BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

CALIFORNIA WATERFIX WATER RIGHT CHANGE PETITION HEARING	)))

JOE SERNA, JR. BUILDING

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

COASTAL AUDITORIUM

1001 I STREET

SECOND FLOOR

SACRAMENTO CALIFORNIA

PART 1B

Wednesday, December 14, 2016

9:00 A.M.

VOLUME 35

Pages 1 - 293

Reported By: Deborah Fuqua, CSR No. 1248

Computerized Transcription by ProCAT

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CALIFORNIA WATER RESOURCES BOARD

Division of Water Rights

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Felicia Marcus, Co-Hearing Officer (observing webcast)
Dorene D'Adamo, Board Member

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Dana Heinrich, Senior Staff Attorney
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Wednesday, December 14, 2016 9:01 o'clock a.m.

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P R O C E E D I N G S

CO-HEARING OFFICER DODUC: Good morning, everyone. Welcome back to this water rights hearing on the Change Petition for the California WaterFix project.

I am Tam Doduc, a little bit under the weather. The Board Chair Felicia Marcus, as those of you will remember from yesterday, was quite under the weather. So she is home watching the webcast today. She has to be well for Friday; we have an engagement in Stockton.

But we are joined today by Board Member DeeDee D'Adamo, who is wisely keeping her distance. And on our left are Dana Heinrich and Kyle Ochenduszko. We are assisted also today by Ms. McCue and Mr. Emanuel. Our court reporter is back with us.

Thank you very much.

This hearing is being Webcasted and recorded, so when you speak today, please use the microphone. Please make sure it's on, and please lean quite closely into it. It is especially important since this hearing officer is a bit congested and won't be able to hear you otherwise.

The court reporter will have the transcript available and posted on our website at the conclusion of Part 1B. If you would like it sooner, please make your arrangements with her directly. Please take a moment right now and identify the exit closest to you. In the event of an emergency, an alarm will sound. We will vacant this room and this building by taking the stairs down to the first floor and meeting up in the park.

If you are not able to use the stairs, please flag down one of us or anyone wearing orange fluorescent colored caps and vests, and they will direct you into a protected area.

Finally and most importantly, especially today because, even congested, I can hear the dings, please take a moment and put all your noise-making devices to silent or vibrate, "do not disturb."

All right. Mr. Aladjem, I believe we have some housekeeping item.

MR. ALADJEM: Good morning, Chair Doduc, Member D'Adamo, and staff. David Aladjem, Downey Brand for the City of Brentwood. With me is my colleague Meredith Nikkel.

Chair Doduc, as is evident to the Chair, we have Dr. Susan Paulsen will be testifying this morning

on behalf of both the City of Brentwood and the City of Antioch.

The cities of Brentwood and Antioch have coordinated with the Department of Water Resources in terms of Dr. Paulsen's presentation. And we'd like to suggest the following order if we could. First of all, Mr. Ehlers, Assistant Public Works Director for the City, will testify, then Dr. Paulsen on behalf of the City. Then we would invite cross-examination by the Department and others about Dr. Paulsen's testimony about both -- for both the City and -- both cities, excuse me, because the vast majority of her technical testimony is duplicative.

I have conferred with Mr. Mizell, and he is agreeable to this as long as the Department is able to also cross-examine Dr. Paulsen about the City of Antioch's testimony. And the City of Brentwood is certainly agreeable to that, and the City of Antioch is agreeable.

Then Mr. Emrick will put Dr. Paulsen on for her direct on behalf of the City of Antioch and any additional cross-examination will happen. And then we can excuse Dr. Paulsen, and Mr. Emrick will call the last witness for the City of Antioch.

That is a way we think would expedite the

proceedings. It keeps Dr. Paulsen from testifying two or three times. And we hope it will allow the Board to complete this part of the hearing either later today or tomorrow.

CO-HEARING OFFICER DODUC: Good. Let me make sure I understand then.

Dr. Paulsen's testimony, the technical basis for some of her recommendations apply to both parties, and there are very specifics that apply to each city in particular.

Is it my understanding from your proposal that the majority of her technical testimony will be presented as part of Brentwood's testimony and that the shorter testimony, focusing only on Antioch but not all the technical basis, will be done as part of the Antioch testimony?

MR. ALADJEM: You are absolutely correct, Chair Doduc.

CO-HEARING OFFICER DODUC: That sounds very good. Once again, I applaud you, Mr. Aladjem, for always proposing solutions rather than just posing problems.

MR. ALADJEM: Thank you for the compliment, chair?

CO-HEARING OFFICER DODUC: With that I will

ask both witnesses to please stand and raise your right hand.

