes, it may weaken your

exposure assessment, because you're putting people in there you're not sure of their exposures and stuff.

Q Okay.

A So as long as it doesn't affect -- it doesn't impact the exposure assessment, yes, the larger the cohort, the better, especially if you're looking at a rare disease, like cancers.

Q Okay. So a large cohort provided that cohort are exposed people?

A That you've defined the exposure properly.

Q Okay.

A So they could have various exposures, as long as you define them properly --

Q Okay.

A -- assess them properly.

Q And would you also agree that extensive or regular follow-up is something also important if you're doing a longer-term study?

A If you can do follow-ups, yeah. Oftentimes, that's -- studies haven't been followed up. But in the occupational field, some have. There have been dry-cleaning studies where the NCI has followed these people over time and keeps reporting new findings from it.

Q And a term that I've seen in some of the

materials is "AIC" -- I don't know how to say this -- Akaike Information Criteria. It's A-K-A-I-K-E.

A Yeah.

Q I don't know how to say that word. How -- do you know how to say it?

A No.

Q Okay.

A It's a person's name.

Q We'll just call it AIC. It's a modeling to define study ranges; is that right?

A Yeah, I see it as one measure of the model fit, and it's useful, I mean, if you're looking at various different models. For example, if you have four variables in one model -- exposure, maybe smoking, alcohol, and, I don't know, some other thing -- and this study has three, you can compare them with this AIC if you take -- if you have two models with -- both having four variables in it, but different ones, you can, again, look at AIC.

If you're -- I used AIC quite a bit to look at the splines, the -- how to explain this -- the dose-response curves that aren't -- that are -- that take into account that the curve may change its shape, and you can look at AIC to see which -- where to put the knots where the changes occur.

So there's various things you can do with AIC. But mostly, in general, it's some kind of goodness-of-fit approach. There are other statistics that also look at goodness-of-fit, but AIC seems to be one that a lot of people use.

Q So you're looking for a high number for AIC, is that -- or just --

A I can't remember now.

Q Okay.

A This, I can't remember.

Q Okay. That's okay.

A I haven't used it in a while.

Q Okay. And if a study has a bad AIC, whatever that -- whether it's high or low --

A Yeah.

Q -- what would that mean?

A Just means that the fit is not as good, so you may want to go with the model that has the better AIC. And, again, I can't remember if it's higher or lower.

Q That's okay.

A That's what happens in retirement.

Q What about SMR, Standardized Mortality Ratio?

A Yeah, SMR could also stand for Standardized Morbidity Ratio. But, yeah, usually -- because it's

hard to do incidence studies, it's usually death studies, it's a standardized mortality ratio. And that's the observed over the expected, and you -- the observed number of cases of the particular cause of death you're interested in. The expected number comes from the age distribution and maybe sex and race distribution of your population times the -- some kind of standard rates, usually taken from, like, CDC WONDER or cancer -- U.S. cancer rates or whatever. And NDI actually has their own death rates that you can use automatically. So if you put the data in properly, you get -- it kicks out an SMR for you for each cause of death.

Q Okay.

A So that's why there's a lot of -- mortality studies, it's very useful, the National Death Index, and makes it easier for you to do these studies.

Q Okay. What about the Cox Proportionate [sic] Hazard modeling? And I think -- if I recall, one of your studies used Cox and the other one Poisson, POISSON.

A Yeah. They're actually similar.

Q Okay.

A The Cox model looks at each age -- or age is the time variable that we do. Other researchers use

time to tumor or some other time variable, but because cancer and age are so highly related, it's useful to use age as your time variable.

So as people age and you have an event, like a cancer, that you're interested in, the Cox model takes that into account. So the Cox -- whereas the Poisson, instead of fine -- more fine ages, the Cox model -- the Poisson model will use age groupings.

So if you want to think about it, Cox model is more individual level, Poisson is more aggregate -- is aggregate level, not more aggregate level.

Q Okay.

A So if you don't have -- if you have broad information on people, but you don't have specific information on when they died or what age they died, but you have sort of a -- if you can group -- if you can use age -- broad age groupings, five-year age groupings, ten-year age groupings, and you have race, sex, and so on, you can do a Poisson model, and you get roughly -- you can get roughly the same answer.

The value of a Cox model is it takes into account when the cancer -- disease occurred, as well as the difference -- the magnitude of the difference between the two, so -- whereas if you do logistic regression, for example, it figures out how many deaths

occur at the end of follow-up and compares that with -- you know, if you have an exposed group and unexposed group, which one has a higher odds, but it doesn't take into account when those diseases occur, what ages, were the ages among younger people. The Cox model takes that into account. So it's more suitable, a better model to use, if you can use it, if you have that individual level of data.

Q Understood. Okay. And then what about QBA --

A Quantitative bias analysis.

Q -- quantitative bias analysis methods --

A Yeah.

Q -- what about that? How does that play into --

A Okay.

Q -- a high-quality study?

A Well, most studies don't use quantitative bias analysis. That's -- there was a textbook that was produced a couple of years -- well, several years ago now that there's been a second edition -- trying to promote the use of quantitative bias analysis to look at confounding.

People concerned about confounding all the time, well, just how bad is it and what direction is

it. It's not enough to say, oh, they didn't take into account smoking; there must be confounding. Oh, yeah, well, how much, which direction? That's what quantitative bias analysis is getting at. If you have a selection bias problem, how much, you know, which direction again. And same with exposure misclassification.

For those biases -- selection, confounding, exposure misclassification -- you can do these methods that we do in these studies. But there are other methods you can use. You can -- again, I mentioned -- it's called negative control diseases. You can look at COPD, and the chemicals that you're interested in don't cause it. So if there's a difference in COPD in the exposed versus unexposed, it must be because there's a smoking difference. But if you don't see a difference in COPD, then they're probably similar in smoking.

So you can do a quantitative bias analysis just by doing that. I would consider that part -- and we use a -- we use both. We use negative control diseases and the formal quantitative bias analysis in the cancer incidence and mortality study.

Q In both of them?

A In both of them.

Q Okay. Now, is that true for all three

mortality studies?

A No. The other ones, we did more of what I -- the other approach. We didn't use quantitative bias analysis. We used negative controls. I think we even call it that in that paper. I can't remember. But yeah, so instead of actually coming up with a -- if you look at the cancer incidence study, for example, there are these tables where -- different possibilities of the bias and what the impact would be. That's a quantitative bias. We didn't do that for the earlier mortality studies.

Q These are factors that you would take into account anytime you're going to do a study, and you decide what to apply in the various studies given the facts and the materials that -- the information that you have?

A Can you repeat that again?

Q Sure.

A I missed the early part of that --

Q So we went through a lot of different factors.

A Yeah.

Q And I realize in some of the factors, just, like you said, for example, the QBA, you applied in the cancer incidence study and the 2024 mortality study,

but not in the 2014 studies?

A Right.

Q So as an epidemiologist, when you're designing a study, do you consider these various factors and decide what you can use based on the information you have? Like, how does one decide which of these components you're going to apply to your data and your analysis?

A I mean, it depends on if you're -- I mean, I anticipate that people will be concerned about smoking and alcohol consumption and maybe even lifestyle differences between Camp Lejeune and Camp Pendleton, for example. And so that pushes me to try to address those by looking at how big the bias might be.

We didn't collect that information. We didn't collect information on what they ate, what they -- drinking. Even if you collected that information now, how good would it be back then? So to address those issues, you try to use negative control diseases, for example, and quantitative bias analysis is also useful.

As I said, quantitative bias analysis is slowly getting used, but I rarely see it yet. I think that it will continue because they're teaching it. And it's easy to do now because they have spreadsheets that

make it easy for you to use it. But, you know, it's new, so to speak, relatively speaking. So that's the reason I did those -- I would do that, is because I'm concerned that people might -- attack the study for those reasons. I want to head that off by saying this is how bad it might be or not bad at all.

Q So you mean, like, the impact it would have on the --

A Yeah, I mean, confounding -- most people think of confounding -- that it means that you have an elevated risk ratio, for example, but it's really not that. It's elevated because of smoking or something.

So that -- you know, so the direction of the biases in that direction to inflate something, that's what most people are afraid of. But actually, it can go in the other direction. It really depends on the prevalence of that confounder, smoking, let's say, in the groups you're comparing.

So if there's no difference, there's no confounding. If one group has -- you know, if the exposed people smoke less, then you're underestimating, you know. And if they smoke more, you're overestimating, for example.

Q Right. So if they smoke less, it --

A Then --

Q Bias is to the null?

A Bias is towards the null. So bias towards the null happens -- it could happen in confounding, but most people think of it as the other direction.

Again, oftentimes because the paradigm is smoking, and comparing a workforce with the general community or something of that sort where that -- there would be differences. But if you actually compare workers in a plant, usually there's no -- hardly any differences. They all smoke. Or in the case of Marines, most of -- many of them smoked back then, and so there are really no differences. You don't see any.

Q When you say "differences," you're thinking of Camp Lejeune versus Camp Pendleton?

A Yeah, I mean, in general, Marines back then, at least half of them, maybe more, smoked a lot. So, you know, smoking is a question, and so it's important to indicate just how bad that might be, how bad -- affecting which direction it would go. And that's -- I think that's important. A good study will -- certainly in the future, good studies will use these methods. I'm sure they will. But anyway -- so I don't know if that answers the question.

Q So for purposes of some of your comparisons

between Camp Lejeune and Camp Pendleton, I know you do address smoking and alcohol consumption in those; but essentially am I correct that because these are similar demographics of young men, predominantly, entering, in their late teens, early 20s, into the military, you didn't see that as a big factor -- as a difference between those two populations; is that fair?

MR. BAIN: Object to the form.

THE WITNESS: Yeah, I didn't think that we would see a big difference, but I wanted to show it.

MS. GREENWALD: Right.

Q (By Ms. Greenwald) Okay, let's go to the 2017 assessment, the big one --

A The big one.

Q -- which I think is Exhibit -- let me just look -- Exhibit 6. No, not Exhibit 6.

A There it is. Five.

Q Exhibit 5. Okay.

Are you one of the principal authors of the 2017 assessment?

A I am the author.

Q You are the sole author?

A (Nods head affirmatively.)

Q Okay. Can you just sort of give, like, an

overview of what you were -- why you did this study and what you were trying to accomplish? And then I'm going to ask you some questions specifically.

A Well, first of all, it's not a study. It's an assessment.

Q Assessment. I'm so sorry.

A It's not a meta-analysis.

Q Right. Correct.

A It's not -- it's sort of, kind of, a systematic review, but the whole -- but we don't normally -- ATSDR doesn't normally do this.

What happened was the VA decided, with a lot of pressure being put on them, to list kidney cancer, acute myeloid leukemia, and angiosarcoma of the liver as the three presumptive diseases that they wanted to do. And that was not acceptable to the CAP or to the three senators in this room that we were in Washington -- in Congress. The three senators were the head of the -- I forget his name. But anyway, there were three senators, the two senators from North Carolina and the senator from Georgia, who I'm blanking on, who's died, who has since passed.

And if you looked at -- kidney cancer, for sure, should be on a presumption list, there's no question about that, when dealing with

trichloroethylene.

Acute myeloid leukemia makes a lot of sense if we're talking about benzene, for sure.

Acute -- angiosarcoma of the liver, you would never see at Camp Lejeune. That's an -- you have to have a heavy exposure to vinyl chloride, which you would only get in certain manufacturing. It's a rare disease anyway; and, in fact, I think there was, like, three at this one plant that started the whole -- that was a cluster. So you rarely see it, even in a vinyl chloride plant, but you shouldn't see it at all.

So putting that on the -- really, there were -- so there were really only two diseases, really, that made any sense to be on that list that the VA was proposing.

And so they were -- the senators pushed them hard. The VA secretary looked to me and Dr. Breysse, who was the head of the agency at that point, and said, "Can you help us?"

And we said, "Yes."

"Can you give us something in six weeks?"

"Yeah, we'll do it."

So I dropped everything and -- most of the tables you see in here were done within that six-week period.

During that period, I had enough material together so that it was peer-reviewed by two people to give their advice. One person liked it, one person didn't like it, but that -- so -- and I took their comments into account. And we briefed the VA researchers/scientists.

So this was, I think, in -- July 2015 was the meeting with the senators, somewhere around there. The briefing was six weeks later. It was, roughly, in the middle of September 2015.

And for the most part, they agreed with what my -- with what my assessment was. There were some disagreements. Bladder cancer was a disagreement. Scleroderma was a disagreement. Chronic kidney disease was a disagreement. Cardiac defects at the end was put in there because a CAP member wanted me to address it, but it was really not something the VA was concerned about. So --

Q I'm sorry. Go ahead.

A So I started to write it up. But we also had this debate with the VA around bladder cancer in particular and tetrachloroethylene. And there was a -- IARC had done -- the International --

Q International Agency for Research on Cancer.

A I always have problems with it. I just call

it IARC all the time.

Again, what they do is just a systematic review at that point, although they did a quickie meta-analysis. I was there when they were discussing the TCE and PCE.

For TCE, the kidney cancer was -- everyone agreed. Non-Hodgkin's lymphoma, there was a debate. Liver cancer was -- it was not as well-supported. Non-Hodgkin's lymphoma, there was a big debate.

Q Can I stop you for a minute there?

A Yeah.

Q The debate, was that with the VA, or was that the debate that you had with IARC?

A No, no. I'm sorry. In IARC, yeah, yeah, yeah.

Q I just want to make sure this is clear.

A Right.

Q So the debates you're talking about right -- I didn't mean to cut you off.

A Right now, this has to do with IARC and TCE and PCE.

Q Understood.

A For PCE, bladder cancer, there was some evidence. There was a debate about that, how strong the evidence was, and then -- and to try to deal with

the issue, IARC commissioned the meta-analysis looking at bladder cancer, in particular with dry-cleaning workers, but also workers who use PCE in the manufacturing process.

And their meta-analysis is included in this report, this assessment. I thought it was strong enough to conclude that bladder cancer was sufficient evidence. I think it was a strong meta-analysis done by IARC. And I'm pretty sure they would have said so too, but they didn't -- they haven't -- I don't know if they've revisited PCE since then.

But anyway, so I pushed that with the VA. I also was able to produce some mechanistic ideas, how PCE might cause bladder cancer. And that's all in here.

So while I was writing the other parts of the assessment, I was researching bladder cancer and PCE and trying to make a case so the VA would change their position, and they did change their position. So that's why bladder cancer is on the presumption list and why it's -- in here, it's called sufficient evidence. I thought there was strong evidence for chronic kidney disease and scleroderma. My understanding was OMB decided there wasn't for scleroderma, without giving any reasons, to me anyway.

Chronic kidney disease, I think the VA felt that that would be a huge grab bag of people having all kinds of kidney problems, similar to the problem they're having with neurobehavioral effects, which is also a grab bag and, you know, can include almost anything. So I think that's why they objected to that. I think the evidence is strong there, but we didn't win that one, that battle.

Q Okay. So let me unpack some of this, okay?

A Sure.

Q So when you were talking about that -- we have a couple of "disagreements" here, and I want to make sure -- you were referring to "disagreements," not you and I.

A Oh, okay.

Q I want to make sure that I know which disagreements you're referring to.

When you were talking about bladder, scleroderma, and chronic kidney disease, that was disagreements --

A With the VA.

Q -- with the VA and the assessment -- or, I'm sorry, the VA believing that those diseases should be --

A Remember --

Q -- [indiscernible] diseases?
A -- initially it was a briefing --
Q Right.
A -- with these tables, for the most part.
Q Okay.
A I did add things to the tables when we continued the literature review. But both of these tables are pretty similar to what I presented to them in the long briefing that we would do.
Q So this -- so the discussion, disagreement, whatever we want to call it, that you were having with the VA was based on the tables but not the text?
A Well, it was based on the text, too, because I had written some of the text.
Q Okay.
A Yeah. The text, I kept working on, and then reacted to peer-reviewers of the -- a draft of this.
Q Okay.
A So, again, the task was to help the VA to develop a presumption list. So the key thing was the initial briefing that I gave them in September 2015, and then the discussions back and forth around bladder cancer.

Once that was decided, and then they decided not to include chronic kidney disease and scleroderma,

they said OMB decided for some reason not to include, that the list was set. And so I just, you know, did some more writing, but most of the writing had already been done, and then we peer-reviewed it, made some changes, and so on.

So a lot of the introduction, too, had been written, and that was peer-reviewed initially by the two people. And I think there were just two. They also looked at some of the tables and some of my assessment, I'm pretty sure. By that point, they would have seen that table you see on page --

Q Which table are you referring?

A Let me see if I can find it in here. Pages 13, I think it is --

Q Okay.

A The table that has the overall summary. I think they probably saw that too, the first group of peer-reviewers.

Q So you're talking about pages 13 --

A Yeah.

Q -- and 14?

A Uh-huh.

Q Okay. And so it was this -- this table that was available during your discussions with the VA?

A Yeah, I think so.

Q Okay.

A Yeah, because I had to have some summary thing. I probably had that already done for them. I also had tables. It was done in a Zoom call, but I think there was someone in the room, and they had -- they were able to get the hard copies, I think. I'm trying to remember. It was a long briefing.

Q Okay. So do you know who the two peer-reviewers were? Do you remember?

A David Kriebel, who's at Lowell. He's done a lot of occupational epi studies. And I'm blanking on the other one. He's at Emory. Kyle Steenland.

Q So were the peer-reviewers reviewing this for methodology, or were they reviewing it for outcomes? Both? Neither?

A Both. I think Kyle Steenland focused a lot on the outcomes. His comments were, "Well, this doesn't jibe with what IARC says." But IARC says some things, EPA says some things, the National Toxicology Program says some things. Trying to bring them all together, that was the point of this. So I had a problem with what -- that advice from him.

But the methodology, he didn't have any problem with. David Kriebel had some ideas on that, in particular trying to decide how long you had to be

exposed before you -- you know, it would be sufficient to see something. And I was trying to figure that out, looking at all the studies. And his comment was, "Don't try. You won't be able to find it." And I think he was right.

It is impossible to know how -- if it's a birth defect, you know, exposures during a particular point in time, you don't know how much, but probably a very low dose could cause something if you hit it at the right moment. But for cancers, how long you have to be exposed really depends on how high the exposure was you got in the first place. But we don't have any information.

I know that the World Trade Center, they've come up with some minimum exposures. But I feel, in looking at the literature, it would be hard -- I wouldn't feel comfortable doing that. And so that was one of the suggestions: Don't do it.

I'm trying to think of something that was --

Q We will get to that in a minute. I guess I --

A The -- no one had a problem with the classification scheme, at least in the initial peer review. So later ones, I think they -- they wanted to know why I put this together. I thought I had made

that case pretty clear, but I probably added additional text to strengthen that.

Q So when you refer to "classification scheme," are you referring to pages 6 and 7? Is that what you mean?

A Yes.

Q Or are you also including page 5, "Classification of Evidence"? I want to make sure --

A Six has -- 6 and 7 --

Q Right --

A What's on page 5?

Q -- that's the scheme. Five is where you talk about the evidence.

A Yeah, here's the scheme. Sufficient evidence, equipoise and above --

Q Right. Okay.

A -- that was the one I chose. IOM used another one for Agent Orange. They used -- I think they used the same one for Gulf War. But they had recommended this for VA work. And they also kept changing the definition, I thought, when I looked through the Gulf War reports.

So I thought the best thing to do was to do what the VA should do, which is give the benefit of the doubt to the --

Q Uh-huh.
A And so equipoise made sense.
Q I know you mentioned IARC earlier. The methodology you -- not necessarily the classification exactly, but the methodology you used to determine whether something is equipoise or above or sufficient or below equipoise, isn't that really similar to the methodology used by IARC?
A Well, IARC takes -- you know, has separate analysis of the animal data, the tox information, mechanistic information, and the epi, you know, and they make -- they classify both, and then they bring it all together and it's an overall classification, so -- so that's different.
I mean, these are all -- they're similar. NTP has one. EPA sort of has one. And, you know, it's roughly -- they're roughly similar. It's all a judgment call, you know, what a high-quality study, do you agree with that meta-analysis, do you agree with that systematic review, do you have any -- you know, it is a judgment call where you put it. And I wanted to make that clear in here too --
Q Right.
A -- that it is a judgment call.
Q And I want to make sure I understand what --

how you -- what evidence you used to reach your conclusions here. Again, I'm focusing on the five diseases in Track 1.

If I understand right, you used data, if it was available, on the chemicals and those outcomes from EPA?

A Uh-huh.

Q National Toxicology Program?

A Yes.

Q IARC?

A Yes.

Q And then you did your own PubMed search?

A Yes.

Q But only for sure epidemiology; is that right?

A Yes.

Q And you only considered animal data and/or mechanistic data if it was included in IARC or one of the epidemiological studies that you looked at; is that right?

A Yes.

Q Okay.

A Because -- right, because you didn't have time. I mean, I had -- you know, it was really done quickly to help the VA. That was the whole point of

it. We wouldn't have done it otherwise, except we were requested.

So in order to do that quickly -- and that's why I did it alone. Because by the time I tried to train somebody in this, I wouldn't have been able to do it in time.

So that -- so, yes, I -- the -- each study, including the Camp Lejeune studies, usually has a discussion section where it pulls in that kind of information. So since these studies did do that, just like the Camp Lejeune study, you could use that to get a sense of what the animal data looks like without having to do a lit review yourself. They've done it.

Q Right.

A So use it.

Q And as you just mentioned, if IARC had done a monograph on this chemical, it would have had a separate section for animal data?

A Yes.

Q And it would have had a separate section for mechanistic data?

A Yes.

Q So the only thing that you would have been missing was if that was 10 years old, and so if there was mechanistic data in that 10-year period and you

didn't pick it up -- and it wasn't in some other epidemiological study, it wouldn't have made it into your analysis --

A Yes.

Q -- is that right?

A Right. Yes.

Q Okay. And then am I also correct that the data had a cutoff period of August 2016?

A That was the last time I looked at the literature.

Q Okay. So if there's been any kind of animal data, mechanistic data, or epidemiological data and/or meta-analyses from August 2016 to the present, that would not be included in your assessment --

A Right.

Q -- in Exhibit No. 5; is that right?

A Yes.

Q Okay. And so the conclusions that you reach here were conclusions based on whatever science was available, based on the ones we talked about, as of August 2016 --

A Yes.

Q -- fair?

A Yes.