(Witnesses sworn)

DR. SUSAN PAULSEN and CHRIS EHLERS,

called as witnesses on behalf of the City of Antioch and the City of Brentwood, having been first duly sworn, were examined and testified as hereinafter set forth:

CO-HEARING OFFICER DODUC: Thank you. Be seated.

And, Mr. Aladjem, do you have an opening statement?

MR. ALADJEM: Chair Doduc, the City of Brentwood submitted a written open statement. I have a very few points to add to that, but I will be brief.

CO-HEARING OFFICER DODUC: All right. Please proceed.

MR. ALADJEM: Madam Chair, the City of Brentwood is here this morning because the City is concerned about the potential effects of the WaterFix project on water quality in the Western Delta.

As you will hear from Mr. Ehlers, the City's water delivery and treatment system is designed to take water of a quality that is as good as or better than

150 parts per million chlorides. Most of the time, as shown in Dr. Paulsen's testimony, the WaterFix project would degrade that water quality and would have a significant adverse effect on the City's ability not only to provide potable water to its residents but also to meet the requirements of its waste discharge requirement, it's WDR, so as to avoid polluting the Delta.

Those requirements will go into effect in 2018, and if the WaterFix project were to come into effect, the City would almost from the beginning be out of compliance with its WDR. So obviously this is a subject of some concern to the City.

The Department, moreover, has taken the position in these proceedings that the project will comply with all of the water quality objectives in D1641, and therefore, there can be no injury to the City of Brentwood.

What Dr. Paulsen will show this morning is that there will be, in fact, substantial degradation of water quality for the City and degradation that fails to meet the requirements in D1641. Dr. Paulsen will show that, even though the Department had a number of graphs that purported to show no effect on water quality in the Western Delta, long-term average charts

when that data is disaggregated shows that there will be significant adverse effects on water quality in the Delta and the department will not be able to meet the 1641 standards.

Moreover, Dr. Paulsen's testimony will show that there will be substantial periods of time wherein water quality will be degraded, which, as mentioned before, will impact the City's ability to provide potable water for its residents and meet its waste discharge requirements.

Those in the City's -- those effects, in the City's view, constitute injury. And consequently, we respectfully request that the Water Board either reject the petition or so condition the petition as to require water quality of the type that the City has been receiving be continued in the operation of the WaterFix project.

That concludes my opening statement.

I'd like to proceed to the direct examination of Mr. Ehlers if that's acceptable.

CO-HEARING OFFICER DODUC: Before you do, a quick question. You had requested a combined I believe it was 50 minutes of direct for both witnesses. With the new arrangement with Mr. Emrick and Antioch, do you need more time for Dr. Paulsen?

MR. ALADJEM: Yes. I think that we can probably finish Mr. Ehlers in about 10 to 15 minutes max. But I think Dr. Paulsen's testimony will be longer, and I would estimate about an hour, maybe a little bit longer.

CO-HEARING OFFICER DODUC: All right. Let's go ahead and put an hour, initially, on the clock.

MR. ALADJEM: Just a clarification, Madam Chair, 15 minutes for Mr. Ehlers and an hour for Dr. Paulsen would be 75 minutes.

CO-HEARING OFFICER DODUC: Yes, Mr. Aladjem.

Seventy-five minutes, please.

MR. ALADJEM: Thank you, Madam Chair.

CO-HEARING OFFICER DODUC: Having glanced at Dr. Paulsen's technical report, I do believe she will need some time.

DIRECT EXAMINATION BY MR. ALADJEM

MR. ALADJEM: Mr. Ehlers, good morning, sir.

WITNESS EHLERS: Good morning.

MR. ALADJEM: Could you please state your full name for the record and spell it for the court reporter.

WITNESS EHLERS: Chris Ehlers, C-H-R-I-S, E-H-L-E-R-S.

MR. ALADJEM: And, Mr. Ehlers, is it correct

that you just took the oath in these proceedings?

WITNESS EHLERS: Yes.

MR. ALADJEM: Is Brentwood Exhibit 1 a true and correct copy of the testimony you provided in these proceedings?

WITNESS EHLERS: Yes, it is.

MR. ALADJEM: And have you had a chance to review that exhibit since it was submitted to the State Water Resources Control Board?

WITNESS EHLERS: Yes.

MR. ALADJEM: Do you have any corrections that you would like to make to that exhibit, Mr. Ehlers?

WITNESS EHLERS: No, I don't.

MR. ALADJEM: Mr. Ehlers, what is your current position at the City of Brentwood?