Q Okay. So did you do this -- you said you did

this all by yourself?
A Yes.
Q And you did this in six weeks?
A Yeah.
Q Had you been working on some of this gathering of data and looking into --
A Sure.
Q -- these chemicals and diseases before then?
A Yes.
Q So you had files that you could pull up and --
A Yes.
Q Okay.
A But I was -- that's why I was the only one to do it, because I had -- in order to write a protocol for the cancer incidence study, in order to write a protocol for the mortality studies, you have to also do a literature search and report what the literature is in order to justify why you're doing the study in the first place.
So I -- and I also attended that IARC meeting where they discussed trichloroethylene and PCE, so I was there for all the discussions. So I was in a good place to do this. That's why Dr. Breysse tasked me with it.

And, again, in order to bring someone else up to speed on that would have taken too long.

Q Okay. Have you done any updates on this since 2017?

A I've identified -- I think it was the end of last year, I had identified a slew of studies since 2017 that would make a different -- an additional -- if we wanted to update this, we could, but there wasn't -- there was some talk about doing that, but then it sort of dissipated somehow.

But I was able to use some of that material in the "Discussion" sections of the cancer incidence study and the mortality study. For example, there were several studies looking at benzene, and I think it was breast cancer, that were new. And that -- those new studies got included in the discussion for the cancer incidence study and the mortality study. So if you look at the "Discussion" sections, you'll see studies there mentioned that aren't in here because they were done after 2016.

Q But in the cancer incidence study, I assume -- correct me if I'm wrong -- that you would not have put in discussions of new data or studies for diseases that you didn't address in the cancer incidence study; is that right?

A Well, there wouldn't be Parkinson's, for example.

Q Right.

A But Parkinson's was discussed in the mortality study.

If I didn't see an association, an increased hazard ratio, which is the measure we use, then I probably didn't address it. But even -- for some of the cancers that I didn't see it for the primary tumor, I saw for a histological subgroup sometimes, and then I would bring in the literature for that.

Q Okay. Okay.

A That was just the cancer incidence study. You don't have histological information --

Q From mortality.

A -- from the mortality study.

Q I learned enough that I knew that.

A Yeah.

Q Okay. And you state on page 2 of Exhibit No. 5, the last sentence of the second paragraph, "This report represents ATSDR's assessment of the state of evidence at this time," right?

A Where is --

Q It's the last sentence of the second paragraph on page 2, under "Overview."

A Oh, yeah. Yes, yes, yes.
Q It says, "This report represents" --
A Yeah. Sorry.
Q Okay. And that would be, really, August of 2016?
A Yeah.
Q Okay. So on page 3, you refer to MCLs for various chemicals.
A Uh-huh.
Q Why is an MCL relevant to your health assessment? How do you use MCLs in your health assessment?
A Well, it's just -- this was background information so that people -- so that people know what the levels -- the maximum contaminant levels that were adopted -- most of them were adopted, for these chemicals, in 1989 or 1991, around that period -- what the levels were and what was at Camp Lejeune prior to these MCLs being established and -- for comparison. So if someone saw 366 parts per billion of something, what does that mean?
Q Uh-huh.
A A hundred parts per billion of 1,2-dichloroethylene is the standard for that. If you see 100 part per billion of TCE, on the other hand,

that's a different story. So we put the MCLs in there just for reference so the reader would know.

Q Right. And MCL is the maximum --

A Contaminant level --

Q -- level that you can put in --

A -- that's set by the EPA.

Q For drinking water, right?

A For drinking water, yeah.

Q Okay. And so no one can serve drinking water above the MCL?

A They shouldn't, no.

Q Okay. No one should serve drinking water above the MCL?

A For example, in New Jersey, there were water companies that did, and they had to get it down --

Q Right.

A -- you know. Yeah.

Q Okay. So on -- also in -- under "Background," there's references to estimated amounts of water that a Marine would drink. Where did you get that data from?

A Well, ATSDR got that data for their public health -- for the Camp Lejeune public health assessment that was published in 2016. There were -- I think there were two different reports that I saw -- I

provided that to the health assessment -- which talks about how much Marines drank.

So this wasn't from the Marine Corps itself. We didn't ask the Marine Corps how much -- this was two documents that discussed this. That's my -- that's all I can remember.

Q Okay.

A I don't remember the names of the documents.

Q That's okay.

A If you go to the Camp Lejeune public health assessment, though, they should list the references.

Q Okay.

All right. So we talked earlier about the fact that you used EPA, NTP, and IARC for your literature -- not your PubMed, but what they had evaluated for these chemicals.

Why did you choose those three bodies for your literature?

A Well, because they -- because -- well, IARC is -- that's tasked -- IARC is tasked to evaluate these chemicals for cancers. NTP is tasked to look at these chemicals for other -- not just cancers, but other endpoints. And that's similar for EPA.

So since we weren't just focused on cancers here, it would have been important, for example, to

look at EPA and NTP. But the other thing is that there are some differences in their assessment, one -- and time differences. Some were more recent than IARC and so on.

So it was important -- I thought it was important to look at all the reports by the agencies that are responsible for this, as part of the assessment. Again, to try to limit the amount of time to do this, because if others have -- who I respect, EPA -- I respect EPA, NTP, and IARC -- if others have done that work, I was going to use it.

Q And IARC isn't an agency, right? That's an independent --

A It's part of WHO.

Q Right. But it is a research arm of the WHO, right?

A Yeah.

Q And so they don't regulate any particular chemicals --

A No.

Q -- in any --

A No.

Q -- governmental setting?

A I don't think so, no. They're research-oriented.

Q Yeah. Okay. And they only look at cancer, right?

A They only --

Q Right. So as you mentioned, you couldn't use IARC for non-cancer endpoints?

A Right.

Q Okay.

Okay, let's go to the "Classification of Evidence" on page 5.

You said you looked at the various ways that these entities classified evidence, and you chose IOM, right?

A Uh-huh. Yes.

Q And tell us why you chose IOM for this purpose.

A Well, I chose -- well, IOM had different classification schemes, one for -- as I said, for Gulf War and Agent Orange, which I think changed over time. But they also had a report specifically for the VA and the presumption program, whatever you want to call it. And so that's what we were tasked to do, is to help them with the presumption list. So I used that classification scheme for that reason.

Q Okay. Fair.

Okay. So you mentioned earlier -- let's go

to page 5 [sic], "Classification scheme categories."

A Uh-huh.

Q You mentioned -- and my notes are bad, so I'm going to --

A We're on page 6, I think.

Q I'm sorry. Page 6.

A Yeah.

Q I'm going to -- my notes are really bad on this. I think you said that everyone agreed or no one disagreed with the classification scheme. Did I get that right? You said something about the classification scheme.

A Yeah, I don't recall anyone having a problem with this classification scheme. I think -- you know, they would say why this one and not another one, but they weren't -- they didn't have a problem per se with this one.

Q Okay. So let me just go through a couple of things with you on this.

So for "Sufficient evidence for causation," you say, "The evidence is sufficient to conclude that a causal relationship exists," right?

A Yeah. Yes.

Q So when you use the word "sufficient" there -- I know IARC uses "sufficient" for epidemiology

as the highest category.

A Right.

Q Are you using it in the same context there that IARC would use it, as the highest category of epidemiological evidence, that bias and chance can be ruled out with reasonable confidence?

A Yeah, again, they also incorporate animal and mechanistic assessments in that, but -- and since this is focused on epidemiology --

Q Okay.

A -- it's slightly -- it would be a little bit different. But, no, this would probably be similar. This is strong evidence, I think, that -- you know, for example, kidney cancer, IARC said it was sufficient evidence. I concluded, certainly, that it was too, and, you know, so that -- it does --

Q Uh-huh.

A It is similar.

Q But your scheme also does take into account animal data, because on -- right, because on No. 2, you do -- you can reach sufficient evidence if there's less than sufficient evidence from epidemiological studies, human studies. But there's sufficient evidence in animal studies, which, again, would be strong, right --

A Yeah.

Q -- strong animal data, and strong evidence that the agent acts through a relevant mechanism in humans --

A Yeah.

Q -- or what we call mechanistic data?

A Yes, I take that into account, but it's not the same as what IARC does, which that's a separate lit review for that and a separate assessment for that.

Q Fair.

A That's the difference.

Q Okay. I understand.

Okay, so -- but there's two ways under your scheme that you can reach sufficient evidence --

A Yes.

Q -- for causation?

A Yeah.

Q Okay. And then you go -- you explain the considerations --

A Uh-huh.

Q -- of assessing evidence using Bradford Hill.

Can you explain why you chose -- I think there's, like, nine considerations. What is it about the ones you chose that are important to your evaluation?

A There's some -- there are viewpoints,

suggested viewpoints, by the way, by Hill, and some are more relevant for infectious disease. For example, a specific -- specificity, an infection will cause a specific disease, okay, but TCE might cause kidney cancer, non-Hodgkin's lymphoma, Parkinson's disease. So you wouldn't want to rule any of those things out because it's not specific, that it doesn't cause one disease. So specificity is not relevant --

Q Okay.

A -- off the top. The -- I'm trying to think of some of the other ones that aren't.

Q Maybe you could just say why these are important [indiscernible] --

A Yeah, these are --

Q -- positive.

A -- relevant to the kind of work we're doing. These would be all relevant to environmental and occupational epi studies.

Q Okay.

A Temporal relationship, of course, would be relevant to anything. If you don't have temporal relationship, you know --

Q Right.

A -- then -- but the rest are also relevant -- some are relevant for infectious disease, but all of

these are relevant to looking at occupational or environmental exposures.

Q Okay.

All right. Then let's look at "Equipoise and above evidence for causation." Before I get -- can I ask you a question? Would you say equipoise would be the same as "as likely as not"?

A Yeah.

MR. BAIN: Objection, form.

MS. GREENWALD: What's the objection?

MR. BAIN: Form.

MS. GREENWALD: Yeah, but what's wrong with the form?

MR. BAIN: Calls for a legal conclusion.

MS. GREENWALD: Okay.

Q (By Ms. Greenwald) As an epidemiologist, do you have an opinion about whether equipoise would -- well, let me ask it this way: What does equipoise mean to you?

A The way I explain it to a layperson is just that, as likely as not.

Q Okay.

All right, so for equipoise and above, this is -- so if it's above equipoise, it would be sufficient; is that fair?

A No. There's -- no.
Q No?
A Just like other classification systems, there's a space there --
Q Okay.
A -- so, you know, it may be equipoise, but it's not here (gesturing), it's in between, so it's equipoise and above.
Q Okay.
A That's how I --
Q All right.
A So maybe the language is a problem here because it's -- it means as likely as not or better, but not to the level of sufficient.
Q And you wrote this "Classification scheme categories," right? The sections we're looking at right now --
A Yeah.
Q -- you drafted these?
A Yes, yes, yes. Yes.
Q Okay. And then you have -- let me see if I have any other questions about that.
So you can have equipoise and above and without sufficient epidemiological studies, right?
A Without sufficient evidence. The way I

thought about it -- and, again, I think I base much -- most of this on the IOM report that pushed this scheme, was if you have one really high-quality epi study, that might be enough to push you over there.

For example, the Parkinson's study that was done of -- the earlier one that Goldman did was pretty strong evidence on its own, but not strong enough on its own to go beyond equipoise, you know, so it didn't reach sufficient evidence, just that study alone, but it was -- that -- I would consider it a high-quality study and would push it at least into this category.

Q Is that the Goldman 2023 study --

A That's the -- no --

Q -- [indiscernible] thinking --

A -- it's the earlier one.

Q -- of the earlier one?

A Yeah. It would be referenced here.

Q Okay. When Dr. Goldman was -- did he write another paper after the one you're referring to that's referenced here on Parkinson's?

A It wouldn't be --

Q No, I'm sorry, in addition to the one referenced --

A Yeah, yeah. Yes. He did one at Camp Lejeune.

Q Okay. And that was when? About 2023?
A Yeah, I think that was late 2023, I think it was, yeah.
Q Okay. Do you recall talking to Dr. Goldman while he was working on that paper?
A On and off, because I gave him the Defense Manpower Data Center data and talked to him about the study. But they had their own researchers, and they did their thing.
Q Did he offer to put you on as an author of that paper?
A No. He acknowledged me. I wasn't really part of the research team, and so I didn't -- you know, I shouldn't be an author, but he did acknowledge me in the paper.
Q Do you remember a discussion with him where he asked if you wanted to be an author of the paper, but there was a discussion between you that it would take too long --
A Oh, well, that may --
Q -- [indiscernible] ATSDR?
A -- we may have discussed it. And everyone knows, I think, that the peer-review process at CDC was a lengthy process. I don't think that's news to anybody, and so -- and I don't know if it's gotten any

better, really.

So that's what I told him, that it would have to go through our own process and may take years to see the light of day. So -- but it wasn't necessary. Again, I wasn't part of the research team. It was nice of him to ask, but I didn't feel that I should be on the list.

Q Okay. And then on page 9, you talk about "Impact of Bias."

A Right.

Q And then the third sentence under that is "The key limitation of all the studies was exposure misclassification. The impact of exposure misclassification bias would likely be to bias dichotomous comparisons (i.e. [sic], exposed versus unexposed) towards the null if an effect of the exposure is truly present, and to distort exposure-response trends." Do you see that?

A Yes.

Q So does that mean that if there are people considered in the exposed group who were, in fact, not exposed --

A Yes.

Q -- that would bias towards the null?

A Most likely.

Q Okay.
A There are rare instances where it could go the other direction. You can't rule it out. But the tendency is in the direction of the null.
Q Okay. You mentioned earlier that you've sort of looked at some of the data on these chemicals since you did the 2017 paper.
A Uh-huh.
Q Are those documents that you left at the CDC when you retired, or did you bring them with you?
A I think that everything was put in a box and given to -- I don't have any of them.
Q Okay.
A But they would be -- a lot of them, also, I had electronically by then.
Q Okay.
A So I had hard-copy paper studies and also electronically. But all that was left behind. I didn't --
Q Do you know what kind of -- what you would have called -- if it was electronic, what would be a likely title or a name for the file if one were looking for it?
A I think the file may have been called "Solvents," actually, if I remember right. That's

where I had all that literature electronically.

Q And how -- if someone were looking for that, how would they be able to see what your update was from the 2017 assessment? Would there be any reference in your files about that?

A The list of studies since 2016 would be in that folder.

Q In the "Solvents" folder?

A Yeah.

Q Okay.

A That's where I would look for all this stuff, yeah.

Q So did you do any analysis, or did you just collect studies and put them in the folder?

A I did have -- I drafted an update for the lung cancer, for cervical cancer, and also made changes -- updated the breast cancer --

Q Okay.

A -- because there were new studies since 2016. And it's all in there, but we didn't go -- it didn't go to peer review. It didn't go any further than a draft because, first of all, I was too busy with the studies, and there was no impetus from the agency to do it. I just couldn't do it on my own. I had to get some kind of sanction to do it.

Q Okay. But am I right that, based on what you just said, you didn't do any of that work for any of the Track 1 diseases -- kidney, bladder, non-Hodgkin's lymphoma, leukemia, or Parkinson's disease --

A No --

Q -- that you recall?

A -- because they were done. I thought this was good enough for that. Any new studies are mentioned in the cancer incidence study, because I did see histological subgroups of non-Hodgkin's lymphoma that were elevated, so I discussed that there.

Q Okay. I want to get through this quickly, and then I'm told we have to break for lunch. Let me just ask you a couple more questions about the assessment, and then I don't want to be in the way of anyone's hunger.

Okay. If you can jump to page 11.

A Duration.

Q Yeah, "Assumptions on Duration of Exposure."

I want to focus on the paragraph that says, "The studies evaluated in this report." And -- I'm going to read it, and then I want to ask you a couple of questions. Okay?

It says, "The studies evaluated in this report provide very limited information concerning the

level or duration of exposure associated with an increased risk of a cancer or other disease. For example, those studies that evaluated cumulative exposure or exposure duration often used wide categorizations (example, duration of exposure greater than zero to five years). An additional interpretive difficulty is the possible inverse relationship between duration and exposure intensity; example, high exposure intensities may require only a short duration of exposure, whereas low exposure intensities may require longer exposure durations. Although cumulative exposure is a useful metric, it obscures this interplay between duration and intensity. Specifying a minimum duration of exposure also presupposes that there is a known threshold amount of exposure below which there is no excess risk. However, there is no compelling evidence that such thresholds exist for the contaminants and the cancers and other diseases evaluated in this report."

Okay, so I want to ask you a couple of questions.

When you mention that there's no compelling evidence that such thresholds exist for these contaminants and cancers and other diseases evaluated, is it correct to say that based on your findings,

there's no minimum threshold of TCE, PCE, vinyl chloride, or benzene exposure below which a person would be safe from a risk of developing cancer or other disease?

A I'm saying that we don't know, basically. There's no compelling evidence. So we don't know where that line would be drawn.

It's not like lead, where we have -- you know, lead is a good example. Asbestos might be, but lead is. We don't have that kind of specific information here.

If you have a certain amount of lead in your blood, you'll have this kind of outcome and so on. There's nothing like that for almost all exposures -- chemical exposures. Even radiation, there's some difficulties there as well.

So that's what I'm saying. I'm saying we don't know, basically. There's no compelling evidence to draw that line. And so what agencies do is assume there's no threshold for cancers when they do their modeling, and that's -- you know, it is controversial, but that's what they've done to be on the cautious side. That doesn't mean that it's inaccurate, necessarily, because there may be a threshold somewhere. We just don't know where it is.

Q Right. And so just because a study -- just because there's, like, for example, a workers study that shows an effect at -- I'm just going to pick a number -- 500 parts per billion of a chemical and an outcome of leukemia --

A Right.

Q -- that doesn't mean that that's the threshold; that just means, for example, that that particular study evaluated people at that level and saw an effect?

A Yes.

Q It doesn't mean that below that number, it doesn't also have an effect --

A Right.

Q -- fair?

A Right.

Q Okay.

A Yes. I mean, in animal studies, they have enough information they control, it's a controlled experiment, so they can try to make a case for we don't see it at this level, we don't see the -- whatever the outcome they're looking at.

So with a controlled experiment like that, you might be able to make a case. I don't -- you know, again, it may not be correct, but you could at least

make a case of where that line may be drawn. But in human studies, as I said, the data is not there.

Q Right. And would you agree that when human studies don't have that data, in other words, there isn't a study that says, "Oh, this person was exposed to 20 parts per billion and there was no cancer outcome," if that doesn't exist, would one look at mechanistic data to try to understand the mechanism by which cancer occurs?

A Sure, if there was such -- and, again, mechanistic information is also very sparse and limited for many of these chemicals. But, yes, if you have -- any information like that would be helpful. If you had an animal study, for example, where they actually picked a NOAEL, as they call it, that would be of interest. However, it's an animal, and is it the right animal model for the human? That's a big discussion right there. And is this the right -- is this endpoint relevant to humans? That's another big problem.

So even though you have -- it's a controlled experiment and you can draw a line where you don't see the endpoint, its relevance to humans has to be argued. I mean, it's not obvious.

Q Right. But some mechanistic studies, you would agree, are -- is done on human blood, is done on

human beings, actually, they look at cause and effect?

A There are some, yes.

Q Okay.

A Yeah, yeah.

Q Would you agree that even low concentrations of the chemicals at issue here could still pose a risk, depending on other factors like duration or intensity of exposure?

A Well, again, it depends on the endpoint too. As I said, with a birth defect, it may not require much at all. It's the timing that's key. For cancers among adults, that's different. So duration is important.

The wording here, I notice how this is written, and it could have been written better. High exposure intensities don't require a short duration. The idea here was that you could have high duration of a very low exposure. You can have a long -- short duration with a high exposure, long duration with a low exposure. Cumulative exposure puts them together, so it doesn't tease it out. So, you know, the studies have this problem.

And oftentimes why you see differences in studies is how the exposure occurred. Did it occur -- how high it was, but also how long it was, and -- so those are issues.

Q So, in other words, the level of exposure is dependent oftentimes on the duration of exposure and vice versa?

A Sometimes, yes. Sometimes --

Q Or it can be?

A Yeah, or not. Like I -- right.

Q So I read this to suggest, and perhaps I read it wrong, that cumulative exposure alone also wouldn't provide a complete picture of the risk associated with exposure. Is that fair?

A Yeah.

Q Okay. What additional factors would you want to consider in understanding the full risk of developing cancer from these chemicals or Parkinson's disease other than cumulative exposure?

A Well, again, it would be good to tease that out from looking at intensity and duration, as well as cumulative exposure, and seeing what you saw.

But in many of the occupational -- in probably most of the occupational studies, again, the categorization of exposure is kind of wide, which doesn't help you. If you're interested in whether one month is enough and the studies look at zero to one year, what are you going to say? I mean, that's been -- that is the problem in trying to do that.

And I know -- as I said, NIOSH has done it for the World Trade Center. I've looked at that. For the life of me, I'm not sure how they did it because the studies they are quoting have this problem. And so it's -- it's a limitation of these studies, in a sense, but that's what they have, that's all the data they have. That's all they can do and still see something that's interesting and important --

Q Okay.

A -- but not for this purpose, to try to find a line in the sand where if you don't have it this much or don't have it this long, it won't hurt you. We don't have that.

Q Okay.

MS. GREENWALD: I am going to break for lunch --

THE WITNESS: Sure.

MS. GREENWALD: -- for you all.

THE VIDEOGRAPHER: The time is 12:34 p.m. Going off the video record.

(Lunch recess taken.)

THE VIDEOGRAPHER: We are back on the record. The time is 1:32 p.m.

Q (By Ms. Greenwald) So welcome back from lunch. I want to move to the cancer incidence study,

which I don't have my exhibit number on it. That's what number?

A Seven.

Q Okay, Exhibit No. 7.

This paper hasn't been published in any journal, right?

A Not yet. It will be.

Q It's awaiting publication?

A Yeah. It was accepted in Environmental Health Perspectives about two-and-a-half weeks ago.

Q Oh. Congratulations.

A Thank you.

Q So like the other studies we talked about -- we've already talked about the peer-review process for this cancer incidence study, right?

A Right.

Q Okay. So I just want to ask you a couple of questions.

A Actually, the journal went through, I would say, two rounds of peer review on this paper.

Q The journal where it's being published?

A Yeah, yeah, yeah.

Q And do you know why two -- why two rounds?

A I think -- well, because it doesn't use significance testing, that might be one reason,

although they didn't have a problem with that. And I think because it's Camp Lejeune, I have a feeling that that might be the issue.

In the past, Environmental Health Perspectives was not that interested in Camp Lejeune studies, at least back in the day when we were doing the early mortality study, so -- but they've changed their mind, obviously, but, um -- I don't know, they're maybe just being careful. The comments the second time around were mostly stylistic.

Q Okay.

A So...

Q So what is the significance -- excuse me using it twice -- of not using significance testing?

A Well, as I said, this is controversy that's existed amongst statisticians for a long time. And the question is: Is it useful to use significance testing to interpret results?

And the problem -- I don't want to get into the whole philosophy and theory about it, but it really -- it's both a decision rule and an inference rule, you know, so -- and it's kind of conflated, unfortunately.

As a decision rule, it's yes, no, whatever level you pick, okay, so that's -- you know, that's

supposed to be a good decision, rule and it's not.

And then there's the inference rule, which is how do you interpret a .05 p-value or .10 p-value and so on, and it's not very good at that either. So it fails on both sides -- issues.

And so there's a number of reasons why significance testing is problematic. And as I said, unless you really want me to go through some of them, there's -- there's the whole number of articles that were never part of the American Statistical Association's 2016 journal on this, and then there was again -- for the 2019, their final say on it, which was don't use it at all.

Q Okay. So this goes back to the -- using the 95th percent confidence interval, right?

A It -- well, a p-value of .05 and using --

Q Okay.

A -- 95th percent, kind of same thing.

Q Right. Okay.

A There's no difference, really.

Q Okay.

A That's a misuse of the confidence interval, is what it is.

Q Okay. If you can turn -- just a couple of questions. We talked about this a lot already, so I'm

just going to ask a couple of questions.
A Uh-huh.
Q If you can turn to the page that, on the bottom, that little Bates number is -- the last three numbers are 106.
A 106.
Q And on this one, I can actually point you to lines.
A Uh-huh, yeah.
Q If you can go to line 157 --
A Uh-huh.
Q -- and 158.
A Uh-huh.
Q It says here, "The drinking water exposures at Camp Lejeune" --
A Right.
Q -- "include contributions to total internal body dose from three routes: ingestion, inhalation, and dermal."
A Uh-huh.
Q When you're talking about that, all of those routes of exposure are from the water at Camp Lejeune, right?
A Yes. Yeah. The chemicals are volatile, so you inhale them when you use hot water, any hot water

use, and they also have a dermal because they're solvents.

Q Okay. If you go to page 117, that little number at the bottom, the Bates number --

A 117.

Q -- and if you go to line 498 and '99, it says, "This study was approved by the Centers for Disease Control" --

A Yeah.

Q -- "and Prevention Institutional Review Board."

A Right.

Q What is that?

A It's for human subjects.

Q Okay.

A So to protect human subjects.

Q So would that be true for --

A Every study has to go through IRB.

Q Oh, so --

A That involves human subjects. Even -- yeah, even the mortality study, we have no contact with people. Or this one, we'd have no contact with people. It goes through IRB.

Q Okay. I was going to ask if the mortality study --

A Yeah.
Q So they all go through that. Okay.
A Oh, yeah, every -- all -- every study that we did at Camp Lejeune when through IRB, except the assessment of the evidence, which wasn't a study, right.
Q So was this like another level of peer review separate and apart from what we've talked about?
A They do -- well, in order to protect health -- human subjects, the research needs to be useful.

Now, if it's not useful research or done poorly, it impacts human subjects. People are put through an ordeal that they don't need to because the study is not good, worthless, or at least the proposed study is not.

So, yes, they -- they do make quite a bit of comments that you would get from a peer-review situation.
Q Okay. And then if you look at page 118 --
A Uh-huh.
Q -- lines 507 and 508, it says, "The median age of the Camp Lejeune and Camp Pendleton Marine/Navy personnel subgroup at the start of follow-up was 35 years, and the median age at the end of follow-up was

57 years." See that?
A Yep.
Q And it refers to Table 1a.
A Right.
Q So this -- am I correct that this cancer incidence study would not reach the median age of many of the cancers that were being looked at for Camp Lejeune?
A Right. Yes, it's a young cohort.
Q Okay. I want to ask you some questions now about some of the data collection for the cancer incidence study --
A Uh-huh.
Q -- and I'll try to -- let me just -- can you explain the process by which personnel data for full-time civilian workers at Camp Lejeune and Camp Pendleton were collected for this study?
A So the Defense Manpower Data Center -- I think that's what you're talking about -- the Defense Manpower Data Center has personnel records for Marines, Navy personnel, and civilian workers.
Q Uh-huh.
A The civilian workers' database starts in 1972 and have it -- I think it's the last quarter of --
Q Uh-huh.

A -- 1972. Yeah. And -- however, they didn't include name in the database until sometime in '81, I think it was. So it's, you know -- but they had Social Security number, and so Social Security number -- so it still could be used for that purpose, for the purpose we wanted to use it for.

But for some reason, they didn't capture either the full name or sometimes maybe there's a partial -- last name or something, if I remember right. But it was -- for some reason, they didn't collect the full name until '81.

Q Okay.

A And the -- and then there's a database for Marines, personnel database, which for Marines starts in April -- second quarter of '75.

Before that, they had data probably going back to '71, but they did not have the unit code. Without the unit code, you have no idea where they were. The unit code is key to knowing which base they were stationed.

Q So what if you -- what if they found someone that didn't have a unit code? They just weren't included in the study?

A No, everyone had a unit code --

Q Oh, I'm sorry.

A -- starting in April '75.
Q I see.
A If you were -- to be in the study, you had to be at Camp Lejeune or Pendleton --
Q Uh-huh.
A -- sometime between April '75 and December '85. Those people who started active duty before that time, we didn't know where they were until April '75. Then we have a unit code.

Now, there are muster rolls that were computerized by the Marine Corps, and I do that in italics because you can really just do one person at a time. It really was not a -- that kind of a searchable database. At least when I was shown it in Quantico, it was not a database like the DMDC, where you can get all this data together and actually use it. So --
Q You didn't use the muster rolls for --
A I didn't use the muster rolls at all, no.
Q And how -- do you appreciate -- do you understand the difference what -- the kind of information that would be on a muster roll versus the data that would be in the DMDC? Is there a difference?
A Yeah. The muster roll would have a lot more information than the DMDC data. It would have -- if would, first of all, say what base you were and your

whole record of what you did.

And so that's not really available in the DMDC. What's available in the DMDC is, again, the Social Security number, their name, date of birth, sex, race, rank at the time when they were there, the quarter, and a few other things, occupational code and so on.

So there's plenty information in the DMDC, but the muster roll will give you more information. In particular, it would tell us what we didn't know. If someone started active duty before April '75, we wouldn't know where they were. The muster rolls tell you.

Q Okay. It also wouldn't show, am I correct, if someone was deployed off base at Camp Lejeune?

A Yes.

Q -- and then came back?

A Yeah, it has more information like that. So that's a problem with the -- with all these studies, is that the unit code is helpful, but the person may not be with the -- where the unit is based at that point in time. They may be somewhere else, yeah.

Q Okay. What specific data points were -- and you may have answered this and I'm just not fully understanding, but what specific data points were

collected for civilian workers and why were they important in assessing cohort characteristics, like, what data points for civilian workers?

A Well, as I said, the key ones, for matching purposes with the cancer registries and the National Death Index, would be the Social Security number and the date of birth.

Q Okay.

A Those two are key. With the Marines, we also had name. That was key.

Q Uh-huh.

A And sex would be key. So those four variables are the key for matching. And we had at least three of them for the -- for all civilian workers, and four for civilian workers from '81 or so on.

Q Okay. And so for the -- for the data points -- now I'm going to talk about Marines.

A Uh-huh.

Q Would it be the same factors, the Social Security, rank --

A For matching purposes, the Social Security number, name, date of birth, and sex, but rank was important. We used that in the model, as well as race and sex. What else, um --

Q Why was rank important?
A I think rank gives you some sense of -- we're looking for some socioeconomic status type of variables, and rank is one of them. Education level at the time they were there at the base is also an indicator. These are not strong indicators, just the only ones in the database that might be useful.
There was occupational code, but that didn't help much. So we really -- we tried to use it, but it didn't really explain anything, so we stuck with the variables of sex, race, education level, and rank. And for the workers, it was their pay grade.
Q Okay. Did you choose --
A Oh, no, it wasn't the pay grade.
Q Okay.
A I'm sorry. It was blue collar, yes/no. Yeah. I'm sorry.
Q Did you choose to use Camp Pendleton as a comparison to the Camp Lejeune cohort?
A Yes.
Q And why did -- why did you choose Camp Pendleton?
A Wanted a Marine base very similar to Camp Lejeune that did not have contaminated drinking water, and so -- especially contamination with these

chemicals. And so Pendleton fit the bill. There were no other Marine bases we could think of that would fit the bill as well as Pendleton would. They're very similar in so many ways, including the activities that go on there and the lifestyle and everything else, even though it's in California.

The other thing is that a lot of Marines went to both bases; in other words, they went back and forth. There's that. And, you know, there was some talk about half the -- the middle of the country on to the West went to Pendleton, middle of the country to the East went to Lejeune. But I find that that probably wasn't necessarily the case at all. So people came from all different places to either one of these camps.

Q If they went to both, were they excluded from the study?

A No, no. No, no, no. The way --

Q So how did you factor in -- I'm sorry.

A The way we describe it is that if you're at Camp Pendleton, as soon as you go to -- if you move to Camp Lejeune, from then on you're assumed to be Camp --

Q Okay.

A -- you're characterized as Camp Lejeune. If the other -- the reverse doesn't happen. If you're at

Camp Lejeune, then go to Pendleton, you're at Camp Lejeune.

Q Okay.

A Okay? Because that's the exposure.

Q That makes sense. Okay..

How does the large sample size at Camp Lejeune and Camp Pendleton contribute to the study's finding of liability?

A Well, it gives you more power, statistical power. You'll have more outcomes. Just, you know, if it was -- if it was a smaller cohort with the same age distribution, you would have very small numbers of outcomes. It's a young cohort. The larger you can make it, the better.

So we looked at two different sizes. We looked at everyone who -- regardless of when they started active duty --

Q Uh-huh.

A -- and then we limited it to those who started active duty -- actually, some were -- we went back to December '74, actually, to get as much of the new people in, I mean, people that weren't in the earlier mortality study.

So we -- from December to the first quarter of '75, those were new people to the study that were

not in the earlier studies.

Q Okay.

A Just, again, to increase the size because we knew, with cancer in particular, if we're going to look at histological subgroups, it was going to be difficult to interpret.

Q So can you explain the process you used to collect the cancer data for the cohorts?

A Right. So the first thing -- we had a contractor, Battelle, and their subcontractor was the North American Association of Central Cancer Registries. We call it NAACCR.

Q Uh-huh.

A NAACCR is the trade group, if you will, or organization of all the cancer -- state cancer registries in the U.S. and Canada. And by having them involved, they were -- at that time, they were starting a program to begin the early stages of having a national registry, at least making it easier to do these kinds of studies, and we gave them Camp Lejeune data to push that effort forward.

They were going to look at three cancer registries and get data for us from three, just for a test. And we said, "No, go after all of them," and that -- some started that group.

But anyway, so NAACCR helped us -- helped Battelle -- it was very important because the cancer registries trusted NAACCR. They didn't know us from Adam. They're very protective, very protective, as they should be, of their --

Q Uh-huh.

A -- cancer data. And so it was really helpful to have NAACCR intercede for Battelle and for us so that -- so we -- I gave them those -- the DMDC data, particularly with those variables I mentioned, and then they had a test run with the registries to see how things -- with a few, to see how things worked out, and then they did it with all of them, sent the data to all the registries, including the VA registry.

The VA registry was unique in the sense that a cancer registry staff person in Kansas who was extremely familiar with the VA registry actually did the matching, not the VA. The VA couldn't do the matching.

The Department of Defense data, cancer registry, I did the matching. That, we spent -- we got all the data from -- I'm jumping around, but we got all the data, the cancer data, from all the states and the VA in mid -- certainly by mid 2020 -- early 2021. And I didn't get the Department of Defense data until,

like, September of 2022, so almost a year and a half of going back and forth and back and forth.

I think the problem there was that they -- they weren't resistant. It was more of their bureaucracy and people not knowing how to navigate their own system, which took forever. But they also said point blank, "We do not do matching."

Q This is DOD said that?

A Yeah.

Q Okay.

A Said, "We'll give you" -- they gave me all their data, and then I -- you know, the entire cancer registry data. And you'll see -- if you've gotten those -- my email -- I mean my files, you'll see it there. It was a big dump.

What that meant was that -- I had already done the analysis, and then I had to redo it with this new data.

So anyway -- so that's how it worked. It worked with the -- I gave the DMDC data to Battelle. Battelle and NAACCR worked with the cancer registries. They did the matching, they all used the same software, except the DOD, because I did the matching --

Q Okay.

A -- and -- linkage software -- and except for

the VA, they all did some sort of quality control, removing duplicates, checking the positive matches and some of the negative matches. They all did that work, which they do, normally, at a cancer registry.

Q You say a negative match. In other words, the --

A A match that didn't -- I'm sorry, a match that didn't -- a non-match.

Q Okay.

A They checked some non-matches just to make sure --

Q Let me try --

A Right. I'm sorry.

Q That's okay.

So you mentioned -- I think this is clear, but I just want to clarify. When you said "all registries," you're talking about the state registries, not any kind of national registry, right?

A There is no national registry.

Q Right.

A So we used all the state registries. We did not get individual-level data from West Virginia. They had a state law prohibiting it. So did Kansas. But Kansas went this extra step to actually get consent from the patients. So for most of the matches in

Kansas, we got individual-level data. There were some --

Q Uh-huh.

A -- we just got aggregate data, just like West Virginia. So that was unfortunate, but that was -- but all the other states gave us individual-level data, and we could link it to a Social Security number and all the DMDC data, so we had a complete data set to do the study.

Q Okay. And I want to make sure I'm right about the VA, but --

A Uh-huh.

Q -- did the VA do manual reviews?

A No.

Q Okay. So for those registries that didn't perform manual reviews, like the VA and the DOD, how --

A Those are the only two.

Q How can you verify the accuracy of the sources coming from those two entities?

A How can I verify it? Well, I went through, also, and removed -- I mean the contractor went through and removed duplicates, and then I saw some extra duplicates and removed them as well. So I went through and combed the data myself --

Q Uh-huh.

A -- to make sure that there were no duplicates.

The problem -- part of the problem was that if someone was diagnosed in Kansas and then diagnosed in a neighboring state, they were in both registries. So that's a duplicate, right? So we had to remove that.

So, no, we could not check -- in the VA cancer data, we could not check for, as I said, checking the positive matches and checking the non-matches --

Q Uh-huh.

A -- like the other registries could do, no.

Q So I'm just trying to understand --

A But that's with the -- I mean, but that's -- if -- anything you see from the VA that has to do with cancer, this is what they do. They -- I doubt that they ever take care of that database, and that's probably the reason why we had to get someone from Kansas who knew the database well, because they -- the states use the VA's data. They want to make -- have complete ascertainment.

If someone goes to the VA hospitals, sometimes the VA doesn't report that to the State, apparently, and so -- we're not sure how big the

problem is, but it's -- the states try to get that information from the VA.

Q You were anticipating my next question. So the VA doesn't automatically provide its cancer data to the state registries; is that fair?

A I'm not sure I understand -- you may have to ask someone from NAACCR --

Q Uh-huh.

A -- in particular about this or the CDC's cancer group. But it's -- it's a -- I think for some states, there is cooperation; and for some states, there isn't. That's my understanding. But we -- but the idea was to get the VA data so we wouldn't be missing any cases because of that.

Q Okay. So you had the full VA data set and then --

A Well, they did the -- as I said, the matching --

Q Right.

A The VA's cancer data was used to do the matching, just like any registry.

Q Okay.

A So -- yeah.

Q So I think you've answered this, how you dealt with duplicate records. Was that the contractor

who did -- dealt with duplicate records except for -- you to DOD, right?

A Well --

Q To the extent there were duplicate records.

A -- the data I get from any contractor, I always go through and --

Q Okay.

A -- I do extra cleaning because you never get an entirely clean data set, in my experience. So they did their job in getting rid of as many duplicates as they saw, but I saw additional ones, and so those I took out.

So if there was a lung cancer at one date and then three years later there's another -- the same lung cancer, again, that's a duplicate, you know. They missed some of those. I didn't.

Q Okay. All right.

Let me just show you one more document. This is a study with your name on it. And am I correct that this is a study that you did when you were with the New Jersey Department of Environmental Health?

A Yeah. But by the time this was published, I was already at ATSDR --

Q Okay.

A -- I'm pretty sure. What's the year on this?

Q I think --
A Yeah. So, yes, I definitely was. Yeah.
Q But this was based on the work you did while you were --
A Yeah, I helped Perry -- first of all, they used my assessment of the contamination, so the exposure assessment here is mine. I also showed Perry how to do the analysis. So that's -- that was my contribution to this. This is -- we did an earlier study. I was the third author there because I came in late into the study. Dr. Fagliano was the last --
Q Uh-huh.
A -- was the lead on that, and I did the Poisson regression in that study.
So, yes, both of these were done -- either I was helping them while I was still in New Jersey and then I left and they continued the study, or I was -- I did it entirely in New Jersey, depending on the study.
Q Okay. And I want to make sure I'm -- and this looked at both TCE and PCE and trihalomethanes, right?
A No.
Q No?
A Just trichloroethylene and perchloroethylene. This -- the birth defect study looked at --

Q Okay. Okay, so this is just TCE and PCE --
A Right.
Q -- in that particular study?
A Yeah, yeah. On the previous one as well.
Q Okay. And did you average those together in coming up with your -- let me get to the right table. Just a minute. If you go to Table 2.
A Table 2. Okay.
Q Do you have -- this is actually -- let me withdraw that question because I see right here it says TCE. So Table 2 only addresses TCE contamination --
A Right.
Q -- is that right?
A There's one that there's a typo, where it says TC -- I thought. I seem to remember there's one that says TCE when it should have said PCE.
Q Okay.
A Yes, Table 4.
Q Okay.
A It says, "TCE exposure (ppb)." It should be "PCE." So they were evaluated separately.
Q So Table 4 is actually PCE, not TCE, correct? Is that what you're saying?
A Yeah. Perchloroethylene, yeah.
Q Okay. Sorry.

A So first we looked at the trichloroethylene, we looked at the --
Q All right.
A -- leukemia and non-Hodgkin's and perchloroethylene.
Q Okay. So looking at page 559 --
A Uh-huh.
Q -- for NHL --
A Uh-huh.
Q -- I just want to make sure I'm reading this right. For concentrations in -- this is drinking water, right?
A Yes.
Q Okay. For concentrations in drinking water between .1 part per billion and 5 parts per billion, you saw a relative risk of 1.28 for males and 1.02 for females?
A Yeah. Uh-huh.
Q Okay. And this is for NHL?
A Yes.
Q Okay.
A Total -- all NHLs, and then we have them defined by grade.
Q Right. And then you have them broken down by subparts -- subtypes --

A Yeah.
Q -- excuse me, right? Okay.
A By grade, yeah. I didn't do that in our cancer incidence study. I separated them by histological subgroup, which I thought was more informative.
Q Okay. So let me go to PCE now --
A Uh-huh.
Q -- on Table 4 --
A Uh-huh.
Q -- which I understand you've just corrected. The "TCE" is actually "PCE" on page 560.
A Same problem with Table 3, by the way.
Q Oh, okay. We'll look at that too.
A Change the T to a P on Table 3 and Table 4.
Q So Table 3 is also P?
A Yeah.
Q Okay.
A One and two is TCE.
Q Okay. So if you look at Table 4, so for PCE for NHL --
A Uh-huh.
Q -- between .1 part per billion and 5 part per billion, the relative risk for males is 1.25; is that correct?

A Yeah.
Q Okay.
A And for females, it's .95.
Q Right. And for 5 parts per billion and over, it's 1.10 for males and 1.08 for females?
A Yes.
Q And, again, underneath there, there's differentials for the various grade of NHL, right?
A (Nods head affirmatively.)
MS. GREENWALD: Okay. I don't have any more questions for you right now.
THE WITNESS: Okay.
MS. GREENWALD: Oh, I didn't put a sticker on your copy. So this will be Exhibit -- thank you -- Exhibit 18.
(Exhibit 18 marked for identification.)
MS. GREENWALD: Thank you very much for your time this morning and early afternoon. I will ask the witness --
MR. BAIN: You want to keep going, or do you want to take a break?
THE WITNESS: Sure, if it's okay.

EXAMINATION

BY MR. BAIN:
Q Okay, Dr. Bove, my name is Adam Bain, as I

introduced myself to you earlier today. I represent the United States in the case. And I'm going to ask you some questions about your Camp Lejeune studies.

A Okay.

Q First of all, what percentage of your work over the past 15 years would you say has been devoted to Camp Lejeune?

A Past 15 years, so that goes back to 2009, I would say a major portion. I also worked on the PFAS stuff as well, which also took some time, but I think Camp Lejeune was the major.

Q So it would be over 50 percent?

A Oh, yeah. Oh, yeah.

Q Now, I know we're focused on the five diseases that --

A Uh-huh.

Q -- Ms. Greenwald mentioned, but I do want to go back to some of your earlier studies just to get some methodological issues --

A Uh-huh.

Q -- clarified.

So I think I want to start with what I believe is, and correct me if I'm wrong, the first Camp Lejeune epidemiological study, which was -- would that be the birth defects and childhood cancer study?

A That's the first one, except for there was a study done by -- what's her name -- Nancy Sonnenfeld, which was part of her dissertation, which looked at birth outcomes, but that was prior to the water modeling being done.

And so there was -- there was a major error in assuming that Holcomb Boulevard was unexposed when they -- there was a period of time before 1972 when it actually received Hadnot Point water. So we redid it for that reason, but -- so based on the water model, that was the first study, yes.

Q Okay.

MR. BAIN: So I'd like to make this the next exhibit, which I believe would be Exhibit 19.

(Exhibit 19 marked for identification.)

Q (By Mr. Bain) Dr. Bove, can you identify Exhibit 19 as the birth defects and childhood cancer study --

A Yes.

Q -- that we were just referencing?

A Yes.

Q And this was published in the journal Environmental Health; is that right?

A Yes.