WITNESS EHLERS: Assist Director of Public Works.

MR. ALADJEM: And how long have you held that possession?

WITNESS EHLERS: Just over 12 years.

MR. ALADJEM: What are your responsibilities, Mr. Ehlers, in that possession?

WITNESS EHLERS: I oversee water -- potable water, wastewater, solid waste, garbage pick-up, fleet and facilities maintenance, and street maintenance.

MR. ALADJEM: And, Mr. Ehlers, do you hold any professional certificates that you rely upon in your position at the City?

WITNESS EHLERS: Yes. I have a Grade 5 water treatment operator certification and a Grade 5 water distribution operator certification.

MR. ALADJEM: Mr. Ehlers, for those of us who don't know what that mean, could you briefly explain those?

WITNESS EHLERS: Those are the highest grade licenses to run a water distribution system and water treatment system for potable water, municipal.

MR. ALADJEM: Mr. Ehlers, have you reviewed Dr. Paulsen's testimony as contained in Brentwood 100 and 102 in preparation for your testimony this morning?

WITNESS EHLERS: Yes, I have.

MR. ALADJEM: Is Brentwood 102 the type of technical report that you receive from consultants who work for the City?

WITNESS EHLERS: Yes, it is.

MR. ALADJEM: And do you rely upon such reports in determining how you're going to run the City's water and wastewater treatment systems?

WITNESS EHLERS: Yes.

MR. ADAGE: Mr. Ehlers, let's turn to some of

the substance of your testimony. Could you describe from where and how the City gets its water supplies?

WITNESS EHLERS: The City gets its surface water from two sources. One is Rock Slough, and the other is Old River pump station. The water's conveyed -- the Rock Slough Canal is a Contra Costa Canal, and the City owns about a 15 percent capacity right in the canal. Old River doesn't own any of the conveyance. We pay Contra Costa Water to pump it.

The Rock Slough source through the Contra Costa Canal goes direct to the City's surface water treatment plant, where the Old River source goes up through the Los Vaqueros Reservoir and then releases down to the City's surface water treatment plant.

MR. ALADJEM: And, Mr. Ehlers, how much water does the City use annually?

WITNESS EHLERS: Before the drought, 2013, we were using approximately 8,000 acre-feet a year. And since, like, last year, we used just over 5-.

MR. ALADJEM: May I infer from that, Mr. Ehlers, that the City was able to comply with the Governor's request that the cities reduce their water use by 25 percent?

WITNESS EHLERS: Yes. The City had an outstanding compliance record with the drought

requirements and exceeded 40 percent reduction at times from 2013.

MR. ALADJEM: Mr. Ehlers, does the City have any specific requirements for water quality, either for delivery to its residents or otherwise?

WITNESS EHLERS: Chloride is most important. One, for potable water and the consumer getting it, and, two, to maintain compliance with our waste discharge requirements.

MR. ALADJEM: And did I hear you correctly? You were talking about a 150-part-per-million chloride requirement?

WITNESS EHLERS: Yes. There's a direct trend that the loading rate within the City is about 200 parts per million, and our new regulation is going to be 344 parts per million. So if it's coming in at 100, and you add 200 to it, it's 300. It's pretty straightforward. So we really need to try and maintain less than 150.

MR. ALADJEM: And I'm sure, Mr. Elder, you speak with other public works directors. How does that 150-part-per-million requirement compare to other cities in the area?

WITNESS EHLERS: Contra Costa Water and the City of Brentwood are closely tied. We share a

treatment plant. We have our own treatment plant that they operate. CCWD's requirement for chloride is in the 80- to 90-part-per-million, never to exceed 120.

MR. ALADJEM: Mr. Ehlers, let me turn my attention here to the proposed WaterFix project. The City filed a protest against that project; is that correct?

WITNESS EHLERS: That's correct.

MR. ALADJEM: Why did the City file a protest?

WITNESS EHLERS: Two main reasons: The City is of the belief that the project, if built and constructed as proposed, would degrade the Delta water quality and increase chlorides, and that would cause the City harm for both its potable water customers and make it unable to meet its waste discharge requirements for periods of a year.

MR. ALADJEM: So, Mr. Ehlers, may I conclude by saying is it correct that the City is opposed to the project because of those impacts on water quality; is that fair?

WITNESS EHLERS: That's correct.

MR. ALADJEM: No further questions, Madam Chair. If I may proceed to Dr. Paulsen?

CO-HEARING OFFICER DODUC: (Nods head affirmatively)

MR. ALADJEM: Dr. Paulsen, good morning.

WITNESS PAULSEN: Good morning.