Q And you're listed as the author, along with Perri Ruckart and Morris Maslia?
A Yes.
Q What was your role as compared to Perri Ruckart and Morris Maslia?
A My role was to sort of direct the study and to -- initially we had -- my supervisor was directing the study. I helped with the protocol. But she moved on, and I directed the study. Perri did the statistical analysis. And Morris, of course, did the water modeling. So -- and then I helped with the interpretation, helped with the writing, and so on.
Q Okay. And as I understand it, in this study you looked at live births between 1968 and 1985 to mothers who resided on Camp Lejeune during a pregnancy?
A Yes.
Q And that would have been a case-control study; is that right?
A Yes.
Q Can you describe what a case-control study is?
A A case-control study in particular, in this situation, we identify the cases and then we take -- so that's the case group. And then we take a sample of the non-diseased or other diseases, depending on the

kind of study, as your control group.
Q Uh-huh.
A And you look and see if the -- if the case group has higher exposures than the control group.
Q So you had a case group that you found of the particular conditions that you were looking at --
A Right.
Q -- and then a control group of people who did not have those conditions?
A Right, yes.
Q And you compared the exposure between the two?
A Yeah.
Q For the exposure value for the mothers, you used the historic reconstruction of contaminant levels that ATSDR had done through the groundwater fate and transport and water distribution model?
A Yes.
Q And that's why Morris Maslia is listed as an author; he was the one responsible for that?
A Right. In fact, the reason Morris was given that task was for this study.
Q And that water modeling provided monthly average estimates of the concentrations of contaminants in the drinking water delivered to certain residences?

A Yes.

Q Would you agree that there was a data limitation, with respect to the water modeling, because there was a small number of drinking water contaminant results from actual samples that were taken at the water treatment plant?

A Well, yes. That's why we had a model, for those reasons.

Q Would you agree that the dose calculations generated from the ATSDR's water model are simulated values with uncertainty inherent in such simulations?

A Sure, yes. And it's stated so in the documents themselves, yeah.

Q So the actual concentrations could have been higher or lower than the values generated by the model?

A Well, again, two different things. A sample is a -- is a -- is a point in time. They're averaging over the month. So the highest average -- monthly average for TCE didn't approach the high level of 1400 parts per billion from a point sample in 1982. So right off the bat, there are those differences because we're looking at different periods of time, point estimate versus month.

But they did try to compare the model estimates with the sample data that they did have, and

it was in agreement to the extent that you would in these kind of modeling exercises.

Q But you're aware they only had actual sampling from the 1980s and they actually modeled it for decades earlier?

A Yes.

Q And the models that -- or you don't really know what the actual concentrations were in those prior decades?

A Of course not. They did not sample it. They -- yeah.

Q And the levels that the model produced could have been either higher or lower than what the actual levels were?

A Sure, yes. There's uncertainty.

Q Now, to determine residency for the exposure inputs for the study, you used the residential information that you collected during interviews; is that right?

A Yes. We also had family housing records as well.

Q Okay.

A So we used both.

Q And you matched that information, using both the residency and the housing records, to the water

modeling results to determine concentration levels?

A Well, yeah, if the resident was at Tarawa Terrace, for example, we used the Tarawa Terrace values. If they were at Hadnot -- Hospital Point or if they were at any of the Holcomb Boulevard areas, we applied the levels --

Q Okay.

A -- for that.

Q So for both the case group and the control group, were there some people who you determined would be, quote, unexposed within those groups?

A Yeah, there were -- there were housing areas where the water was not contaminated. Holcomb Boulevard treatment plant, for example, from '72 on, except for a few periods, was clean, and so that would be -- and then there was variations on levels. So earlier our estimates were lower, then as -- then as time went on, they kept going up.

Q Okay. So you divide that -- you divide the people who were in the study, both the cases and controls, into exposed and unexposed groups; and then for those who were exposed, you matched those to the concentration levels in the model?

A Yeah, and so we have -- if you see some of the tables, we have different levels of contamination

for each of the mothers. So you either had none or -- I'd have to look and see what the levels are, but the tables have -- let me see if I can get to the table. Let's see.

So Table -- 797, Table 4, for example, unexposed -- so we have unexposed versus exposed. Let's say for PCE, you can see the values there and the numbers and so on.

Then we looked at below MCL and above MCL. Okay? So we divided the cases and controls into those categories to see if there were more cases in those categories than controls. But for some, like benzene and clefts, we just looked at unexposed versus exposed. We didn't have enough data to do anything more. And similarly for neural tube defects.

Q And did you -- so differentiating into the different levels, were you looking for some type of an exposure-response relationship?

A Yes, yes. That strengthens your interpretation if you see that, yes.

Q Okay. And do you recall generally what the results of this study were?

A The odds ratios for benzene and trichloroethylene were elevated for neural tube defects. For childhood cancers, it was PCE,

perchloroethylene. We didn't see anything for clefts, if I recall, which is -- I've seen in other studies that you don't oftentimes see an effect among clefts, so that wasn't surprising.

Q Okay. Since we're not really focused on childhood cancers and birth defects, I'm not going to spend too much time on that, but this paper was -- was this paper first submitted to Environmental Health Perspectives?

A No.

Q No?

A No. It was submitted to Environmental Health.

Q Okay. And why was it submitted to Environmental Health; do you recall?

A Well, it's a good journal. I think at the time, we thought that Environmental Health Perspectives was not interested in Camp Lejeune studies, so that was -- I don't know who -- how that -- who found that out or what. I just heard that from leadership, that they probably won't publish Camp Lejeune work. And why, I have no idea.

Anyways, but it was a good journal, and so we decided to send it to them. We could have sent it to an epidemiologic journal, like American Journal of

Epidemiology, but this kind of study really fit this journal better than just a straight epidemiologic journal.

Q Okay. But do you recall any communications between ATSDR and Environmental Health Perspectives about this study or any of the earlier --

A No.

Q -- Camp Lejeune studies?

A No. I just hear -- it's hearsay, and so we just didn't bother to even try --

Q Okay.

A -- Environmental Health Perspectives. That was true for the mortality studies back then too.

Q Okay. I want to turn to the male breast cancer study that was done.

A Okay. Do I have that or --

Q I'm going to give you a copy.

A Okay.

MR. BAIN: Mark this as the next exhibit.

(Exhibit 20 marked for identification.)

Q (By Mr. Bain) I've marked as Exhibit 20 the 2014 study entitled "Evaluation of contaminated drinking water and male breast cancer at Marine Corps Base Camp Lejeune: a case control study." Do you see

that?

A Yes.

Q And you're the author of the study again, along with Perri Ruckart and Morris Maslia and, on this study, also Edwin Shanley?

A Yes.

Q What was your role on this study?

A It was my idea. And also, I developed the protocol. And that's about it. I think that -- and I reviewed the write-up, helped with the write-up, but I did not -- oh, no. I'm sorry. I did do some analysis, yes. The proportional hazards analysis is mine in here.

Q And this study was also submitted to Environmental Health; is that right?

A Yes.

Q Do you know whether it was submitted to any other journals?

A I don't think so, no.

Q And like the childhood birth defect and cancer study, this was a case-control study, right?

A Yes.

Q But unlike the birth defect and cancer study, the cases and controls were not limited to those who had been at Camp Lejeune; is that right?

A Right. It was all Marines.
Q And --
A So the -- but the exposure was Camp Lejeune versus all other Marines, yeah.
Q Right. So the cases and controls were Marines that were included in VA's Central Cancer Registry; is that right?
A The cases were those who were in the Marines and the database, the VA database, who had male breast cancer. And the controls -- we would pick three other cancers that we felt were unrelated to these contaminants as the control group and took those.
Q And the controls were those who had a type of cancer that you determined were not associated with solvent exposures, including skin cancer, bone cancer, and mesothelioma?
A Right, yes.
Q And as with the childhood birth defect and cancer study, you used ATSDR's water modeling as part of the exposure assessment?
A Yes.
Q And, again, that's why Morris Maslia is listed as an author?
A Right.
Q And, in fact, if you look at this particular

study --

A Uh-huh.

Q -- it actually includes charts for the different housing areas at Camp Lejeune, right?

A Right.

Q And those charts are included in the paper as Figures 1 through 7?

A Yes.

Q Those charts designate different residential areas such as Tarawa Terrace, Knox Trailer Park, Midway Park, Paradise Point, Watkins Village, Berkeley Manor, and Hadnot Point, right?

A Yes.

Q And you used this data, with information from family housing areas and barrack units, to assign contaminant-specific residential exposure levels for each case and control assigned to Camp Lejeune?

A Right.

Q However, a case or control, even if assigned to Camp Lejeune, was designated as unexposed if the individual lived off base or in an area that received uncontaminated drinking water?

A Right, yes.

Q The actual contamination levels during most of the study period were unknown, right?

A The sample -- there's no sample data before 1980.

Q Okay. So the actual contamination levels -- what was the -- what was the year of -- the subjects of this study, what were the years at Camp Lejeune; do you recall?

A I'm trying to remember. It should be somewhere here. Let's see. Well, we wanted to make sure they were -- the eligible study members were male Marines born before 1969 and diagnosed with or treated for cancer from January 1st, 1995, which is when they -- the VA registry actually started, till May 2013, when I guess the data was last available.

So they excluded those born after January 1st, 1969, as those individuals were not old enough to serve during the period of contamination at Camp Lejeune. You have to be at least 17 years -- right, so that's -- so they wanted -- so these -- it could have gone back quite a bit, whatever -- if they were diagnosed in the VA registry, right, they could have been at Camp Lejeune in the '40s --

Q Uh-huh.

A -- for all -- for all I know, or '50s.

Q So if you look at page 3 where it says "Exposure Assessment," the first sentence says,

"Actual contamination levels during most of the study period are unknown." Do you see that?

A Right. Yes. Yes.

Q And then if you look at the Table 4 on page 12 --

A Uh-huh.

Q -- the study found some positive hazard ratios above 2, as reflected in Table 4, right?

A Right.

Q In particular, hazard ratios were above 2 for higher cumulative PCE, TCE, and vinyl chloride exposures?

A Right.

Q Would you agree that the confidence intervals were very wide for all relationships?

A Yes. There were only two cases, for example, and eight controls in the high exposure group for PCE, for example, and something like that for some of the -- you know, similar small numbers like that. So when you have small numbers, you have high confidence intervals.

Q And I noticed in several of your studies, you refer to confidence interval ratios, or CIRs, right?

A Right. We didn't do that for this study.

Q Okay.

A Yeah.

Q What is a confidence interval ratio calculated to reflect?

A Okay, well, the ratio is upper limit divided by the lower limit, okay?

Q Uh-huh.

A And it's a measure of precision. Instead of worrying about where the confidence interval lies, because it can move because of bias, it's trying to get at just the precision issue, just how wide it is --

Q Uh-huh.

A -- and have a metric that you can use to compare with other studies and other associations you might have. So that's what a confidence interval ratio is.

It's been promoted by -- it's new, relatively new, although there is a 2001 paper that advocated for it. And Dr. Savitz, for example, in his book recommends it too, and others have recommended it, and so we use it.

Q So is it fair to say the narrower the confidence interval ratio is -- or the narrower the confidence --

A The smaller the ratio is, yes, but it also is -- it indicates how narrow the confidence interval is, sure.

Q So the smaller the ratio is, the more precise the effect?

A Yes. Yes.

Q And the more confidence you have in it?

A I hate to use that term. It's a poorly chosen term by the people who came up with it. It's just a precision; it means that there's less uncertainty about that point estimate.

The focus is on the point estimate, the hazard -- in this case, the hazard ratio; and in the other cases, it's the odds ratio, whatever. And you're just trying to get a handle on what kind of -- how much uncertainty there is about that estimate.

So that's what we're trying to do with a confidence interval ratio. And that's what you should be doing with a confidence interval in general.

Q Is the confidence interval ratio -- I think you mentioned it's relatively new.

A Uh-huh.

Q Would I find it in any standard epidemiological references?

A I just mentioned one.

Q Okay. Which one is that?

A Dr. Savitz's book, which I'd have to -- I don't have it in front of -- the title, but it's in

second edition, I know that, and it was published a couple years ago. Yeah.

Q So it's Savitz's -- he has several books, I know.

A Well, this one is on interpreting epi -- epidemiological data. I don't know if I referenced it in the cancer incidence study or not. I can't remember. Because I had other references for it. You can see journal articles. I'm wondering if it's -- I mean, the Modern Epidemiology, Volume 4 -- not Volume 4, the Fourth Edition, talks about how to use a confidence interval in similar ways, but they don't actually use the term "confidence interval ratio." They're just basically saying -- looking at the width of a confidence interval, which is what that --

Q Uh-huh.

A -- ratio is. And similarly, that's what Savitz says in his book. So I think those are pretty standard. Certainly, Modern Epidemiology is the standard book in the field.

Q Modern Epidemiology?

A Yes.

Q Do you consider that to be an authoritative treatise in your field?

A Yes.

Q Are there any others in the field of epidemiology that you consider to be, you know, authoritative treatises?

A Not -- I mean, that is --

Q That is it?

A That -- to me, that's the most important epidemiological textbook. It's the most difficult as well, but it involves a whole slew of well-known researchers, including top theoreticians in epidemiology. It's always been the standard. Each edition is pretty much the standard.

Q And as far as, you know, determining what an appropriate confidence interval ratio is for precision, has that been agreed upon and --

A No.

Q No?

A No.

Q So you would not find that specified in any literature, like it needs to be 2 or it needs --

A No.

Q -- to be 3?

A No, no.

Q And here in the male breast cancer studies, the confidence interval ratios were well above 3 for all relationships, right?

A Right. Some of them are more than 10, yeah.
Q Yeah, in fact, some of them were more than 20, right?
A It may be, yeah. Yeah, yeah, so -- yes. But you can see the width. You could see it. They're wide. I mean, you don't have to calculate a confidence interval ratio.
Q And, in fact, you say in the "Limitations" section of the study on page 13, in the second sentence, that "Findings from this study were based on a small number of exposed male breast cancer cases resulting in wide confidence intervals for the estimated ORs."
A Right. My view was this was a first look that could be done quickly, although it wasn't done as quickly as I was hoping it would be, because we had VA data. Getting data on -- getting additional data on each of the cases and controls using service records, that took time.
Q Uh-huh.
A And that probably slowed things down.
Q Okay, I'm done with that one now. I'm going to go to the 2014 mortality study, which I think you already have.
A Yes.

Q Exhibit No. 3.
A The first one, yeah. Yeah.
Q So I'm showing to Exhibit No. 3. This is entitled "Evaluation of mortality among Marines and Navy personnel exposed to contaminated drinking water at USMC Base Camp Lejeune: a retrospective cohort study," correct?
A Yes.
Q And you are listed as an author of this study, along with Perri Ruckart, Morris Maslia, and Theodore Larson?
A Yes.
Q What was your role in comparison to the other authors?
A I wrote the protocol, did the analysis, wrote it up, pretty much did almost everything, except the water modeling, of course. Morris Maslia does that. Perri helped with working with the contractor in collecting the data, so I included her. And she was involved in the writing to some extent, or at least editing my writing. And Ted Larson gave me some statistical -- not statistical -- programming codes and helped with the data management.
Q Okay. And like the childhood birth defect and cancer study and the male breast cancer study, this

was also published in Environmental Health, right?

A Right. Yes.

Q Is there any reason that you kept submitting studies to the same journal?

A We just think it's a good journal that people read, and we were trying to get these results out, disseminated.

Q Ms. Greenwald brought up the fact that you had gotten the Ozonoff Award. Do you recall that?

A Yes.

Q And is it true that David Ozonoff is the founder of this particular journal?

A He is one of the two founders. Dr. Grandjean is the other, as far as I understand, yes.

Q Did you have any particular relationship with Dr. Ozonoff during this period of time?

A No.

Q Okay. You did not really know him personally?

A Oh, no, I did --

Q Uh-huh.

A -- years ago. When I worked for Science for the People, he wrote an article for the magazine way back in '76.

Q Uh-huh.

A So I've known him for a long time. We both participated in a -- in the NAS panel on drinking water. We produced three books, and he was the lead person in that committee, and I was on that committee.

So we've worked on stuff before, and we've been interested in toxic waste sites and health effects, so -- but we -- but -- we sent it to this journal not because he was there, but because we felt that the journal would be interested in these and also would be receptive to the idea that they weren't using significance testing to decide what was important and what wasn't.

So we figured that that -- this journal would be open to that as well. So for those reasons. And also because, as I said, it is a popular journal for environmental health. It's gotten more popular as time has gone on.

Q You were questioned by Ms. Greenwald about the precautionary principle, and you were asked several questions about that.

A Uh-huh.

Q Would -- the scientists who do not use significance are more in line with those who believe in the precautionary principle?

A No.

Q Okay. There's no relationship at all between --

A Not that I -- no. For example, Sander Greenland, who, as I said, is one of the top theoreticians in the field, is definitely opposed to significance testing. He's been writing about that for years. But I doubt he would be for the precautionary principle. I just don't -- I don't know if he would even have a position on it, for example.

Q Okay. Now, this particular study was a retrospective cohort study, correct?

A Yes.

Q And that's a different type of study from the prior two studies that we looked at, the childhood birth defects and cancer study and the male breast cancer study, right?

A Yes.

Q And what's the difference between those two types of studies?

A This is following a cohort over time to see if they have an event, in this case death --

Q Uh-huh.

A -- from a particular cause. So in that sense, it's different. You're following two cohorts, basically, the exposed cohort and the unexposed cohort,

over time and seeing if -- when the event occurs, and you use proportional hazards for that too. I used proportional hazards in the case-control study. That's not normally done.

So for the male breast cancer -- you can do it, and there's papers that tell you how to do it, but most people don't do it. I did it just because I wanted to see if there was anything else we can get out of this information that we had, but -- so what was I saying?

Q But it's standard for cohort studies, is that --

A Proportional hazards is standard. So are SMRs. And both are in this paper.

Q Okay. And for this particular study, you had data from about 154,000 personnel at Camp Lejeune between 1975 and 1985 and about 154,000 personnel at Camp Pendleton during that same period --

A Uh-huh.

Q - who had not been stationed at Camp Lejeune, right?

A Right.

Q And this study did not include any individual who began active duty before 1975; is that right?

A Right.

Q And the deaths in the group at Camp Lejeune were compared to the deaths from the group at Camp Pendleton, right?

A Yes.

Q And in the abstract on the first page, you report elevated hazard ratios for kidney cancer, liver cancer, esophageal cancer, cervical cancer, Hodgkin lymphoma, and multiple myeloma, right?

A Right.

Q The only hazard ratio that was above 1.5, however, was for multiple myeloma; is that right?

A It looks like that, yes. Yeah.

Q It was at 1.68?

A Six eight, yeah, yeah.

Q All the rest were below 1.5?

A Right.

Q And the confidence interval for each of those hazard ratios are reported in the abstract, right?

A Yes.

Q And would it be correct to say that none of the confidence interval ratios for these diseases were less than or equal to 2?

A I'd have to look and see. But for all cancers, it was -- it was certainly less than 2. For individual cancers, probably not, because, again,

it's -- it was a young cohort, and these are rare outcomes, so I -- no, I don't see it, so no.

Q In fact, for cervical cancer, Hodgkin lymphoma, and multiple myeloma, the confidence internal ratios were all well over 3, right?

A Probably, yeah. Remember, there are very few women in this cohort to begin with.

Q For cervical cancer, right?

A Yes.

Q I'm going to come back to this, but I want to look at the mortality study for civilian employees --

A Exhibit 4.

Q -- which I believe is also in here.

A Yeah, Exhibit 4.

Q Okay. Exhibit 4. So just to identify this, Exhibit 4 is the "Mortality study of civilian employees exposed to contaminated drinking water at USMC Base Camp Lejeune: a retrospective cohort study," right?

A Yes.

Q And you're listed again as the author, along with Perri Ruckart, Morris Maslia, and Theodore Larson, right?

A Yes.

Q And would you have had the same role for this study that you had for the study looking at Marines and

Navy personnel?

A Yes.

Q And this, again, was published in Environmental Health, right?

A Yes.

Q And this is -- the type of study is a retrospective cohort study comparing Camp Lejeune to Camp Pendleton?

A Right.

Q But for this study, the population was the civilian employees, right?

A Right. Yes.

Q And where did you get the information about civilian employees from?

A Defense Manpower Data Center personnel records.

Q And for this particular study, the results were based on data for approximately 4600 full-time workers employed at Camp Lejeune between 1973 and 1985 and about 4700 full-time workers employed at Camp Pendleton between '73 and '85 who had not been to Camp Lejeune, right?

A Right. In this study, we had less -- we really did not have a problem with people going back and forth between the two bases; where with the

Marines, we did.

Q Right. Because if you're in the military, you might be --

A Right.

Q -- changing your station --

A Workers tend to stay on the same base, yeah.

Q And, again, you compared the deaths with the -- this group between Camp Lejeune and Camp Pendleton, right?

A Right.

Q And in the abstract, you report elevated hazard ratios for kidney cancer, leukemias, multiple myeloma, rectal cancer, oral cavity cancer, and Parkinson's disease, right?

A Right.

Q And none of the confidence interval ratios for these diseases was less than or equal to 2, right?

A Right.

Q And there was only one hazard ratio greater than 2, which was for Parkinson's disease at 3.13, right?

A Right.

Q And, in fact, in this particular study, the confidence interval ratios were much higher than for the Marine and Navy personnel cohort study, right?

A Right.
Q And it's because there were fewer subjects? One of the reasons was there were fewer subjects, right?
A That's the main reason, yeah. This is an older cohort, so there were -- if there were more workers to study, it may have had a lot more power and narrower confidence intervals, but we were stuck with what we had.
Q Because you might have had more deaths to study?
A More deaths to study, yes.
Q For all the diseases where you reported a hazard ratio of over 1.5, the confidence interval ratios were well over 5, right?
A I didn't calculate them, but I can see that they are, for some of them anyway, yeah. For most of them.
Q In fact, except for leukemias, all the confidence interval ratios were over 10, some well over 10, right?
A For what? I'm sorry. Repeat that.
Q In fact, for all the results, except for leukemias, the confidence interval ratios were over 10, some were well over 10; is that right?

A Again, I'm looking at them -- it looks like that, yes.

Q Okay. In both of these two studies, in Exhibit 3 and 4, exposure assessments were done, right?

A Uh-huh. Yes.

Q And those assessments were done based on ATSDR's fate and transport and distribution models?

A Yes. We first compared Camp Lejeune to Camp Pendleton without using the model information. And then we used the model information for residential exposure.

Q So there were two type of exposure assessments done?

A Well, we decided -- we determined who was at Pendleton and who was at Lejeune based on the unit codes --

Q Uh-huh.

A -- and did that analysis just straight up with the idea that the residential exposure would be important, but there was also training exposures, which we had no information on.