MR. ALADJEM: Would you please state your full name for the record and spell it for the court reporter?

WITNESS PAULSEN: My name is -- sorry.

How's that? My name is Susan Paulsen. "Susan" is S-U-S-A-N, and "Paulsen" is P-A-U L-S-E-N.

MR. ALADJEM: And Dr. Paulsen, have you taken the oath in these proceedings?

WITNESS PAULSEN: I have.

MR. ALADJEM: Dr. Paulsen, is Brentwood 100 a true and correct copy of the summary of your written testimony that was submitted on behalf of the City of Brentwood in these proceedings?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Is it the case, Dr. Paulsen, that the conclusions you offer in Brentwood 100 and in your oral testimony today are based on the analysis set forth in Brentwood 102?

WITNESS PAULSEN: Yes, that's right.

MR. ALADJEM: So in that regard, Dr. Paulsen, Brentwood 102 contains your testimony regarding the technical analysis that you performed regarding the California WaterFix project?

WITNESS PAULSEN: Right, yes.

MR. ALADJEM: Dr. Paulsen, would you say that Brentwood 102 supplements and explains the opinions offered in your written summary of testimony and the oral testimony you're giving today?

WITNESS PAULSEN: Yes.

MR. ALADJEM: And, Dr. Paulsen, do you affirm that the statements contained in Brentwood 102 are true and correct to the best of your knowledge?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Turning to Brentwood 101, Dr. Paulsen, is that a true and correct copy of your curriculum vitae?

WITNESS PAULSEN: Yes, it is.

MR. ALADJEM: Is it true, Dr. Paulsen, that you received your Ph.D. from the California Institute of Technology, otherwise known as CalTech?

WITNESS PAULSEN: Yes, in environmental engineering science.

MR. ALADJEM: What was the subject of your Ph.D. dissertation, Dr. Paulsen?

WITNESS PAULSEN: The title of the thesis was a study of the mixing of natural waters using ICPMS. And we looked at the natural chemical signatures or fingerprints of water and could use that chemistry

along with this analytical technique to figure out where water that was a mixture of waters from different sources, what sources those were and in what proportion those sources of water were present.

The bulk of the work, probably 80 or 90 percent of the work for the thesis was done in the Delta, where we -- it's easy -- it's relatively easy to tell the differences between freshwater and saltwater. You can do that with a conductivity meter. But it's harder to tell the difference between different sources of fresh water.

And the source of freshwater is important because different sources of freshwater have different water quality. And so we used this technique with samples that we collected in the Delta over a period of a few years to develop a method for fingerprinting the sources of water and then for determining the source of water in the interior to the Delta. And it worked fairly well under most conditions, dry weather in particular.

MR. ALADJEM: For those of us who are not technically competent, Dr. Paulsen, essentially was this an ability to say whether freshwater entering the Delta came from the Sacramento River or the San Joaquin River? Is that the essence of it?

WITNESS PAULSEN: Yes, we fingerprinted three main sources of water to the Delta -- the Sacramento, the San Joaquin, and then the Bay -- using samples collected and measured at Martinez and then developed a mathematical method, once we had a sample from the interior of the Delta, for figuring out where that sample had come from based on the source fingerprints.

MR. ALADJEM: Dr. Paulsen, you're a professional engineer as well as a Ph.D.; is that right?

WITNESS PAULSEN: Yes, I'm a registered civil engineer in California.

MR. ALADJEM: And, Dr. Paulsen, as part of your professional experience, you're familiar with the models DSM2 and CalSim II?

WITNESS PAULSEN: Yes, I am.

MR. ALADJEM: Do you regularly run a DSM2 or supervise those in your firm that run DSM2?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Am I correct also in understanding that your firm does not actually run CalSim but you are familiar with using CalSim modeling results as part of your analyses?

WITNESS PAULSEN: Yes, exactly. We don't have the in-house expertise to run the model, but we

routinely use CalSim output as input to the DSM2 model.

MR. ALADJEM: Dr. Paulsen, is Brentwood 102 a true and correct copy of the report that you prepared for the City of Brentwood in these proceedings?

WITNESS PAULSEN: Yes, it is.

MR. ALADJEM: Did you prepare that report, Dr. Paulsen?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Did you direct staff at Exponent to prepare any of the detailed technical analyses?

WITNESS PAULSEN: Yes. We did that together. I had staff assist me, and they worked under my direction to do the technical analyses in the report.

MR. ALADJEM: Do you concur with all of the statements in Brentwood 102 and all the conclusions that were drawn therein?

WITNESS PAULSEN: Yes. I should note that there are a handful of minor errata.

MR. ALADJEM: I will get to those in a moment.

WITNESS PAULSEN: Other than those, yes.

MR. ALADJEM: Dr. Paulsen, is Brentwood 104 a true and correct copy of the comments that you prepared for the RDEIR/SDEIS for the California WaterFix project?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Did you prepare those comments?

WITNESS PAULSEN: Yes.

MR. ALADJEM: And do you concur with all the statements in those comments and all the conclusions that were reached therein?

WITNESS PAULSEN: Yes.

MR. ALADJEM: And can you affirm that the statements in Brentwood 104 are part of the testimony that you're offering the Water Board this morning?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Dr. Paulsen, are Brentwood 103 and then 105 through 117 true and correct copies of documents that you relied upon in the preparation of Brentwood 102?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Are those the types of documents, Dr. Paulsen, that you typically rely on as part of your professional efforts in analyzing the effects of the water project?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Now, since you prepared Brentwood 100 and 102 and those documents were submitted to the Water Board, I believe you have a couple of technical corrections.

WITNESS PAULSEN: Yes, I do.

MR. ALADJEM: And are they to Brentwood 100, 102, or both?

WITNESS PAULSEN: A little bit of both.

MR. ALADJEM: Okay. Could you please state those for the record?

WITNESS PAULSEN: Sure. The first correction would be to the caption of Table 4 on Page --

MR. ALADJEM: Which document are we in?

WITNESS PAULSEN: Page 53 of the report, which is Brentwood 102.

MR. ALADJEM: Thank you.

WITNESS PAULSEN: The caption should read, inside the caption, "Thresholds of 150 milligrams per liter and 250 milligrams per liter." The original had "100" instead of "150." The table is labeled correctly, but the caption carried the wrong number.

MR. ALADJEM: Thank you, Dr. Paulsen.

WITNESS PAULSEN: The second correction that I would have is also within the report which is Brentwood 102 at Page 63. The second line of that, there's a number in parentheses. The number reads "5,182 days." It should read "5,844 days."

And then the last three corrections are within both the testimony and the report. Specifically, it was stated that Scenarios H3 and H4 would result in

about 500,000 acre feet per year of additional water exported from the Delta. All three of these locations that I'll give you in a second should read "H3" only, "Scenario H3." Those are located on Page 22 of the report which is Brentwood 102 in the last paragraph. Also in the report at Page 43 -- so there's Brentwood 102 at Page 43, the first full sentence on that page. And then in the testimony, which is Brentwood 100, at Page 3, Line 15.

MR. ALADJEM: Madam Chair, if it would be helpful for the Board, we will prepare a written set of errata, or in the alternative, we can prepare corrected versions of Brentwood 100 and 102.

CO-HEARING OFFICER DODUC: I believe the City of Antioch submitted errata also covering some of the corrections that Dr. Paulsen made. Perhaps you might duplicate that format.

MR. ALADJEM: We will be glad to do that.

Dr. Paulsen, would you summarize for the Water Board your testimony this morning.

WITNESS PAULSEN: Sure. If I may, I think we prepared a PowerPoint or a pdf. I'd like to --

MR. ALADJEM: Madam Chair, these PowerPoint slides are all taken from Brentwood 102. And if you look on -- at the upper right-hand corner, it indicates

"Brentwood 102," and the page I believe is there somewhere.

CO-HEARING OFFICER DODUC: It's on the bottom right hand.

MR. ALADJEM: At the bottom. Okay.

CO-HEARING OFFICER DODUC: Thank you. I appreciate that -- rather than looking up a huge 80-something-page document every time.

And before Dr. Paulsen begins, let me congratulate you, Council, for being very wise in skipping over Dr. Paulsen's undergraduate activities.

MR. ALADJEM: Madam Chair, as a fellow alum, I understand that that was an important thing to do for the Hearing Officer.

Dr. Paulsen.

WITNESS PAULSEN: All right. What is shown on the screen right now is a map of the Delta. I don't think we need to spend much time on this. This is Figure 2 from the report, which the report is labeled "Brentwood 102," and this figure appears on Page 16.

The purpose of this slide is to show the statutory boundary for the Delta and to show the location of the City of Brentwood.

In summarizing my testimony, there are three primary opinions that I'd like to share today. The

first is that the proposed WaterFix project is not, in my view, adequately defined.

There are several reasons for this. The first is that all of the modeled scenarios have climate change and sea level rise. And when the City asked me to help evaluate the impacts of the project to the City, they -- their goal was to tie it into their current operations.