Also, the fact that they had a -- had family housing did not necessarily mean the person lived there. The family may have lived there. The person could be deployed elsewhere.

So there were problems with -- just because of those reasons. But we used the modeling for that analysis to see if we could -- what exposure-response relationships we could see given the limitations that I just mentioned. Yeah.

Q Okay. Just so I get this straight, is that when you're comparing the -- Camp Lejeune to Camp Pendleton, you don't really need the exposure model for that?

A No.

Q You're just looking -- you're just assuming everybody at Camp Pendleton was exposed?

A No.

Q I mean, excuse me, everyone at Camp Lejeune was exposed, everyone at Camp --

A Right.

Q -- Pendleton was unexposed?

A Right. Exactly.

Q But you did have the model that had been done, so you looked at --

A We felt that we should use the model because it was -- it was -- you know, a lot of work was put into it. We could see what we could see with it, but the -- but because of those limitations I just said -- for example, a lot of people either were in housing

that didn't get contaminated water or lived off base, but could have been more exposed in training than some of the people who lived on base in Tarawa Terrace, for example. It's -- you know, it depended on where they were training, what their unit was, and so on. And that information, we really didn't have.

So there's going to be a lot of exposure misclassification, not due to the modeling, but due to these issues. Okay?

Q Yeah. You also mentioned people being deployed when they would be a resident --

A Yeah, the unit says they're here, but they're somewhere else.

Q Okay.

A And, again, without the muster rolls, you really can't tease that out.

Q Okay. Well, nevertheless, I want to ask you some questions about that analysis that was done.

A Okay.

Q So the model produced monthly mean contaminant concentrations of TCE, PCE, and vinyl chloride at Tarawa Terrace, right?

A And Hadnot Point.

Q Yes. And Hadnot Point, you looked at those chemicals and also benzene, right?

A Right.
Q As I recall, benzene was not part of the Tarawa Terrace model?
A Benzene was not a problem, yeah.
Q Okay. And --
A The Tarawa Terrace was a dry-cleaner, so they don't use benzene, so...
Q Right. So that was perchloroethylene breaking down into TCE and DCE?
A Right. And vinyl chloride, yeah.
Q And vinyl chloride, right.
In the Marine Corps/Navy study, which I think is Exhibit 3 --
A Oh, okay.
Q -- each Camp Lejeune subject in the study was assigned as exposed or unexposed based on certain information; is that right?
A Are you quoting from somewhere?
Q Well --
A The -- okay, again, there's two different analyses.
Q Yeah.
A Yes, no, ever at Camp Lejeune.
Q Right.
A This is -- okay. And then the second

analyses takes into account where we thought the units were barracked. Again, we had very little information on that, and the information we did have was from the CAP members and people who had -- other Marines who had recollections. The Marine Corps couldn't help us. So where the barracks were and the family housing records, and all that was used with the modeling results.

And, you know, there were some things we didn't know and learned maybe later from the Marine Corps, for example, where women were, were they with their unit, were they at Camp Johnson. We never got a clear answer on that, which added more problems with that exposure-response analysis, using the modeling and the -- and the residential exposure.

Q Okay.

A So...

MR. BAIN: Do you want to take a break now, short break, 10 minutes?

THE WITNESS: Sure.

MR. BAIN: If you need to.

THE WITNESS: Yeah.

MR. BAIN: Okay.

THE VIDEOGRAPHER: Okay. The time is 2:41 p.m. Going off the video record.

(Recess taken.)

THE VIDEOGRAPHER: We are back on the record. The time is 2:52 p.m.

Q (By Mr. Bain) Okay, Dr. Bove, before we went off the record, we were talking about the mortality study among Marines and Navy personnel at Camp Lejeune in comparison to Camp Pendleton.

A Uh-huh.

Q And we talked about two different type of analyses that you were doing here. One was just comparing the Camp Lejeune to Camp Pendleton groups.

A Uh-huh.

Q The other was doing an exposure analysis for those who were at Camp Lejeune. And I want to refer you to Figure 1, which is on page 5 --

A Right.

Q -- of the study. And this shows how you determined how to categorize people for purposes of exposure, right?

A For the second analysis, the exposure-response, yes.

Q Exposure-response analysis, right?

A Yes, uh-huh.

Q And so depending on information you had on different individuals, you put them into different categories; for example, you could categorize them as

unexposed, based on information, right?
A Yes.
Q And those who were in the exposed category were assigned a monthly average contaminant concentration based on other information, right?
A Based on the modeling information and where they were --
Q Okay.
A -- with the residences, yeah. Or where -- yeah, based on this. If they had family housing records, that was the residence. If they -- if they had different unit codes, we asked the CAP members and other Marines to tell us where units were barracked.
Q Okay. So let's go through a couple of examples. For example, if the information showed that a person was married and lived at Tarawa Terrace or Mainside, Hadnot Point, they would be categorized as exposed, correct?
A Yes.
Q If the information showed that the person --
A Hold on.
Q Okay.
A They would be given a monthly average -- or cumulative exposure based on the monthly averages at that residence.

Q Okay.
A Okay?
Q But they would be considered exposed and then given a monthly average?
A Yeah. Yes.
Q If the information showed the person was married and residing at Holcomb Boulevard, you would consider them to have intermittent exposures during the summer and spring, right?
A Right. Because by the time this study starts in '75, Holcomb Boulevard system is up and running.
Q If the information was the person was married and residing elsewhere on base or off base, in other words, not at Tarawa Terrace or Mainside or Holcomb Boulevard, that person was classified as unexposed, right?
A Yeah. And, again, this is residential exposures. They could have been exposed in training.
Q But for purposes of the exposure-response analysis, they were considered unexposed?
A Yes, yes.
Q And you made these determinations based on family housing records as well as the name, rank, occupancy, and dates stationed at the base?
A Family housing records and unit code and

whether they were married or not.

Q Okay. So looking at the other side of the figure, if an individual was single, divorced, or marital status was unknown, then you would divide them up into either males or females. So if it was a male --

A Uh-huh.

Q -- and enlisted, for example, and the barracks were on Mainside, they were considered exposed, but if the barracks were not on Mainside, considered unexposed, right?

A Right.

Q How did you get the information on which barracks an individual was in?

A Again, we asked the CAP members, and they identified other retired Marines who had the knowledge of where units were barracked. We would have liked to get that information from the Marine Corps, but they said they didn't have that information, so we had to rely on that.

Q Do you recall where the barracks were that weren't on Mainside, where they were located?

A They could have been at the rifle range. They could have been down near the beach area, I forget what it's called, Onslow Beach.

Q Onslow Beach?

A They could be -- where else would barracks be? There was another -- I'm trying to -- I'm trying to remember the different areas. But there were no barracks at Tarawa Terrace. I don't remember -- there were probably some -- maybe there were some barracks at Camp Johnson. I'm trying to remember. And so that's -- but most of them -- most of the barracks were on Mainside, a majority of them anyway.

Q There's a note in Figure 1 that says, "8th Marines" --

A Right.

Q -- "(both enlisted and officers) moved to Camp Geiger."

A Right. We're not sure when. The only information I had was from a CAP member who said they moved in '77, and then the Command Chronologies -- I was able to find a 1980 Command Chronology, which talks about them at Geiger. So 1980, I know they're at Geiger -- I'm pretty sure they're at Geiger, I should say. Before that, I don't -- I'm not sure when they moved.

Q And did Geiger have barracks, as far as you know?

A Yeah. For the 8th Marines, yeah.

Q Okay.
A And probably other units too. Yeah.
Q And Geiger was considered -- Camp Geiger was considered an unexposed area for purposes of this analysis?
A Yes, yes.
Q Okay. One more scenario. If an individual was single, divorced, and marital status unknown --
A Right.
Q -- was male and an officer --
A Okay.
Q -- if an individual was at the bachelor officer quarters at Holcomb Boulevard, that person had intermittent exposures during the dry spring and summer months, right?
A Right. But it could be -- I mean, again, some of the officers may have been -- it's not usual, but they could have been barracked with their unit, but we assumed that they were at the BOQ.
Q If the individual was single, divorced --
A Divorced.
Q -- or unknown marital status and the individual was male and an officer, if the individual was not at the bachelor officer quarters at Holcomb Boulevard, that individual was considered not

exposed, right? If you look at the note at the bottom, "BOQs elsewhere on base were" --

A Yeah, yeah, yeah. Yes, yes, yes, yes. Sorry. Yeah, yeah.

Q That's correct?

A Yeah.

Q Do you know where the bachelor officer quarters were that weren't at Holcomb Boulevard?

A I can't remember.

Q Okay. And then you mentioned females earlier in your testimony. And here on this particular figure, there's an indication for females who are single, divorced, or marital status unknown. And it mentions that prior to June 1977, they were barracked at Mainside and considered exposed; but after June of '77, they were barracked at Camp Johnson and considered unexposed. Is that right?

A That's what we assumed at this point. But later, talking to the Marine Corps, they said, well, some of the women may have been barracked with their unit.

Again, there's a lot of uncertainty not in the water -- the water modeling has its own uncertainty. There's plenty of uncertainty here, which is why I put more emphasis on the -- just a straight-up

Lejeune versus Pendleton comparison.

Q Okay. Do you recall what the June 1977 distinction was based on?

A There's a document, actually, that says that. That was pretty clear. There was a document about it, and the Marine Corps agreed with that assessment as well. The question was what happens after 6/77, not before, whether they were -- some went to Camp Johnson for sure, but some may have went with their barrack -- the unit.

Q Okay. So just so I'm clear, with respect to this exposure-response analysis only, is what I'm focusing on --

A Uh-huh.

Q -- the people who resided off base were considered to be unexposed, right?

A Right.

Q The people who resided at Camp Geiger were considered to be unexposed?

A Right.

Q The people who resided at Camp Johnson were considered to be unexposed?

A Right.

Q But as you mentioned, another analysis that you did comparing Camp Lejeune to Camp Pendleton, you

assumed everyone at Camp Lejeune was exposed to contaminated drinking water at their residence or during daily activities, while those at Camp Pendleton were unexposed, right?

A Right.

Q Did you consider removing the people who resided off base from the analysis comparing Camp Lejeune to Camp Pendleton?

A No.

Q Why not?

A Because they could have been exposed in training, as I said before. And, in fact, they might have been more exposed in training, depending on the kind of training they were doing and where they were training, because the water buffaloes that were used at Hadnot Point, sort of a general area where a lot of the training was, came from the Hadnot Point system, so -- and they also showered on site too.

So they could have had at least -- certainly if someone had residential exposure and training exposure, they have higher. But it could be that some of the people, residential exposure wasn't that high and the training exposure could have been higher.

So for all those reasons, we -- I felt that the straight-up comparison made sense.

Q And for the same reason, you did consider removing the people who resided at Camp Geiger or Camp Johnson from the comparison analysis?

A The -- that's -- I think what happened there was I looked at a number of different scenarios, and that was true for the mortality study here. 8th Marines at Geiger, 8th Marines not at Geiger, and looked at it in those ways.

So if they were -- so for the analysis where I looked at Lejeune versus Pendleton and I decided to put 8th Marines at Geiger, then they wouldn't be at Camp Lejeune. They would be out of the -- out of the study. But for the main analysis, they're all in.

Q Even if they're at Camp Geiger?

A Even if they're at Camp -- well, for the 8th Marines, they're kept in, yes.

Q And what about people at Camp Johnson?

A Camp Johnson is always in.

Q Okay. And why are you making the distinction between Camp Geiger and Camp Johnson?

A Camp Johnson, there was a connection with Tarawa Terrace of sorts. And even some people think that there might have been some exposure over there. But the reason -- the main reason is that the Camp -- and the reason the VA counts the whole area as

Camp Lejeune and exposure is because people don't stay at Geiger. They come in, they're -- a lot of the facilities are at Hadnot Point. And so they would get exposure if they came in and ate in the commissary or whatever.

So -- but, again, that's part of the exposure misclassification I talked about earlier. No matter which way you do these -- this analysis, you're going to be faced with those problems.

Q Uh-huh.

A There's no question about it. And then you have to figure out how bad it is and what it might mean for the interpretation.

Q With respect to the information that you mentioned about people at Camp Geiger going to Mainside, what was that based on?

A Just what -- discussions with the Marine Corps. There was -- there's no documents, no.

Q With respect to people training and using water buffaloes from Hadnot Point, what was that based on?

A Again, discussions with the Marine Corps.

Q Any particular people in the Marine Corps who were giving you that information?

A Well, Scott Williams -- I've had a lot of

conversations over the years, so some of this information probably came from him.

Q What about from Jerry Ensminger?

A Jerry Ensminger, of course, and other CAP members.

Q Okay. Let's go back to the exposure-response analysis --

A But when I say "Marine Corps," I'm talking about Scott Williams --

Q You're talking about --

A -- not Jerry Ensminger.

Q Okay.

A When I talk about the CAP, I mean Jerry Ensminger --

Q Okay.

A -- and others on the CAP.

Q Okay. But you received information from both?

A I received information from all kinds of people. But the Marine Corps, in particular, Scott Williams was our point of contact. So a lot of information from him, a lot of information from the CAP, a lot of information with people who were retired Marine Corps calling me about their health and then talking to me about the situation there. I tried to

get information every which way because I could not count on the Marine Corps to give me information that I needed all the time.

Q Uh-huh. Okay.

Going to the exposure-response analysis, with respect to those who were considered exposed -- we've talked about this before -- you determined cumulative exposures --

A Uh-huh.

Q -- that were expressed in microgram/liter/months for each contaminant and for total contaminants, right?

A Right.

Q And that was based on average contaminant concentrations in the water system serving the individual's residence?

A Uh-huh. Yes.

Q And those concentrations are based on the values generated by ATSDR's water model, right?

A Yes.

Q And the cumulative exposure number was based on the length of a person's occupancy at the residence?

A Right. Or the barracks where their unit was if they were single, for example.

Q Okay. And how was the length of the

residency determined?

A How was the length of the -- we had concentrations for each housing, for each water system.

Q Uh-huh.

A Okay? So if you were barracked at Hadnot Point, you got the Hadnot Point values. If you were barracked elsewhere, you were either unexposed -- or if you lived in family housing in Tarawa Terrace, of course, you'd get that, and then so on.

So -- and Holcomb Boulevard, if you lived there, it -- you got some contamination on occasion. We took that into account. So you'd have probably on the low end of the cumulative exposure, because most of the time the water was clean.

Q But did you assign a cumulative exposure to each individual --

A Yes.

Q -- in the study?

A Yeah. Well, I mean, for Pendleton, they'd have zero.

Q Right.

A People who were unexposed, they'd have zero, but yes.

Q I should have been more specific. For each exposed person --

A Yes.
Q -- in the study, you had a cumulative exposure?
A Right, we had a cumulative exposure.
Q So was that also based on how long that individual was at that particular area?
A Yes.
Q So it's not only the average concentration for the area, but how long that --
A Duration, yes. Yeah, uh-huh.
Q And to determine how long that person was there, what information did you use?
A The DMDC data. For family housing, the family housing records. That's all we had. Yes, that's all we had.
Q Were you able to take into account a Marine's deployment off of Camp Lejeune?
A No.
Q So for purposes of this analysis, you assumed that the DMDC data represented continuous presence at Camp Lejeune?
A For the quarters that they were there, yeah. For the quarters that they're in the DMDC data with their unit code that corresponds to Camp Lejeune, yes.
Q But you're aware that a Marine could be

deployed overseas while the DMDC data represented a duty station at Camp Lejeune?

A Overseas, other -- they're training at other basis. During the survey, we heard that from some Marines, yeah.

Q And what significance would that have in the exposure-response analysis?

A Well, that is exposure misclassification. It could distort the -- instead of a line like this (gesturing), it could go like this (gesturing). It could go, you know, all kinds of different ways because of the exposure, but usually what happens is it goes like this (gesturing).

The upper people -- or more exposed people tend to be put in the middle and -- but it could go the other way. It could go any which way, and that's why it makes it even more difficult, when you have exposure misclassification, to interpret an exposure-response relationship, because the curves are funny that way.

Q Yeah.

A And, in fact, they used splines to capture that. I'm pretty sure I did it in this study. Yeah, yeah, I did.

Q Okay. And I'm going to move so some questions regarding that now.

A Uh-huh.
Q So, generally, seeing an increase in effect as the dose of exposure increases supports a conclusion of causality, right?
A It's more evidence, yeah. Yeah, yeah. Yes.
Q But if you don't see an increase in effect as the dose of exposure increases, the dose-response analysis does not support a conclusion of causality?
A You could take that position, or you can say that there was exposure misclassification and it's hard to interpret. You get more information if you see a monotonic straight relationship. If you don't see it, it doesn't -- obviously it doesn't provide much support for what you've seen already, but it doesn't necessarily oppose that. It's just not helpful.
Q Right. I'm not saying it opposes it. It's just not providing support?
A Yeah, right. It doesn't provide additional support, no.
Q Now, in this report, you distinguish between monotonic exposure-response trends and non-monotonic --
A Right.
Q -- exposure-response trends, right?
A Right.
Q And can you describe the difference between

the two?

A A monotonic relationship is an increase with every increase in dose. It could stay level for a period, but it can't go down.

So as I said, some of the curves, you'll see it go like this (gesturing). That's not monotonic. It has to either be straight like that (gesturing), or it can be like this (gesturing) --

Q Uh-huh.

A -- but it -- okay? So it can't change direction.

Q (Gesturing.)

A Right.

Q So, for example, if you have three or more exposure values, a monotonic trend means each incremental higher exposure has either the same effect or an incremental higher effect?

A Exactly.

Q But for a non-monotonic trend for three exposures means that each of the incremental higher exposure shows a higher effect from the lowest exposure, but they aren't incremental where the highest exposure category is always the highest effect?

A It -- the shape could be any which way, you know. It's unclear. That's all I can, you know -- so

with exposure misclassification, it can look any way.

Q What is the basis for a non-monotonic exposure trend supporting causality?

A If you have some -- for example, if the curve goes like this (gesturing), you may have some additional information that says that at a certain level of exposure, you don't produce any more cases, you've reached the limit -- the saturation --

Q Uh-huh.

A -- for example. So if you have additional information to explain the non-monotonic relationship, then that actually might be supportive even. Without that, I would say that it doesn't really -- it doesn't add additional support, a non-monotonic relationship.

Q Okay.

A But if you see -- if you see -- if you can figure out what's going on -- if you see something like this and then it goes up and it's definitely higher in the higher exposure group, it could be that you needed more exposure for an effect to be actually seen in this -- in that study. So, again, it's not a dichotomous cut, yes, no, provide support.

Q Uh-huh.

A You know, if you have additional information or can explain the curve, it might provide support.

Okay?

Q So if you have a non-monotonic trend, you would need additional information to --

A I would say it would help, yes. Yeah.

Q Okay. If you look at Table 7 on page 10 --

A Table 7 on page -- yeah, right here. Uh-huh.

Q -- you report the exposure-response relationship for certain chemicals and certain diseases. Do you see that?

A Yes.

Q And some of the relationships are monotonic and some of the relationships are non-monotonic, right?

A Right.

Q So the only monotonic ones that I see are total VOCs in kidney, TCE in Hodgkin --

A Uh-huh.

Q -- benzene in Hodgkin --

A Uh-huh.

Q -- TVOC in Hodgkin, and PCE in ALS. Does that look right to you?

A Uh-huh, right.

Q And the rest are --

A Well, if the initial -- if any of them are below 1, that would not make it a monotonic. So .69 would make it not monotonic.

Q Okay. So it has to be at least 1?
A Yeah, it has to be at least 1, so that's not -- I wouldn't consider that monotonic.
Q So you're talking about PCE in ALS, right?
A Right. So none of the ALS ones -- yeah, none of the ALS ones are monotonic, I would say. The only interesting thing about the ALS was at the high exposure level, cumulative exposure level, we had odds ratios that were pretty high there, but it wasn't -- and, again, you could say something about that. It goes as far as -- it doesn't go that far, but it does provide some indication.
Q So Table 7 is somewhat selective in that you did not report the exposure-response relationships for many of the chemicals and many of the diseases, right?
A Right.
Q Would it be fair to assume that the relationships that were not reported in Table 7 did not exhibit any type of exposure-response relationship?
A Yeah, I think that -- I must say something about that in the -- well, there was an additional file, that's right, an additional file that had all the splines and all the results. So, yes, these are the ones I highlighted, but all the results were in the supplemental file.

Q So, right, the ones that you highlighted here were the only ones that showed an exposure-response relationship, increasing exposure-response relationship?

A Yeah, but I also put them -- for kidney cancer, I was going to do it anyway because of the trichloroethylene.

Q Uh-huh.

A Hodgkin's lymphoma, we don't have much information on Hodgkin and these chemicals. Non-Hodgkin's is different.

Q So you mentioned -- is there reference to a supplemental file in the report that was provided to the journal along with the article?

A Yeah, they have -- they had all of it, yes.

Q And that would have shown all the relationships?

A Yes. I think it says that on page -- well, 1111, "Analysis internal to the Camp Lejeune cohort: Full results for categorical and continuous cumulative exposure are in Additional File 2, Additional File 3." It looks like -- I think the splines are there too.

Q What page are you referring to?

A It -- in the bottom, it's -- the last four digits are 1's, 1111. At the top it says, "Page 9 of

14."

Q Okay. I see it.

A Yeah, let me just see. I'm sure I did -- yeah. Yeah, I did splines. Yeah.

Q And, again, if there isn't an exposure-response relationship, that factor cannot provide a support for a finding of causality, right?

A Unless -- unless with the caveat I said, that if you have additional information, then you might be able to explain why it's not monotonic.

Q Right. But if there isn't either a monotonic or non-monotonic relationship, but -- nothing there at all, then it doesn't provide support for causality?

A Unless it's -- yeah, if it's a monotonic, it does. If it's not monotonic, then in that situation it wouldn't. Yes.

Q And so what is the universal relationships? There's monotonic, non-monotonic. What would you call everything else?

A Those are the two. It's either monotonic or non-monotonic.

Q What if it's going down? As the exposure increases, the effect --

A Well, the idea of monotonic is it's increasing unless -- the hypothesis is that it's

protective, and that's the hypothesis. Then going like this (gesturing) would be similar to if it went like this (gesturing) for a positive hypothesis -- in other words, if the hypothesis is this chemical protects you from ALS --

Q Uh-huh.

A -- for some reason, and you have this (gesturing,) that's strong evidence. Okay?

If it's TCE in kidney cancer, you would want to see -- I'm using the same hand -- you like to see it going this way (gesturing), right? So it depends on the hypothesis too.

So that's why I say if it's less than zero -- because the hypotheses we're evaluating are not protective. We don't assume these are protective of anything. We assume that either they don't have an effect at all or they're going to have an effect if it was -- but there are instances where some things are protective. In fact, I think smoking -- was it smoking and Parkinson's? I think I wrote about that. Yes. The direction went the other way. Yeah.

Q So just so I'm clear, on these dose-response relationships, if it's a monotonic increasing trend, that, without anything else, supports causality?

A That provides some support, yeah. It's part

of Hill's viewpoints.

Q Right.

A So you can -- you can use that as part of your argument. It doesn't make it definite or anything of the sort.

Q Right.

A It's just more evidence.

Q And if there's a non-monotonic increasing trend --

A It would be helpful to have more information or at least -- at least try to explain why you're seeing that and why, by explaining that, you might be able to provide support.

Q And if you have any other trend, then it does not support causality?

A Well, you wouldn't have any other trend. You either have one or the other. I don't -- it's either non-monotonic, which is not as -- if it -- in other words, it has different shapes, non-monotonic. So it's really monotonic or not, okay? I mean, I don't know what could fit what you're trying to get --

Q If it was decreasing, if every level of a -- you know, you called it protective and it might support a hypothesis --

A If your hypothesis is that it's not

protective and the curve is going that way (gesturing), I wouldn't call that a monotonic relationship. It's --

Q Or non-monotonic?

A All right. Okay, you got me. You could call --

Q I'm just trying to understand.

A You could call it that. Again, you could call it non-monotonic in the sense that it's not increasing with every increasing dose.

Q Okay.

A That's the definition of "monotonic."

Q I thought non-monotonic at least had to show some increase on the curve, just not a linear increase.

A Well, it can go down. You look at some of my splines, they go below 1.

Q Uh-huh.

A So no.

Q Okay. Okay. I think I've exhausted my understanding of that.

Let's look at Table 6 on this.

A Still on the same -- okay.

Q It's on the same page. Page 10 at the top.

A There it is, Table 6. Okay.

Q Table 6 of this study reflects the "Categorization of cumulative exposure variables within

the Camp Lejeune cohort," right?

A Right.

Q And this shows how many people within the cohort were in each exposure level, right?

A Yes.

Q What does the reference level indicate?

A It's similar to saying they're not exposed. If you -- it's the -- it's where you're comparing it to.

Q Okay.

A So instead of comparing Camp Lejeune to Camp Pendleton, you're comparing greater than 1, greater than 155, greater than 380 with the less than or equal to 1 group.

Q So would it be fair to say that the reference level indicates the people who are at Camp Lejeune who are classified as unexposed for the exposure-response analysis?

A For that -- yeah, for residential exposure, yes.

Q And so if you look at the TVOC level, which is the one at the -- at the bottom, would that mean that 57,328 people were considered unexposed to any of the chemicals for this analysis because the total VOC number is less than 1?

A Well, they would have less than 1. They may have had some -- a tiny bit of exposure. Again, residential, yeah.

Q And that represents approximately 37 percent of the entire Camp Lejeune cohort; would that be fair?

A Yes. That's what I have there, yeah. Uh-huh.

Q Would it have been possible for you to exclude these individuals from the Camp Lejeune cohort, in the analysis comparing the Camp Lejeune cohort to the Camp Pendleton cohort, to reduce the potential for the exposure misclassification?

A No. Because, again, they could have had training exposures, and that could be worse, as I said before, than the residential exposure, so no.

Just because there's 37 percent without residential exposure -- and this could be -- it's a weak number, as well, given the information. It does not mean that all 37 percent of these people, or even most of them, didn't have an exposure. Okay? So that's why they can't be deleted.

Again, the -- this is why I don't do it in the more recent studies. This is problematic. We wanted to use the water modeling as much as possible, but really the water modeling made sense for

characterizing people who actually got their exposure almost entirely, if not entirely, residential. And that would be family members who resided in -- on base. Okay? That's -- and that's why we did the water modeling in the first place, was for those studies, the reproductive outcome studies.

Q Okay.

A Stretching it to fit this study was probably not the best idea because of all these issues. And people would say what you just said, "Oh, well, 37 percent were not exposed." That's not true. Okay?

Q Because this is based just on residential exposure?

A Just based on what information we have on residential, which, as I said, has some uncertainty as well.

Q Did you consider doing -- or confining the exposure-response analysis to just those people who had only residential exposure?

A I wouldn't know that. Right. I wouldn't know. If I had that information, I would have done something totally different here. That is the problem, is we don't have information on training.

Q Okay. Did you do any analysis -- did you do the analysis, run the numbers excluding that group of

57,000 people, just to see what it looked --

A No. That's the reference group. No. That's the reference -- you need a reference group.

Q I know, but going back to the Camp Lejeune versus Camp Pendleton analysis -- and I understand your position that if you were to exclude them, that would be exposure misclassification, but did you do that analysis, did you -- did you look at what that would look like?

A So you're saying in the analysis comparing Camp Lejeune and Camp Pendleton, did I remove these people?

Q Yes.

A No. No, I wouldn't even consider doing that.

Q Okay. Let's look at page 12 of the paper, which is the "Limitations" section.

In this section, you state that exposure misclassifications could bias hazard ratios in comparison between the Camp Lejeune (exposed) and the Camp Lejeune [sic] (unexposed) toward the null value of 1.0, resulting in underestimates of the effects of the exposure, right?

A Uh-huh.

Q Is that a yes?

A Yes. Sorry.

Q But as you just said, you didn't do any analysis removing the people who were considered to be unexposed, in the exposure-response analysis from a cohort, to determine what those odds ratios would have been?

A Right, because residential -- again, residential exposure is not the only way you get exposed at Camp Lejeune.

Q Okay. You have a statement at the bottom of that page that "specificity of the exposure classification would be much lower (e.g., between 0.70 and 0.85) because all members of the Camp Lejeune cohort were considered 'exposed' although it is likely that some were not exposed." Do you see that?

A I'm trying to see what I'm saying here.

Yeah, the specificity would be much lower because all members of the Camp Lejeune cohort were considered exposed, although it is likely that some were not exposed. Yes.

Q And what's the basis for that statement?

A It's a guess. How many I thought might not be exposed because they didn't get it residentially and they didn't get it in training. Or if they did get exposure from eating at the commissary, it wouldn't be that important, necessarily. If that's the only source

of exposure, is going to a restaurant at Camp Lejeune, it may not have any effect at all.

Q And then above that, you're talking about sensitivity, and you say "the sensitivity of the exposure classification would be very high (e.g., greater than 0.95) and the false-negative proportion would be very low because very few of those classified as 'unexposed' (i.e., the Camp Pendleton cohort) would have an exposure to these contaminants." Do you see that?

A Yes.

Q And what's the basis of that statement?

A I'm assuming that no one at Camp Pendleton was exposed because the drinking water was not contaminated with these contaminants during this period.

Q Did you do any research into whether there was a potential for exposure to these chemicals at Camp Pendleton?

A I looked at the health assessment. We have a health assessment of Camp Pendleton.

Q That's the ATSDR public health assessment?

A Yes, ATSDR public health assessment.

Q Do you recall what year that was?

A I reference it somewhere.

Q Do you recall having a communication with Dr. Sinks in 2007 saying that there were problems with trying to do a comparison between Camp Lejeune and Camp Pendleton Marines because the Pendleton Marines may have been exposed to contaminants at that base?

A I don't recall a conversation, no.

Q Okay.

A That might have been something he said, not --

Q Okay, well --

A I don't think I said that. That's what I'm trying to --

Q That might be correct.

A Yeah. There always was some question. I remember not only Sinks, but Dr. Funk and -- also asking that question. And they were also questioning whether there were other exposures that might be important, like when you clean your gun and things of that sort. So we had those discussions back then while we were thinking of how we were going to do these studies.

Q Okay.

MR. BAIN: Let me just make this the next exhibit.

(Exhibit 21 marked for identification.)

Q (By Mr. Bain) So, Dr. Bove, I've marked as Exhibit 21 an email between you and Dr. Sinks and others.

A Uh-huh.

Q It's an email chain from April 2007. And take a minute to look it over.

A Okay, I sort of perused it, but in particular what --

Q Yes.

A What are you focused on here?

Q Does this reflect some communication you had back and forth with Dr. Sinks regarding the suitability of doing an analysis of Camp Lejeune versus Camp Marine [sic] populations?

A This is a discussion of what kind of study and whether a study made sense at Camp Lejeune, not more than dealing with Camp Pendleton.

The question -- what I see from Sinks is, "Before we commit to any cohort analysis, we ought to know if we can reasonably estimate exposure," and so on and so forth.

So the issue right off the bat was: Can we do a study at Camp Lejeune? Does it make sense?

And as I said, some of the issues raised were not only do we have an unexposed group, can we actually

properly assess exposure to the Camp Lejeune Marines, and what about other solvent exposures at work and, again, cleaning your gun and so on and so forth.

So at this point -- we were asked in 2005 to do a mortality study, to do a cancer incidence study if it was feasible, and here we are going back and forth as to whether we could actually do one and what it would entail. So that's my understanding of this. That seems to be what's going on here.

Q And if you look at the email that you wrote to Dr. Bove [sic] on Monday, April 2nd, 2007, and if you look at the next-to-last paragraph, it starts "At the CAP meeting." Do you see that one?

A Uh-huh.

Q You mention here, third sentence, "Another approach is to compare the Lejeune Marines to Camp Pendleton Marines, but this may be difficult to do, and the Pendleton Marine may have been exposed to contaminants at that base," right?

A Okay, I see that, yeah.

Q And --

A I'm not sure whether the health -- I had looked at the health assessment at that point or whether it had been published by that point. It probably was either in the pipeline or published by

2007, but I'd have to look that up.

Q Okay, but --

A Again, we were -- I raised -- a number of things have been raised in this memo or whatever, email. A lot of different ideas were thrown around between Dick Clapp's idea of using NIOSH data and so on. So we were at the exploratory point here, so this is a deliberate -- what do you call it, a deliberative discussion, or whatever you want to call it. This --

Q You're right, deliberative process.

A Yes. We're -- you know, we're throwing around ideas. I had no information indicating -- at this time for sure -- that Pendleton had a problem, you know, because I was raising the possibility that Pendleton would be the comparison group, and that's why we're having that discussion.

Q So as far as you can recall, what you did was looked at the public health assessment for Camp Pendleton, and that assured you that there wasn't that problem?

A Right.

Q Did you look at anything else with respect to Camp Pendleton?

A I tried to. I tried to look at water quality statements that might have been online. I searched

high and low, but the only information we had was from that PA, that public health assessment.

Q Okay. Were there any other issues --

A And the public health assessment, now that I remember it, so it must have come out after that, talked about other issues at the base such as -- the same issues that Camp Lejeune had, lead in certain areas because the piping and the kind of -- soft water and so on. There was those issues. There were a few THM issues which also was a problem at Camp Lejeune, and New River in particular.

So it's not like the drinking water was totally clean. It just did not have those contaminants in it. There was some of -- a type of radiation that was found in a groundwater sample, not necessarily in a drinking water sample. So during the -- there was also a pesticide that was detected in groundwater sample. I remember that. Again, not found -- not detected in the drinking water itself.

So there is a potential, but the PHA basically did not -- basically said that this is it, that was the only contaminants, if they were contaminants, in my understanding -- in my recollection of the PHA.

Q Okay. Were there any other issues that you

recall comparing the Camp Lejeune population to the Camp Pendleton population?

A I mean, people raised the issue, and Marine Corps certainly raised the issue, "Well, that's California." I know some people in my agency thought, "Well, you know, they're New Age out there," and, you know, Camp Lejeune -- in fact, one of the reviewers said, "Well, Camp Lejeune, they probably smoke a lot more because it's North Carolina," not understanding that that -- the people came from everywhere and that everybody smoked.

So, you know -- so there were these kinds of things brought up, but there really -- there really was not a better comparison group than Pendleton.

Q Okay. Turning briefly back to the civilian study, which is Exhibit No. 4.

A Uh-huh. Exhibit 4.

Q Go to page 11 of that study.

A Okay.

Q The last full paragraph, which starts with "Another serious limitation." Do you see that?

A Yes.

Q You state, "Another serious limitation of the study was exposure misclassification bias."

A Uh-huh.

Q This is because you assumed that all the Camp Lejeune workers spent considerable time during the workday at the Mainside area of the base --

A Right.

Q -- served by Hadnot Point even though, undoubtedly, some did not work at Mainside, right?

A Yes.

Q And additionally, you didn't have information on the workers' water usage, and some may have been unexposed because they didn't use the drinking water?

A Yes.

Q You also assumed that all the workers resided off base and were not served by contaminated water at their residences, right?

A Right. And I subsequently learned that there may have been some teachers that lived on base.

Q Okay.

A You know, but -- you know, we didn't distinguish teachers from the rest of the workers.

Q Okay. Let's turn to the 2017 assessment of evidence, which Ms. Greenwald asked you about, Exhibit No. 5.

A Yep.

Q You testified, in response to Ms. Greenwald's questions, that you were the sole author of this

particular document; is that right?

A Yes.

Q I notice, though, your name, as far as I can tell, is not listed anywhere on the document.

A Yes, that's true.

Q Is there any particular reason for that?

A I wanted it to be an ATSDR report. I didn't want it identified with me because I felt that if it was -- if my name was the only name on there, they just would say that it's Dr. Bove's opinion --

Q Uh-huh.

A -- and not take into account that it was peer-reviewed twice, went through agency clearance and so on, in other words, the agency stood behind it. So that's why I felt I didn't need my name on it, make it an ATSDR report. The leadership had no problem with that, agreed with it.

Q So there was some discussion at the agency about that?

A Not much. I -- you know, I said it makes sense that we do it that way. They agreed. There wasn't a formal discussion. I just -- if I remember right. I just had a good relationship with Dr. Breysse, and we probably just talked it out informally.

Q Was there any precedence in the agency for this type of report?

A No.

Q So this was the first of its kind?

A Yes. And, again, I think I went through why we did it. We would not have done it if the VA had not requested assistance.

Q Are there any type of reports that you know at ATSDR that do not list who the author is?

A I'm trying to think. Does the survey have our names on it, the report online? Any other reports? I'm not sure.

Q Okay.

A I'd have to say that.

Q So you said that you were the sole author, but there were two peer-reviewers, I believe you said, right?

A Two different sets of peer review. There were two peer-reviewers in the -- in the initial stage, before I did the briefing, in September of 2015. That was David Kriebel at the University of Lowell and Kyle Steenland at Emory.

And then there was a subsequent peer review when the document was written in draft form later in 2016, before it was published on our website, and I

don't remember who those peer-reviewers were. There were -- there were three, I'm sure, just like we normally do.

Q Were those people within ATSDR?

A No, no, no. No.

Q They're external?

A Always.

Q Okay.

A The peer-review process is always external.

Q By the time you got the second peer review, were there any substantive comments in that peer review; do you recall?

A I'd have to look.

Q Okay.

A I'm sure there were some. I don't remember having to change much. There were disagreements. A peer-reviewer comment you disagree with, you -- you can disagree with it and write your reasons, and then the Office of Science decides whether you answered the issue or whether you responded appropriately.

So -- but that was -- whatever comments I got, we solved any of them that might have been problematic, or it wouldn't have been released.

Q So were the peer-reviewers, Dr. Kriebel and Dr. Steenland, were they both epidemiologists?

A Yes, both of them have worked in the field of occupational epidemiology. Kyle Steenland worked at NIOSH before he taught at Emory. David went to Harvard. I was in the same class as him. It's -- well, he may have been ahead of me, but we knew each other from school. He has worked on a lot of exposure-response-type modeling, as well as occupational epi studies, and was a co-author of one of the key books in occupational epidemiology.

Q Would it be fair to say that there were no toxicologists involved in the assessment of evidence in this report; you were the sole author, but no toxicologists involved in peer review?

A No toxicologist was involved in peer review. The tox program made comments, and we went back and forth. There were a lot of disagreements.

And, again, the problem here was the toxicologists are not epidemiologists and do not understand epidemiologic studies or the methodology or how to interpret them. They know how to interpret animal studies.

And so we had a back-and-forth internally. I don't know if there are any documents that you are able to find with that, but there was an internal discussions about the tox.

And some of the -- some of the stuff I did here ended up in tox profile, so it was -- they didn't totally object to what I'm saying in here.

And the other thing is, it's a different purpose. The purpose here is to discuss what evidence there -- what diseases might make sense for presumption at Camp Lejeune, and the tox people at ATSDR have a different mandate. They're looking at chemical-specific, not sites, not -- and what the animal data looks like, what the human data looks like, and so on.

So we're -- we're not really working in the same ballpark, and so that came -- that was part of the problem. We were talking past each other.

But no toxicologist per se was a peer-reviewer. I'm -- but I'm not sure about that because I don't remember who the three peer-reviewers were in the --

Q The second peer review?

A Yeah, I can't remember who they were. I'd have to -- if you have documents, that might refresh my memory and I could tell you if one of them was a toxicologist.

Q Yeah, I don't have any right on the top of my head.

A It was -- you should have gotten --
Q Uh-huh.
A -- that because I identified it in the -- among the files.
Q Okay.
A I'm pretty sure.
Q Okay. When you said the tox program was involved in providing some input, that's separate from the peer review?
A Totally separate. In fact, they did it on -- they decided to do it on their own for some reason. It was not something that Dr. Breysse wanted them to do, let's put it that way.
Q Do you recall who that was?
A It was -- no, I don't. It was a couple of people in the tox program who worked on it, and I can't remember who they were, but they were -- they've been involved with the tox profiles themselves. So this is something they decided to do on their own.
Q Okay.
A You know, I listened to it because there is some material in here that's toxicological, that's mechanistic. As I said, for bladder cancer, I evaluated studies that looked at mechanism.
And so I was interested in seeing how they

felt about those -- that part of the text, because that is something they do know something about. And I can't remember whether they provided useful information on that or not.

Q Okay. Were there any oncologists involved in this report at all, either giving you input informally, like the tox program did, or through peer review?

A Oncologists? No.

Q Okay. Were there any people who held themselves --

A But why would an oncologist have any information on the evidence for an exposure -- chemical exposure and a cancer? Oncologists know about cancers. They don't know about exposures unless they're -- also have background in environmental or occupational health.

Q Right.

A That's part of the problem, okay, with --

Q That's a good -- that's a really good point.

A Yeah.

Q What about people who are experts in these particular chemicals, were there any of those people involved, other than the toxicologist you already mentioned?

A I'm not sure who the other three

peer-reviewers were. I mean, Kyle Steenland has worked with -- as I say, worked at NIOSH, looked at a lot of different occupational groupings. And I'm sure at least one of them would be workers involved with TCE or PCE or both.

So Steenland -- and David Kriebel, he -- his -- I think the exposures he's focused on are more respiratory issues, but I'm not positive. I don't have his CV. But David would know. David Kriebel would know about TCE and PCE.

And Dick Clapp was around to talk to. He was on the CAP. And Dick Clapp knows about TCE and PCE for sure and also knows about cancer. But he was not a peer-reviewer because he's on a CAP. Right.

Q Did the CAP get a copy of this before it was issued?

A I think so. Again, I can't remember when we gave it to the CAP. But either -- when we published it, we certainly gave it to them. We may have given them -- I don't remember --

Q Okay.

A -- I have to say. I have to say. Probably when we released it, we gave it to them, and they also made it available to the Marine Corps. I don't think -- Marine Corps, sometimes we gave them materials

a day or two before so they could handle the press on it.

Q Uh-huh.

A I don't know if they did that for this.

Q Other than what has been mentioned with respect to the tox program and the peer-reviewers, were there any other scientists from any other disciplines who became involved in this report?

A No.

Q Was this submitted to any academic journal for publication?

A No.

Q Any particular reason why not?

A That wasn't the purpose of it. The purpose was, again, to help the VA and their presumption list. And once they put the presumption list, we felt we ought to at least put this out as a report.

Q You mentioned the background of this being to assist the VA with respect to their presumption list.

A Yes.

Q Is that basically true?

A Yes.

Q What -- how did that affect the standards that you used, if at all, in reviewing the evidence?

A It just meant that they gave me six weeks to

brief them.

Q Okay.

A And so it made me have to make quick decisions on classification scheme and to also -- the literature -- gathering the literature together, making the tables and so on. So that's the only impact.

Q At one point this morning, I think in response to one of Ms. Greenwald's questions, you mentioned giving the benefit of the doubt to the veteran. I think that's also mentioned here in this report.

Did that have an effect on how you reviewed the evidence?

A No, that's -- that had an impact on the choice of the classification scheme because they have that position, the VA has that position, and the IOM acknowledged that in determining what kind of classification that made sense for presumption. So I followed that. But that doesn't impact the specific assessments of each of the chemicals and diseases in here.

Q It affects the classification scheme?

A Scheme, yeah. The classification scheme was adopted because it fit the VA's presumption and the way VA does things.

Q Okay.
A And, again, I'm briefing the VA on a program they're going to establish, so I want it to be relevant to what they do.
Q Okay. If you look at the second paragraph of page 2 --
A Okay.
Q -- it states, "ATSDR integrated the findings from its Camp Lejeune studies with findings from studies of other populations exposed occupationally or environmentally to the chemicals detected in the drinking water at Camp Lejeune: trichloroethylene (TCE), tetrachloroethylene (also known as perchloroethylene or PCE), vinyl chloride and benzene."
A Uh-huh.
Q "The purpose was to assess the strength of the evidence supporting causality of adverse health effects from exposures to the drinking water contaminants at Camp Lejeune. This report represents ATSDR's assessment of the state of the evidence at this time." Did I read that correctly?
A Yes.
Q So is it fair to say that this analysis considered the findings of prior Camp Lejeune studies, as well as epidemiological literature, with respect to

the specific diseases and chemicals listed: TCE, PCE, vinyl chloride, and benzene?

A Yes, we tried to integrate those findings. Uh-huh.

Q And the report includes a table of the epidemiological literature for each disease, followed by a summary of the EPA, NTP, and IARC toxicological reviews and the ATSDR's assessment, right?

A Right. For some chemicals and diseases, there wasn't a report. So if there wasn't one, of course, we didn't discuss it. But if there was one by EPA, NTP, or IARC, we discussed it.

Q Okay.

A Uh-huh.

Q On page 7 of the report, there's a section entitled "ATSDR's Methods Used to Assess the Strength of the Evidence for Causation."