They know very well -- Mr. Ehlers knows very well how the City operates its drinking water and wastewater operations now. It is less known how they would operate those facilities in the future. So we tried to tie everything back to a current condition so they could relate it to their current operations.

I will show -- I'll focus on three primary scenarios during this testimony: an existing condition model scenario; the future no action, which is called the NAA in the documents; and then the Boundary 1 scenario. We did provide results for the other modeled project scenarios in an appendix to the report as well.

The second concern is that the project operations are poorly defined. They're quite vague. We know --- they've stated that they'll operate between scenarios Boundary 1 and Boundary 2. But the difference in the amount of water that would be

exported from the Delta between those two scenarios is on the order of 2 1/2 million acre-feet per year.

Considering that typical exports are on the order of 4- or 4 1/2 million acre-feet per year, that's a very broad range, and it makes it hard to understand the impacts to the City.

It's also not clear to us how the Department would decide where within that range they would operate at any point in time. So, in other words, we don't have an understanding of the rules or the guidelines that they would use to choose where within that range they would operate.

We have a concern also with the AMMP, the adaptive management and monitoring program. It likewise is described very vaguely. And, you know, we understand the need for adaptive management. Most projects are managed adaptively. But even in spite of that, in my experience, most projects that are adaptively managed have a clearer framework or guideline within which that management happens.

The other concern that we have with DWR's evaluation of the project -- and we'll discuss this in detail -- is that DWR has presented a lot of the information in terms of long-term averages, and you can't see the day-to-day variability in water quality

that's expected to occur when you're looking at long-term averages. And drinking water operators such as the City do not operate in long-term averages; they operate in a realtime basis. So we did break apart the modeling -- or actually go back to the original model output to look at the simulated water quality on a realtime basis.

The second opinion that I would like to offer is that the WaterFix project will result in substantial changes to the hydrodynamics and water quality within the Delta. And this can be summarized briefly, really, in two parts. In most water year types, the WaterFix project would export more water from the Delta then would be exported under current conditions or the no action alternative.

In addition, because the North Delta diversion locations are located on the Sacramento River, the projects would export more high quality Sacramento River water. So the projects would export, one, more water and, two, much more Sacramento River water than would occur under the other scenarios without the project. That changes the distribution of water within the Delta which, in turn, results in water quality impacts.

And the third opinion that I'd like to offer

is that compliance with water quality objectives, the D1641 objectives, is likely to be more challenging in the future and that we do expect the WaterFix project to degrade the water quality of the City's water supply.

So what I hope to show you is that the water quality objectives are likely to be met less frequently with the proposed project than they would be without it and that, while there is a change due to climate change and sea level rise, there's a greater change caused by the proposed operation of the project.

The second thing we'll see is that, even when water quality objectives are met, water quality at the City's intake is degraded under WaterFix project.

And as Mr. Ehlers explained, we did look at DWR's modeling results focusing on salinity, the chloride content, using thresholds that are relevant to the City's operation. Mr. Ehlers talked about the threshold of 150-milligrams-per-liter chloride. And we focused on that threshold in order to evaluate the water quality impacts using the same metrics that the City uses in its day-to-day operations.

And I think that summarizes what I hope to tell you. If we could move to the next slide, please.

This slide is a figure that's taken from a DWR

exhibit, DWR-4, at Page 10. We have added a yellow star and the label "Brentwood" to show you the approximate location of the City.

MR. ALADJEM: Dr. Paulsen, this is Brentwood 102, Page 7.

WITNESS PAULSEN: Yes, apologies. This is Figure 1 of the report at the location just cited. Sorry. Did you hear that? Okay.

When we look at this report, the purple arrows show the inflows of water to the Delta. You can see a large arrow to the Sacramento River, a slightly smaller arrow for the San Joaquin River. And you can see Delta island consumptive use. You can see also flows from the eastside streams and the Yolo bypass area.

The red arrows show the locations at which water is exported or diverted from the Delta. You can see the Central Valley Project, the State Water Project diversions in the southwest corner of the Delta.

You can see a red arrow just above the yellow star at the City's location. That is the diversion point at Rock Slough. And then you can also see that water's removed from the system at the North Bay Aqueduct location.

Water is also removed from Delta channels by Delta island consumptive use. Most of that water is

used for agriculture. Some of that water returns to the Delta as return flows.

In terms of water quality, the Sacramento River and the eastside streams have the highest quality water, meaning the lowest salinity water. The San Joaquin River and the ag return flows have higher salinity. And especially during dry periods of the year, the Bay has the highest salinity of all. And, of course, the Bay enters through the Carquinez Straight area, near Martinez.

And you can see on the graphic there, some fluctuations for tidal water levels. You know already this is a tidal system, and water moves in and out with the tide cycle every day.

Brentwood does take the majority of its water from Pumping Plant 1, near where the yellow star is located. That is also the location at which many of the D1641 M and N, municipal and industrial, water quality objectives are evaluated.

Now, one important point about the Delta is that the channels throughout most of the Delta are below sea level. So the bottoms of the channels are below sea level. This means that water will fill those channels even in the absence of freshwater flow.

The salinity or the water quality within the

Delta is a balance of the water quality of the sources of water that flow into the Delta. And in some cases, the CVP and the State Water Project pumps in the southwest corner of the Delta pull Sacramento River water into that corner of the Delta resulting in more Sacramento River water and fresher water quality than would likely otherwise be present.

Now, one of the impacts of the project is that more water and more Sacramento River water will be removed from the Delta under some of the proposed project operations. And that will result in a change of the distribution of water in the system, the water from other sources.

One other point I'd like to make is to discuss briefly residence times. There's a lot of water present in the channels of the Delta at all times. The residence time is a measure of how long water stays present in the Delta before it leaves the system, either by being pumped out or flowing out to the Bay.

The residence time for Sacramento River Water, based on some studies done by DWR, is lowest in February, when freshwater inflows on the Sacramento side are typically highest. And it ranges from a low of about 3 days to a high of about 38 days with a mean of about 16 days.

For Sacramento River water, the residence time is highest in October, which is a low-flow month typically; ranges from about 37 to about 74 days, with a mean of 51.

For the San Joaquin River, it's a little bit different. The lowest residence times occur in January. They range from about 6 to 37 days with a mean of about 16 days or about 2 weeks. And then the highest residence times for the San Joaquin River are in April with a low of 8 days, a high of 54, and a mean of about 33 days. The lowest residence times occur, of course, when the inflows are highest, and the highest residence times occur when the inflows are lowest.

The reason residence time is important is really two reasons. Water that enters the Delta days to months before -- water enters the Delta days to months before it is pumped out. And, second, the water quality of the Delta, especially in the interior of the Delta, is a function of residence time. The lower the residence -- the higher the residence time, the longer, more days water is present in the Delta, the less flushing there is. And the higher concentrations of salt from ag drainage and other sources can build up when residence times are very high and flows are very low.

Regarding WaterFix operations, DWR did provide a very wide range of potential operations. But, again, we don't know exactly how the project will be operated or the decision criteria that'll be used to decide between implementing one operation scenario over another. We also don't understand very well how the AMMP would be used to adjust the initial operation scenarios.

One of the concerns that the City has is that the RDEIR/SDIES for the WaterFix project specifies that at least some of the adjustments to project operations would be made based on the protection of fish. And it cites to Delta and long-fin smelt. Protection of the M and I, the municipal and industrial beneficial uses is not mentioned. And so there's a concern that the adaptive operations would place the primary focus on modifying operations to protect fish but not modifying operations to protect the M and I beneficial uses that currently occur.

All right. If we can move to the next slide, please.

This slide is Figure 3 from the report, Brentwood 102, at Page 28. The first thing that we did in evaluating the impacts of the proposed project on the City were to dig into DWR's model results to try to

understand the impacts. We focused primarily on chloride. The model output is in the form of EC, electrical conductivity. We converted that to chloride so that it could be compared to water quality objectives in the City's operating criteria.

We did also look at the D1641 objectives, and to understand the water quality results we looked at the source of water at the City's intake and how that source would change with the project. So I'm going to walk through those three things here.

In this figure, what we're showing is the monthly average chloride concentration at Pumping Plant 1 for the 16-year model period. There are five bars -- the NAA Boundary 1, Boundary 2, H3, and H4 -- that are derived directly from DWR's modeling results. We also added a bar for a scenario called EBC2, which is existing condition. That is from a model run that was provided by DWR in, I think, about 2013 as part of the BDCP model runs.

If we just look at the left-hand set over bars here, that's the month of October. These bars represent, first, averaging all of the salinity information from the model during each month of October and then averaging the 16 Octobers together. So it's creating a monthly average, and then averaging the

monthly average.

And what we see is the existing condition bar -- these colors are a little indistinct here, but the existing condition bar is sort of a reddish color on the left of these sets of the bars. So in October for the 16-year period, you can see that the average salinity for the existing condition's probably about 120 milligrams per liter. For the no action alternative in this month of October, it's slightly higher. And for Boundary 1 scenario is probably about 160. So, again, that's the 16-year monthly average.