A Uh-huh.

Q Do you see that?

A Yep.

Q On page 8, if you turn it, and it's in this section, it's the last full paragraph, it says, "In the disease-specific tables, 95 percent confidence intervals were provided in order solely to indicate the level of precision or uncertainty in the effect

estimates. An effect estimate (e.g., risk ratio, odds ratio, or standardized mortality ratio) was considered to have good precision (or less uncertainty) if the ratio of the upper limit to lower limit of its 95 percent confidence interval was less than or equal to 2," right?

A Uh-huh.

Q Is that yes?

A Yes. Sorry.

Q That's okay. It's common.

So then that's what we talked about before, is the confidence interval ratio, right?

A Yes.

Q And as you mentioned before, there's no standard in epidemiological [sic], setting it at a particular number?

A Or in a statistical setting, no. There -- it's a judgment call.

Q So --

A What you decide.

Q So would it be fair to say that using less than or equal to 2 was your judgment call with respect to the precision needed?

A Yes.

Q And what would you explain as the purpose of

using a ratio of less than or equal to 2?

A Well, again, it's not -- was not meant to be a dichotomous thing, like a .05 p-value, which is just as arbitrary, by the way, as a confidence interval ratio of less than or equal to 2 or any other value.

But I thought that if it has a confidence interval ratio that tight, that's good -- that's darn good precision. Higher than that doesn't mean it's got bad precision. Of course, if you a confidence interval ratio of 4, 5, 6, 10, then we're talking about very little precision. So it's a continuum. It's not yes, no, good precision. It's a continuum.

Q So what would be the effect of changing that number to 3?

A I don't think it would have much effect at all.

Q Okay. If you look to page 30, and I believe this is the table for non-Hodgkin's lymphoma. Can you confirm whether that's correct or not? It goes back to page 23. I think it's the table that starts on page 23.

A So this table goes on. Okay. Let me double-check. Okay. Yeah, yeah. Okay. Okay.

Q Okay. I want to focus on the part of the table that has the Camp Lejeune studies.

A Yeah.
Q So for NHL, the assessment of the evidence found sufficient evidence of causation, right?
A Yes.
Q With respect to the specific Camp Lejeune studies, the hazard ratios in both the Marine/Navy mortality study and the civilian workers mortality study were less than 1, right?
A Right. This is causes of death, yes.
Q Which means that there were fewer NHLs at Camp Lejeune than there were at Camp Pendleton, controlling for other factors?
A Right, for causes of -- as a cause of death, yeah.
Remember, non-Hodgkin's lymphoma is a survivable cancer. It's a cancer of older ages, and this is a young cohort. So it's included in here because it's done -- it was done, it was analyzed, but the other studies in the occupational field were much stronger on this issue.
Q Okay. Let's look at the table for bladder cancer.
A Do you know what page?
Q The Camp Lejeune study's on page 89. The table, I'm sure, starts before that. The table starts

on page 86 --

A Uh-huh.

Q -- and the Camp Lejeune study's on page 89.

A Right.

Q Bladder cancer, the assessment of evidence found sufficient evidence of causation, right?

A Right.

Q The Camp Lejeune studies, both the Marine/Navy mortality study and the civilian worker studies, show the hazard ratio of much less than 1, right?

A Right. For civilian workers, it's based on only two cases.

Q Okay. But it's based on much larger cases for Marine and Navy?

A Eleven.

Q Okay. And so what this indicates is that more individuals at Camp Pendleton had bladder cancer or died of bladder cancer than those at Camp Lejeune --

A Yes.

Q -- controlling for age and other factors?

A Right. That's what -- yeah.

Q Okay. Let's go to page 3 of the report, and I think Ms. Greenwald asked you about this as well. If you look at the paragraph right before the "Methods"

section, it states, "A Marine in training at Camp Lejeune consumes an estimated 6 liters of water per day for three days per week and 3 liters per water [sic] the rest of the day [sic]." Do you see that?

A Yeah. No, no --

Q "Per day for the rest of the week." I'm sorry. I misstated that.

And you cite the ATSDR 2016 for that statement, right?

A Yes. It's the public health assessment at Camp Lejeune, yeah.

Q Do you recall what the public health assessment relied upon for that statement?

A There were at least two -- one document, probably two documents, where the information was mentioned. And I think I found them and gave them to the health assessment, but I don't have -- I don't know if I have referenced it anywhere. They referenced it. So if you've got the health assessment, you can see the references.

Q I think you referenced it in --

A Did I reference --

Q -- your mortality study.

A The new one or the old one?

Q 2014.
A Let's see.
Q Wait. Maybe not.
A No, I don't think so. I don't think I found it until after that.
Q Okay.
A I think it came up because the health assessment wanted to have some notion of how to evaluate the exposures that a typical person -- a typical Marine, a typical civilian worker, a typical resident, a dependent would get. And so we scoured around looking for articles that would tell us this.
Q Okay. If you look back on page 3, the next sentence says, "Under warm weather conditions, a Marine may consume between 1 and 2 quarts of water per hour and shower twice a day." Do you see that?
A Yes.
Q And you cite --
A Right.
Q -- Bove 2014a, which I think is the --
A Yeah, it's the Marines study. I'm not sure where I got that from, so I'll have to look, if that's the same document.
Q I believe that's Cite 30 in that particular document.

A Oh, yeah. Oh, yeah. Okay, so that's -- that -- now I remember. That is one of the two I'm talking about.

Q Kolka 2003?

A Yeah, yeah. Aviation, Space, and Environmental Medicine, yes. Yep. There was another one, I thought, too, but it's not listed here. I may have found that later.

Q I'm going to make the Kolka article an exhibit.

MR. BAIN: Can you get that?

THE WITNESS: Oh, you have it.

MR. BAIN: Yeah.

THE WITNESS: Okay.

(Exhibit 22 marked for identification.)

Q (By Mr. Bain) Dr. Bove, I have shown you what's been marked as Exhibit 22. Do you recognize that as an article by Kolka, et al., on "Current U.S. Military Fluid Replacement Guidelines"?

A Yes.

Q And is this an article that you cited for the statements regarding a Marine's water consumption?

A Let's see. So this is one of the two. I think there's another one that -- again, if you went back to the health assessment, you could confirm that

there is -- whether there was another one. I seem to remember that there was.

Q Okay.

A Because I don't see -- this -- the first -- the first statement, where it actually breaks it down by -- in the same way I have it here, so -- I'd have to go through this and look it over anyway. But I would again refer you to the health assessment because that's where they reference it and that's -- I wasn't involved other than to help. I was not involved in writing the health assessment.

Q But you believe there's another article aside from this one?

A I think so. So -- but, again -- because I don't -- it was clear to me in one article that -- and it was clear to the people writing the health assessment that it was 6 liters of water per day for three days and 3 liters for the rest of the week. And it was specific for Marines. Not specific for Marines at Camp Lejeune, but Marines. And I don't see that here. So I think this is the source for the other statement, the 1 to 2 quarters -- 1 to 2 quarts of water per hour.

Q Okay.

A I think that's where this -- that came from.

But where the other statement came from, I think it's another document.

Q I'll try to run that down tonight.

A Yeah.

Q But with respect to this particular study --

A Uh-huh.

Q -- were you aware that this study was focused on -- I'm going to mispronounce this -- hyponatremia?

A No.

Q Do you know what hyponatremia is?

A My guess is just dehydration, but I do not know for sure.

Q My understanding is hyponatremia is having ill effects from drinking too much water. Have you ever heard of that before?

A No.

Q Okay. Do you know whether the -- and this study appears to be focused on whether or not the guidelines that the Marine Corps had could result in hyponatremia.

A Uh-huh.

Q Other than that other study you think might exist, are you aware of any studies regarding how much water Marines at Camp Lejeune actually drank during training?

A No. But the Marine Corps did review the health assessment. I saw that statement and --

Q Okay.

A -- had no problem with it, as far as I know.

Q And ATSDR independently never investigated Marines' actual water consumption habits at Camp Lejeune?

A I think we -- in the survey, we might have asked. But the problem was you're asking them now what they drank 20 years ago, and you never get good information doing that.

So I -- if we did ask in the survey, the health survey, the big one, whether -- how much they drank, I don't think the information would have been useful anyway, so we may not have asked. So I --

Q Would information about how much water Marines currently drink in training have any value to you in determining -- making determinations on this?

A It might. Again, I wasn't -- the purpose -- it depends on what your purpose is. For the purposes of the public health assessment and trying to figure out what the typical person might have been exposed to and what the health effects might be, yes. For the epidemiologic studies, no.

Q Why not? Why the distinction?

A Just not as useful. I mean, you won't know whether -- what individual drank how much, even with that information. It's only good for the typical person. Okay.

Q And you believe -- because I didn't see anything in the Kolka article about the showering habits of Marines. You believe that might be in the other document that's referenced?

A I believe that that -- but I'm not -- I don't know for sure, so I want to be honest. But I think there were two documents. I seem to remember two documents. But, again, you can check the health assessment. It should be referenced there. And if it's not -- if it's not clear there, you need to talk to someone who worked on that health assessment --

Q Okay.

A -- if you can still find them.

Q If there is another document, it either should be referenced in the health assessment or the person who did that assessment should know what the statement is based on?

A Yeah, but I think it has -- they really should reference it. If they didn't, they were neglect -- negligent, but they should have.

Q Negligence, that's a word we've got to watch

out for.

A I'm sorry. I don't want to use that term either. They should have made the references known, yeah.

Q Okay. At the end of that paragraph, you say, "It is likely that during training, the water supplied in the field came from the Hadnot Point water system with both measured and estimated levels of TCE and PCE substantially higher than their MCLs," right?

A Uh-huh. Yes.

Q And what's the basis of that statement?

A Again, discussions with the Marine Corps where water was -- where the water for training came from and -- and the water buffaloes. That's my memory of it. There may have -- I don't remember a document saying it specifically, but there may have.

Again, you may want to check the public health assessment to see if they discuss it and if they have a reference.

Q Are you aware of whether ATSDR did any investigation of where the water fill points were at Camp Lejeune?

A Where the?

Q The places --

A Where the -- no, no, we did -- we did not.

Q So ATSDR would be not have been familiar whether there were water fill points for the water buffaloes on both the western and eastern side of New River?

A I wouldn't know that, no.

Q Are you aware of where the training areas were on the eastern and western sides of New River?

A No.

Q Do you know how many miles the training areas on the western side of New River are from Hadnot Point?

A No idea.

Q Do you have any basis to state as a fact that the water buffaloes were filled at Hadnot Point for training exercises on the western side of New River?

A Was that said here in this sentence? What we said here is that if you were -- well, what was implied here, I think, is that if you were training on Mainside, where a lot of the training occurred, your water buffalo would have been coming from Hadnot Point. If you were training at New River, obviously the water might -- it would come closer to where that training is. But that's not what we're saying here.

What we're saying here is that much of the training, if not most of the training, was in the Hadnot Point or Mainside vicinity and that the water

would come from there.

Q Okay. Yeah, I understand that now, and that helps clarify this sentence because it just refers to training generally, not training --

A Yeah, we should have made that clear, I agree. Okay.

Q I think you answered this this morning, but why does the report compare levels of TCE and PCE to the MCL?

A Just as a reference. This is the background section of this assessment. Just, if people see -- we did this for the studies too -- if people see 1400 parts per billion, what does that mean? If they see benzene at 12 parts per billion, what does that mean? I mean, they -- you know, people aren't -- who are not drinking water experts might have a problem understanding what that might mean.

Let's -- I know that the Marine Corps doesn't like it when we mention MCLs because they keep saying that they weren't in place when the drinking water was contaminated. This is a true statement, they weren't, but that's not the point I'm mentioning. The point is, again, to give people a sense of what -- how high this -- how high this contamination really was.

MR. BAIN: Do you want to take a break?

THE WITNESS: No, let's --
THE COURT REPORTER: I would like to take a break.
MR. BAIN: Okay.
THE VIDEOGRAPHER: The time is 4:12 p.m. Going off the video record.
(Recess taken.)
THE VIDEOGRAPHER: We are back on the record. The time is 4:23 p.m.
Q (By Mr. Bain) Okay, Dr. Bove, I want to keep talking a little bit about the assessment of the evidence --
A Uh-huh.
Q -- which is Exhibit No. 5. If you turn to page 5 and the last paragraph of page 5, it says, "The classification scheme adopted for this report is the one recommended by an IOM panel that reviewed the VA's presumptive disability decision-making process for veterans," and you cite IOM 2008. Do you see that?
A Yes.
Q And we talked a little bit about that earlier -- or you did with plaintiffs' counsel.
Are you aware whether or not the IOM ultimately adopted this recommendation for the classification scheme?

A It was not for their purposes. I think the report, if I recall, is for the VA's purposes, the idea that -- but in many instances, the VA then turns to IOM and asks them to do an assessment, like Gulf War or -- so on and so forth.

So -- but my understanding is that this -- if the VA was going to have a presumption program and wanted to assess, they should use this classification -- or at least they were recommending that classification scheme.

Q Do you know whether the VA ultimately ever used that particular classification scheme?

A I don't -- that's a question for the VA because they claim that they did their -- they looked at this, but they have their own assessment. I've never seen their -- a real assessment from them. I saw some brief tables that a toxicologist put together, and I don't know if that went anywhere. So I don't know if they used this or not.

Q You're aware that the NRC, in their report on Camp Lejeune, used a different classification scheme?

A Yes. Yes.

Q How would you characterize the difference between the classification scheme that the NRC used and the one that you used?

A Well, the one that they used is more in line with -- I think with the Agent Orange, which is sufficient evidence, I think it was, then there was statistical association, and then there was limited, and then non -- or whatever the heck it was below that. So it doesn't quite fit with -- I mean, sufficient evidence would be the same.

Q Uh-huh.

A The equipoise and above could be a combination of some of the limited and some of the statistical. So it doesn't fit exactly. It's a different -- it's a different classification scheme because of -- the focus was of the VA, and the NRC was using just a classification scheme that they had used for Agent Orange. IOM, but, you know, the same entity, National Academy, so...

Q So would you say that this classification scheme that you used was more lenient in any way than the classification scheme that the NRC used?

A No. In fact -- no, no. It's different. It mirrors the fact that the VA has this policy. So if the VA has this policy of giving the veteran the benefit of the doubt, then you want to tailor a classification scheme to their -- the way they -- their policy. So that's -- that's my understanding, again,

of why IOM recommended this classification scheme.

Q And how does this classification scheme, in your view, give the veteran the benefit of the doubt?

A Well, having an equipoise and above does that. And I think that's what the IOM thought.

Q Okay. The next sentence of the report says, "This scheme makes clear when the evidence for causality is 'at least as likely as not' or at the level of 'equipoise and above.'" Do you see that?

A Yeah.

Q What do you mean by that?

A Just that -- I'm not sure what I mean by that, I have to say. Just -- it's basically a restatement of what the classification is, there's -- that there is a classification level called "equipoise and above," which means "at least as likely as not." I mean, I don't know that there's anything more that that sentence is saying.

Q Are you trying to contrast it to the one that the NRC used?

A No, no, no. I think it's just trying to define what that level is. It's at least as likely as not, and we're calling it equipoise and above. I think that's what the sentence is all about.

Q What methodology did you use to weigh the

evidence to determine which category applied to the relationship between the chemical and the disease?

A Okay, that -- some of that is mentioned on page 6 and some on page 7. So for sufficient evidence, I had a couple of rules there, one -- two rules in particular. There is sufficient evidence from human studies in which chance and bias, mostly bias, can be ruled out, because that really is the main reason, the main issue.

And the second one is that there's less than sufficient evidence from human studies, but evidence from other sources, animal studies, mechanism, whatever, that is relevant to humans.

So -- and then I give some of Hill's viewpoints under that that I use in assessing a study's quality and what -- and assessing the evidence that a study can provide.

And then the next level was equipoise and above, which that previous sentence we talked about is describing. And there, there's less information than sufficient evidence. There's -- there may be only one high-quality study, but a meta-analysis may be inconclusive, you know, so -- but there is at least one high-quality study that pushes it above the next level, which is there's not enough information here to make a

determination almost, and that's below equipoise.

Q And how did the odds ratios and confidence interval ratios in particular studies factor into this classification scheme?

A Right. The point estimate, the odds ratio, the SMR, the relative risk --

Q Uh-huh.

A -- the hazard ratio, depending on the study, what they used, is the key element, key -- that's the key, along with, of course, temporal, but we all assumed that there was a temporal relationship with these studies that are included in here. So the rest of Hill's criteria are how -- what's the magnitude of that point estimate.

And the next thing is what the exposure-response relationship looks like, if there is one, if they did that. And then whatever other information makes it biologically plausible, including animal data and mechanistic data and so on.

If the studies are pretty consistent, you see something that's somewhat the same kind of effect, not the exact same point estimate, but in the ballpark across studies, that's helpful.

If you understand why there are differences, because the exposures might have been less at one plant

than at another, one study than another study, or something of that sort, that's another thing to take into account.

So that's what -- that's how the assessment is done. And, again, some of the work was done already for me by the meta-analysis done by NCI, by EPA, by IARC, and so on.

Q Okay.

A Yeah.

Q So for the third factor in the Hill criteria, the magnitude of the effect, you're looking at the point estimate, which could be the risk ratio, the odds ratio, the SMR. And is that where you integrate the 1.2, and looking at a confidence interval ratio of less than or equal to 2, and to the analysis? Is that where that comes in?

A The -- I think that the confidence interval ratio really doesn't come into the assessment unless the -- there is such a wide confidence interval that you can't really have any confidence -- I hate to use that term -- that there's so much uncertainty in the point estimate.

The magnitude of the odds ratio absolutely does impact the assessment. Whether it's 1.2 or higher is not necessarily -- again, there's no cutoff.

Everything is a continuous measure and a judgment call throughout, you know, and so -- so that's how the assessment was done.

Relies on work that others have done, as I said, if they've summarized -- you know, if EPA has summarized the evidence themselves and I think it's a good summary, then I go with that because -- unless there's additional studies that even provide more support or whatever.

Q So would it be fair to say there's no particular algorithm, but a lot of it is just dependent on your judgment as an experienced epidemiologist?

A Yes. There's no specific algorithm. It uses whatever information we have on that chemical and that disease. At the time, up to 2016, middle of 2016.

Q Okay. You were asked about this a little bit by plaintiffs' counsel, but she stayed on pages 8 and 9, when you're talking about the Hill criteria or Hill viewpoints, as you refer to them, that the assessment of the evidence considered some of the viewpoints associated with Hill.

A What page are you on?

Q Pages 8 and 9, bottom of 8 and over to the top of 9.

A Oh, bottom of 8. Okay. Some of the -- okay,

here it is. Uh-huh.

Q And these are also referred to sometimes as the Bradford Hill criteria, right?

A People do call it a criteria. He did not.

Q How do you -- how do you distinguish "criteria" from "viewpoints"?

A "Criteria" has a stronger connotation to it. What he is suggesting here is these are things to think about when you're trying to make a case for causality, so if you think about it that way. These are -- you know, may want to touch on the size of the relationship.

Now, of course, as I said, you can't have a relationship at all if it's not temporal. If the exposure happened after the cause, you know, it's -- but the other ones are points that you may want to raise in making a case.

That's pretty much how he's -- if you read the original article, that's where he's coming from. He doesn't use the word "criteria" and doesn't want to -- doesn't want these to sound like hard-and-fast -- or an algorithm or anything of the sort. So I take the same position on it.

These are -- these are qualities or issues or whatever you want to call them, viewpoints, that should

be looked at when you're assessing the evidence.

Q And one of them that was discussed earlier, that is not even here considered a viewpoint, was specificity. And you mentioned earlier in your testimony that you didn't consider this to be particularly relevant to environmental exposures, that it was more applicable to infections. Is that --

A I'm not the only one who thinks that.

Q Okay.

A Right. But yes.

Q But that's what you said, right?

A Yes. And I agree with those who say that, yes.

Q And when you say you're not the only one who says that, is there any particular reference that you can point me to that says you shouldn't apply this to environmental exposures?

A I'm not sure. If you look at Modern Epidemiology, they discuss Hill's criteria. Actually, they -- okay, I used that term. Hill's viewpoints. They are pretty negative about using Hill's viewpoints, actually, at all, if I remember right, but they may have a discussion there. There may have been a discussion in Savitz's book. It's just general knowledge that there are certain viewpoints that make

sense to use and others that don't in any particular situation.

In occupational and environmental health, we never use specificity because it's not -- there's no exposure we can think of that it only causes one disease. Even asbestos. It causes mesothelioma, yes, but it also causes lung cancer and other -- and possibly gastrointestinal cancer, you know.

Certainly the chemicals we're talking about here could cause a multitude of different cancers, so why -- specificity doesn't make any sense to use.

Q Okay. Well, if I state the principle this way -- I'm going to ask you whether you agree with it or not.

A Okay.

Q "When an exposure is associated with only one or a small number of health outcomes, it is more likely to be causal than when it is associated with many health outcomes. The reasoning is that finding an inordinate number of conditions that are associated with exposure suggests some form of bias."

Do you agree with that statement?

A No, because I -- yes and no. There -- if -- what is an inordinate amount? I mean, I would have to unpack that definition. What is -- this is my

philosophy training here -- what's the inordinate amount?

Certainly, a chemical like TCE could because kidney cancer, non-Hodgkin's lymphoma, Parkinson's disease, and so on. Is that -- you're going to rule it out then because it shouldn't have so many endpoints? I mean, smoking --

Q Uh-huh.

A -- we're going to rule that out because it has all these different endpoints. Does that mean there's bias? So that's what I'm trying to say. It's not a useful viewpoint, and I'm sure Hill would say the same for this -- for these -- for this context.

In infectious disease, it makes a lot of sense, and he's writing these viewpoints with the idea of both infectious and non-infectious disease. And so he lists viewpoints that you can consider. Again, he's not saying this is a checklist, okay --

Q Uh-huh.

A -- he's not saying you have to use all of them or most of them. These are just suggestions on how to address the issue of causality, the evidence for causality. So I wouldn't agree with it.

Q You wouldn't agree with that statement?

A No, not entirely, because I think there are

many cases where that wouldn't fit.

Q With respect to biological grading or dose-response --

A Uh-huh.

Q -- you include a parenthetical -- and I'm looking at the top of page 9, and this is No. 4, "exposure-response relationship." You say "although the relationship could be non-linear or non-monotonic." Do you see that?

A Yes.

Q And is that included in Hill's discussion of that relationship?

A I'm not sure it is or it isn't. I'd have to go back and look at Hill. Again, I -- he doesn't have a hard-and-fast rule about what a gradient would look like. That, I seem to remember. But I'd have to go back to the article to see it. But that goes back to our earlier discussion that if you have additional information as to why it's non-monotonic or you had some information as to -- well, if you have information on why it's non-monotonic and it refers to evidence that would support it, then -- so...

Q Okay. Let's turn back to page 5. And at the bottom of that paragraph, you -- in the last sentence, you say -- this is in reference to the classification

scheme that you're using -- "Additionally, the scheme is one that is already in use by the U.S. Department of Veterans Affairs (VA) in its decision-making concerning compensation for service-related disability compensation claims. The issue of compensation has been of major concern for the Camp Lejeune community." Do you see that?

A Yeah, so I wasn't -- maybe I misspoke when I said they haven't used it. Maybe they have used it on certain of the presumption -- for example, for -- I'm trying to think. They do have one for Agent Orange, but they -- how they decided on that, I think it was based on the IOM's classification.

So I'm not aware -- I guess I'm confused here. I'm not sure where the Department of -- where the VA used this classification scheme --

Q Okay.

A -- and whether they have. That's a question for the VA, I guess.

Q What I want to focus on is the sentence, "The issue of compensation has been of major concern for the Camp Lejeune community."

A Yes, it was.

Q And why did you consider that to be something that should be included here in this evaluation of

scientific evidence?

A It could have been in the background instead, more appropriate in the background section.

Q But why would that be relevant at all to include in a report like this?

A I think that it's important to state what the community -- the affected community, what their concerns were in a study or a report, if you can, if it makes sense to do that. I think this sentence probably is in the wrong place, but I don't see why it wouldn't be in the background section.

Q Okay, so --

A I agree with you, it's not a scientific statement --

Q Okay.

A -- or have anything to do with the evaluation of the assessment of the individual chemicals and diseases.

Q So you're saying it might be misplaced in the "Classification of Evidence" section?

A Yeah, yeah, probably was.

Q Okay. If you turn to page 13, this is a chart you referred to earlier, which is, I think, the overall summary --

A Yes.

Q -- of the evidence.
A Yes.
Q The diseases that you classified as sufficient evidence of causation for at least one of the chemicals are kidney cancer for TCE, NHL for TCE and benzene, leukemia for benzene, liver cancer for vinyl chloride, bladder cancer for PCE, and cardiac defects for TCE, correct?
A Yes. I don't think I see any other ones. The other ones were equipoise and above, yeah.
Q Yeah. So the other diseases you classified as equipoise and above evidence for causation for at least one of the chemicals are NHL with PCE; multiple myeloma were TCE and benzene; leukemia is TCE; liver cancer, TCE; Parkinson's disease, TCE; kidney disease, TCE and PCE; and systemic sclerosis/scleroderma, TCE?
A Yeah.
Q Correct?
A Yeah.
Q For the other diseases you looked at, which were pancreatic cancer, prostate cancer, breast cancer, esophageal cancer, rectal cancer, and brain cancer, the evidence was all right below equipoise?
A Right, uh-huh, as of 2016. And, again, some of this might have changed with the recent literature,

if this was updated.

Q This was -- this study was done in 2017, and you included some other prior reviews that had been done by EPA and IARC and NTP, is that right, or NCP?

A Okay, it was -- most of the work was done between July or August of 2015 and January -- well, by January 2017, the work had been finished and peer-reviewed and everything else. So most of the work was done between, say, July or August of 2015 and mid 2016.

It's not a study. That's second thing. It's an assessment, similar to a systematic review, though systematic reviews can have an algorithm or some other method, so we don't call it a systematic review.

Q Okay, so it was an assessment. Most of the work was done in 2016?

A And late 2015.

Q Late 2015.

A Yeah.

Q And it included, I think as we discussed earlier, a review of the systematic reviews that had been -- or inclusion of the systematic reviews that had been done by EPA, IARC --

A NTP, National Toxicology Program, yeah.

Q And then you also did PubMed research of --

A Yeah.
Q -- any epidemiological studies that might have been done?
A Right.
Q But I notice, by its absence, was the National Academy of Sciences' 2009 report, which was a review of evidence, some of the same relationships between these diseases and these chemicals. Any particular reason why that was not mentioned at all?
A Yes. I thought that their review was inadequate, to be nice. Seriously, for them to say that there was limited evidence for kidney cancer at a time when it was obvious that there was sufficient evidence or very close to being it, the fact that no disease made it beyond -- made it above limited, but we know that benzene causes acute myeloid leukemia, where we know that many of these things I'm saying as above equipoise or equipoise and above should at least have been in the statistical association. So, to me, that report is useless.
Q So you disagree with the judgments made by the scientists?
A I think it's useless, yeah.
Q Okay.
A Yeah.

Q So for that reason, you didn't -- you didn't mention it at all?

A Right, because the other -- the other documents, the documents from EPA, NTP, IARC, were far and away better and later, too, than theirs. And I just felt that those were the reliable sources. They are the ones mandated to look at these chemicals and make an assessment. NRC responds to questions provided to them by the entity that pays them. That's a different situation. Okay?

So if we're talking about EPA, they have a mandate to do this kind of analysis, so does IARC, so does NTP, so that's why I rely on them. NRC does great meta-analyses. I rely on that. They have -- their mandate is to do good research.

NRC, in this case, was to respond to the kinds of questions that they were paid to look at. And that's different.

Q Have you ever referred to or relied upon studies done by the National Academy of Sciences?

A I've written -- I've been a part of three books with the NRC -- the National Academy of Sciences, I should say.

Q But at NRC?

A Well, I guess it was the NRC at that point.

It was back in -- I can look at my resume, whether I put NAS or NRC. But we were asked -- in that situation, we were asked by EPA to come up with a new method of evaluating emerging threats to drinking water and how would you do that, what kind of algorithm you would develop. So that was our mandate, and that's what we did in those books. Whether EPA did anything with that is another story, but that was the mandate for that.

The mandate -- I'm not sure what the exact questions were that the Navy gave to the NRC for that NRC report, but it certainly wasn't to do a thorough assessment, because they did not do it, of the diseases and the chemicals, so...

Q Wasn't the mandate actually from Congress but the study was funded by the Navy?

A No, my understanding is that the Navy provided the questions.

Q That's your understanding. Okay.

A That's my understanding. That's what I was told, so...

Q You referred to one authoritative treatise today, which was second edition of Interpreting Epidemiological Data [sic] , right?

A Savitz's focus --

Q He's the author of that book, right, David Savitz?

A Yes, he is.

Q And you're aware that he was a chairman of the NRC committee?

A Certainly was, yes. Yes. Just because I like his book does not mean I like everything he does. I do think it's a useful book, and I have -- you know, again, Modern Epidemiology is extremely difficult to slog through. And as I said, it is the key book for epidemiology, but it's difficult. And Savitz's book is written in a way that most epidemiologists could follow in terms of at least interpreting -- how to interpret studies.

Q Okay.

A So...

Q That's helpful. Okay, I'm done with this for now, and I'm going to start -- we're making headway. I want to turn to the 2018 morbidity study. I don't think --

MS. GREENWALD: I didn't mark it.

MR. BAIN: You didn't mark that one?

(Exhibit 23 marked for identification.)

Q (By Mr. Bain) I'm showing what's been marked as Exhibit 23. Can you identify this as the "Morbidity

Study of Former Marines, Employees, and Dependants Potentially Exposed to Contaminated Drinking Water at U.S. Marine Corps Base Camp Lejeune"?

A Yes.

Q And were you involved in this study?

A Yes.

Q What was your role?

A To help with the -- well, let's start with the protocol, which I would say was co-written with Perri Ruckart -- I don't think I wrote it entirely by myself -- and was involved in the -- in the data management, like I've done with all the studies. I didn't mention that, but I've been involved with the data management for all the studies, and some of the analyses. And I'm also -- you know, gave advice to Perri on her analysis of this.

Q Other than you and Dr. Ruckart, was anyone else involved in the study?

A The contractor. I forget which contractor. And I don't know if they mention it in here.

Q Yeah, I didn't see any names listed on this study either of contractors.

A Yeah. Okay. Yeah. I don't mention the contractor --

Q You just don't recall who it was?

A Right. We had -- I'm also blanking on -- we had RTI at one point for some studies. We had another -- I forget the one in the D.C. area. I'm blanking on it. Sorry.

Q Okay. Was this study ever submitted to any peer-reviewed journals?

A No.

Q Why not?

A Because the participation rate was so low. And also, we really couldn't verify the outcomes, so -- we tried. Some people sent in their medical records, but there was extreme limitations.

It was mandated by Congress that a survey be done. We were supposed to just supply the questionnaire, and the Navy/Marine Corps was supposed to actually do the survey, if I remember, legislation, but we decided that we would take it on. I don't think the Marine Corps wanted to take it on.

And we thought we might be able to use this as a way of getting at cancer and other diseases that we couldn't get in the mortality study, but we -- but it didn't turn out that way. And so we didn't send it to a journal because we thought it was a very limited study.

Q Did the study undergo any peer review at all?

A Nothing gets done without a peer review.
Q Okay.
A No, it was peer-reviewed.
Q And can you describe what the peer-review process was for this study, if you recall?
A It's the same. They use outside peer-reviewers that either we recommend to the Office of Science and/or they add to it or they decide who it is.
Q And --
A Also, in this -- in this -- now things are coming back. We did have a panel to look over the protocol for this study, as well, because we are not experts in survey research. We wanted to bring in some people who were, and so we did. And, again, my recollection is good. Both Perri and I worked on the protocol, and it went -- we presented it to this panel as well, so -- but be that as it may, still the results of the study were that we had a low participation rate, and we didn't really feel that we could make a lot out of this, unfortunately.
Q The study included both a cohort study and a nested case-control study, right?
A Right.
Q And I understand the cohort study which

compared Camp Lejeune to Camp Pendleton. What was the nested case-control study?

A Do you know what page we're -- because that might help my memory.

Q No, I don't know. I don't know.

A Okay. This is, again, trying to use the residential exposures.

Q So that would refer to exposure-response analysis?

A Huh?

Q Would that refer, then, to some type of an exposure-response analysis?

A Yeah. Yeah, I mean -- yeah. So let me look this over because my memory is not good for this study.

Yeah. Okay. So two different types of samples were taken here. And a case -- case control is really a sampling method.

So the first one, we were interested in, say, kidney cancer, for lack of a better -- okay, so we get all the kidney cancers. And the first analysis includes Pendleton, so we get all the kidney cancers regardless of which base --

Q Uh-huh.

A -- okay, and then we take a random sample of the people without that disease from -- a random sample

which includes people from both bases.

Q Uh-huh.

A And that's the first analysis. And then there's the internal analysis, which we would then -- instead of having Pendleton in the sample at all, it's all just Camp Lejeune, and the idea there would be your -- the reference group would be those people who had no exposure -- or no residential exposure, I should say, as the reference group, just -- okay? So that's how we did that.

Q I see.

A And we did that in order to see if we could get better information, we could use the family housing records and their survey information to try to get at where they were on base.

One of the things about -- I didn't mention before about -- the family housing records, trying to match them with the DMDC data, just for your knowledge, is difficult because the family housing records has their name -- sometimes they have a middle initial for middle name, sometimes they don't have that middle name -- and rank, and then the place where they lived and the dates. Okay? Trying to match that with the DMDC data, when there's so many common names, was very difficult.

Q Uh-huh.
A We tried to do it. We had a contractor do it. I tried to do it. I'm sure that a lot of the matches were not correct because of that problem of trying to go from one to the other. But you would have to do that to do a good job of using that -- you would have to link the two.
Q Right.
A And so I think what we're thinking about here is we -- if we had a smaller group of people, we could more intensely see if -- but we'd still have this problem. We still had this problem, yes. So that's -- so you understand what --
Q Yeah.
A -- [indiscernible] case control --
Q Got it. Got it.
A Okay.
Q Thanks. That's helpful.
A Yeah.
Q I didn't understand that before.
So it appears that you sent out or someone sent out about 250,000 surveys --
A Right, our contractor, yeah.
Q -- contractor did -- for those who were present at either Camp Lejeune or Camp Pendleton in the

mid 1970s through mid 1980s, right?
A Yeah.
Q If you look at page 65 of the report, Table 1, for the Camp Lejeune Marines, you've got about a 25 percent completion rate, right?
A Something like that. Let me see.
Q In the first column, 25.2 percent.
A Yeah. Completed a survey, yeah.
Q And for Camp Pendleton, you got 23.3 percent?
A Yeah.
Q And --
A Yes. Yes.
Q That's true? Okay.
You also asked the participants to complete a HIPAA form so you could confirm the reported diseases; is that right?
A Yes.
Q And there was a larger percentage of Camp Lejeune survey respondents who complied with that, completing the HIPAA form, than the Camp Pendleton respondents, right?
A Yes.
Q And for about 50 percent of Marines and 40 percent of civilians, you could not confirm the diagnosis because a HIPAA form was not completed; is

that true?
A Where are we?
Q That's on page 55.
A Okay. Fifty-five or sixty-five?
Q Fifty-five, I think. Yeah, look at 55, middle of the page. You see where it says --
A Yeah, yeah, yeah. So that's another limitation. As I was saying, we didn't -- we couldn't confirm a lot of the reports --
Q Okay.
A -- reported diseases.
Q And I think you mentioned before and you're familiar with the term "epidemiologist selection bias"?
A Yes.
Q And it was a significant limitation for this study, would you agree?
A Yes.
Q And that would be because people at Camp Lejeune with health problems would have been more likely to return a survey due to publicity surrounding the Camp Lejeune contamination?
A Sure, yes. And on the other side of the coin, Pendleton wouldn't participate because they, you know, either don't have a health problem or don't care, this is a Camp Lejeune issue. Yeah. Yeah.

Q And that bias would have overestimated any effects resulting in higher odd ratios when comparing Camp Lejeune to Camp Pendleton?

A Most likely, yes. Yeah. So you had the selection bias problem, but you also had exposure misclassification problem. They could have crossed each other to some extent. We don't know the magnitude of either one in this study.

Q And like the other cohort studies that we looked at from 2014, this one assumed that all the study participants at Camp Lejeune were exposed, in comparison to Camp Pendleton?

A Yes.

Q And this -- again, as you mentioned in the other studies, this likely would have included people in the Camp Lejeune cohort who had little or no exposure to contaminated water?

A Yes.

Q And as in the earlier studies, you used the water modeling to assign exposure values for the study participants in the Camp Lejeune cohort?

A Yes.

Q Did you follow the same criteria for determining exposure as you used in the 2014 study, do you recall, or did you have --

A Yeah, I think so.
Q Okay.
A Again, if we know their residence and we know -- then we have the data from the water modeling to apply to, and we know how long they were there, so yes.
Q So essentially that same figure that we looked at, as to how you classify people as exposed or unexposed, would have been used?
A I think here the survey participant was asked where they -- where they were, where they -- what --
Q Okay.
A You know, so where they lived on base, so where they -- you know, whether they were in barracks and where the barracks were. I'm pretty sure we asked those questions. So between the family housing records and what they said in the survey, we could pinpoint to a better extent where they were.
But the internal -- the case -- the nested case-control sample was done precisely for this purpose. My understanding is when we were comparing Camp Pendleton and Camp Lejeune straight up, we were using all the people, not taking a sample. It's not a case-control sample. Okay? So I think that that's -- my memory is that that's probably what we did because

it made sense. You have a smaller group of people you have to evaluate when you do a case-control sample, and it's still as good as if you had gotten everybody in. That's the beauty of that kind of approach.

Q Okay. So stepping back a little bit --

A Okay.

Q -- instead of making assumptions based on married or unmarried, you would have used, actually, the information they gave you on the form?

A Yes. If they provided it, right, yeah. Yes.

Q And what happens if they didn't provide the information?

A Then we would have to use other --

Q Other assumptions?

A Yeah, other assumptions. We may have to use what we did in 2014. We would look at the family housing records and see if they matched this person, if we could make any -- you know, so on and so forth.

Q And based on, you know, the -- those determinations and the time that they lived at Camp Lejeune, you assigned separate cohorts into low, medium, and high exposure?

A I think so, yeah. Yes. I'd have to look at the tables, but I think that's what we did. Yeah, low, medium, and high.

Q Okay. On page 20 of the study --
A Uh-huh.
Q -- at the last paragraph, you say, "Self-reported cancers and other diseases of interest were confirmed by medical records, cancer registry information, or death certificates." Do you see that?
A Yes.
Q So if you did not have a HIPAA release, were there other ways to confirm self-reported cancers? Could you use the cancer registry information to do so?
A I think that we'd have to have the HIPAA to do that --
Q Okay.
A -- my recollection. First of all, it wasn't like the cancer incidence study where we had a relationship -- we formed a relationship with all the cancer registries. And you would have had to have done that here. People were diagnosed all over the country.
So I'm not sure how we used cancer registry data. I think there were some cancer registries that participated, and I can't remember how many. They may be mentioned in here.
Q Yeah, there's a statement in the report that you had approval from 13 cancer registries, covering 60 percent of the cancers in the study.

A Yeah, so we may have asked the cancer registry, "This person X said they have kidney cancer. Do you have a record in your registry?" So we may have done it that way.

We didn't do what we did in the cancer incidence study, where we sent all the DMDC data -- or the whole cohort to every registry to match. Okay? So it would have been individual by individual.

Q Okay. Do you have -- do you know what percentage of self-reported cancers or other diseases were confirmed?

A Well, I thought these -- that other sentence, we said 40 to 50 percent couldn't be confirmed.

Q Okay.

A I don't know. I'd have to go look through this report. I haven't looked at this in many years. And because we didn't really want to emphasize this report because of the limitations, it's hard for me -- I'd have to look it through.

Q Okay. Okay.

A There may be a -- there may be a table that actually tells you this, and that's what I'm wondering. I'd have to read the survey. I don't see it, so I'd have to --

Q Okay.

A -- look harder for it.
Q That's okay.
I want to focus on the five diseases that we've been focusing on, which are kidney cancer, bladder cancer, NHL, leukemia, and Parkinson's disease. And the first four -- kidney cancer, bladder cancer, NHL, and leukemia -- were identified as sufficient evidence of causation in the study we just looked at earlier, the 2017 ATSDR assessment, right?
A Right.
Q Parkinson's was classified as equipoise and above, right?
A Right.
Q Now, if you look at Table 6 in this particular study --
A Which -- the survey?
Q The survey.
A We're still at the survey?
Q Yes.
(Discussion off the written record.)
THE WITNESS: Do you know where it starts?
MS. GREENWALD: It's on page 74.
MR. BAIN: Page 74.
THE WITNESS: Because before that,

there's a summary table. Okay.

Q (By Mr. Bain) So at least this one compares the odds ratios, comparing cancers and other diseases among Camp Lejeune Marines with those at Camp Pendleton.

A Uh-huh.

Q If you look at Table 6, comparing the Camp Lejeune Marines and the CCamp Pendleton Marines, of those five diseases that we've been focusing on, only bladder cancer has an odds ratio above 1.5 at 1.64?

A Uh-huh.

Q Is that right?

A Yes.

Q And turn back a page -- to page 72. And you're looking at the Camp Lejeune Marine high-exposure subcohort and the Camp Pendleton cohort. The odds ratio for bladder cancer drops below 1 to .9. Do you see that?

A Yes. Yes.

Q Looking back at Table 6, the odds ratios for leukemia and Parkinson's disease were below 1. Do you see that?

A Say that again. Sorry. Parkinson's disease was less than 1. And what was the other one?

Q Leukemia.
A Yes.
Q And that means that there's a higher percentage of these diseases in the Camp Pendleton cohort compared to Camp Lejeune?
A In the survey, yeah.
Q In the survey, right.
A Yes.
Q The odds ratio for lymphomas, you don't have a breakdown here of non-Hodgkin's. It's just classified all as "lymphomas." Do you see that?
A Yes.
Q It's slightly over 1 at 1.06, right?
A Right.
Q And the odds ratio for kidney cancer is 1.31. Do you see that?
A Yes.
Q There were higher odds ratios in the survey above 2 for cancers that are not referenced in the 2017 ATSDR's assessment of the evidence as sufficient or equipoise and above, such as you see pancreatic cancer is at 2.26?
A Where is -- oh, there it is, up here. Okay, yes, 2.26. Laryngeal is 2.28. Cervical is 2.01. There's a whole bunch -- again, the problem with

this -- what you're seeing probably here is selection bias for some of these. Who knows.

Q Okay.

A I mean, we don't know. But, yes, there are a number of them, including abnormal sperm, having a high -- and infertility. So a lot of different outcomes here that had higher -- whether these are real or bias is, you know, hard to tell.

Q And there were a couple that were significantly below 1, such as scleroderma at .37 and --

A Right.

Q -- ALS at .81, right?

A Right, right.

Q Which would mean that there were more cases at Camp Pendleton, as reported in the survey, versus Camp Lejeune, right?

A Yeah, well, we're talking seven -- yeah, we're talking small numbers of cases.

Q Okay.

A Oh, that's right. Yeah, right. Yes, because -- I mean, there are less cases at Camp Pendleton than Lejeune in the table, but that's because Pendleton is a smaller group, right.

MR. BAIN: I think I'm going to stop

right there. I'm in the middle of this report, but I promised the court reporter we'd stop at 5:15.

THE VIDEOGRAPHER: Okay. The time is 5:13 p.m. Going off the video record.

(Deposition adjourned at 5:13 p.m.)

C E R T I F I C A T E

STATE OF GEORGIA
COUNTY OF COBB

I, MICHELLE M. BOUDREAUX-PHILLIPS, do hereby certify that DR. FRANK J. BOVE, the witness whose deposition is hereinbefore set forth, was duly sworn by me and that such deposition is a true record of the testimony given by such witness.

I further certify that I am not related to any of the parties to this action by blood or marriage and that I am in no way interested in the outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my hand this 21st day of October 2024.

_____

MICHELLE M. BOUDREAUX-PHILLIPS, CCR

ERRATA SHEET FOR THE TRANSCRIPT OF:

Case Name: In Re: Camp Lejeune Water Litigation

Deposition Date: October 17, 2024

Deponent: Dr. Frank J. Bove

Pg.	Ln.	Now Reads	Should Read	Reason
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Signature of Deponent

SUBSCRIBED AND SWORN BEFORE ME
THIS _____ DAY OF _____ 20___.

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(SIGNATURE OF NOTARY PUBLIC)
MY COMMISSION EXPIRES:_____

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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