What we can see is that, if we focus on the Boundary 1 scenario, which is the light gray bar sort of in the middle of the -- each grouping of bars, you can see that the salinity would increase on a monthly average 16-year basis for the months of October, November, December, January, February, and March relative to both existing conditions and the no action alternative.

For the other months of the year, the remaining six months of the water year, the salinity would decrease relative to existing conditions.

There were three primary reasons that we added an existing condition scenario to the information we're going to show you. The first I've already described a

little bit. It's that the City knows how it operates under current conditions and has a feel for the water quality under current conditions. So they had requested that we add that in order to understand how the future might relate to current operations.

The City had also asked us, and we were curious, about how much of the change that will occur in the future will be due to climate change and sea level rise and how much change would be due to the operations of the proposed project.

The only way that we knew to tease out those differences was to present the existing condition and the no action and one of the project operation scenarios.

And then the final reason for doing that is that we have a pretty good feel for how the existing condition model runs compares to current water quality. That model has been calibrated. We have measured data that we can compare the model output to. And by definition, we don't have that for the future runs. We don't have measurements for climate change or sea level rise that we can compare the climate to.

So as you'll see as we move through this, we're presenting results primarily for the EBC2 existing condition scenario, the no action alternative,

and then we're going to focus on Boundary 1.

If we move to the next slide, this is an excerpt from the D1641 objectives. This is in Brentwood 102. On Page 11 is Table 1. There are two primary M and I water quality criteria we're going to focus on.

One is a 150-milligram-per-liter chloride threshold. That's a sliding scale. The number of days that that threshold must be met is based on the water year type. It can be met at either Antioch or Pumping Plant 1. Practically speaking, it's met at Pumping Plant 1.

The second kind of water quality objective is the 250-milligram-per-liter threshold. That must be met at Pumping Plant 1 and at four other locations. We're going to focus on Pumping Plant 1. And it's required to be met every day of the year.

All right. In moving to the next slide, this slide is from Brentwood 102 at Page 30. It's Figure 4. This slide shows the daily average chloride concentration from the model results for the existing condition scenario, that's the dark greenish color; the no action alternative, that's the bluish color; and the Boundary 1 scenario, which is sort of an orange color. This also shows a red line at the

250-milligram-per-liter salinity threshold.

What we see -- I should say also this is for two water years, water year 1978 and water year 1979. Water year 1978 was an above-normal year; water year 1979 is a below-normal year.

On the left-hand side of the graph, you can see that the EBC2 scenario does bump up above the 250-milligram-per-liter line for a few days; it's for ten days. The no action alternative bumps up above that line in that left-hand edge for about 87 days, and the Boundary 1 scenario exceeds 250 milligrams per liter for 105 days.

In the right-hand group of exceedances, early in water year 1979, the EBC2 condition does not exceed the 250-milligram-per-liter threshold. The no action alternative exceeds it for 16 days, and the Boundary 1 scenario exceeds it for 64 days.

So what we see here is that we do have an increase in salinity due to climate change and sea level rise, the no action alternative. But we have an even greater increase in salinity in these two years for the Boundary 1 operating scenario.

DWR's provided some testimony stating that the exceedances they believe are caused by the smoothing that's needed to convert the CalSim monthly model

output into daily output or, you know, finer scale input to the DSM2 model. I don't think that that explanation explains these long exceedances that last for several months at a time.

This increase in salinity is pretty significant compared to existing conditions. The Boundary 1 scenario, just in the time span shown in this plot, would exceed the 250-milligram-per-liter threshold for 159 more days than the existing condition EBC2 scenario would exceed it.

All right. The next slide, please, is Figure 5 from the report. It's Brentwood 102 at Page 31. This is just superposing or putting the two prior slides together.

So we have the wiggly line, which is the daily average chloride concentration, and then the bars are the 16-year monthly average salinity concentrations. And the main point of this is that, when we look at a long-term 16-year average, obviously we do not capture the variability that's present in the model results on a shorter time scale.

Again, DWR's averaged the data in two ways: through each month to calculate a monthly average and then averaging each of the 16 months together for all the Octobers, all the Novembers, et cetera. Drinking

water operators don't operate to long-term averages. They operate on a daily or hourly or sub-hourly basis. So the finer scale of predicted water quality is important to them.

If we move to the next slide, this slide is Figure 6 from the report, Brentwood 102 at Page 33. I'm going to show four slides that are going to be similar.

In these slides what we're looking at is how the monthly average water quality differs by year type. So this particular slide is for the critical years in the 16-year model period. There are five of them, 1976, '77, '88, '90, and '91. So we've averaged over all the October -- through the month of October, and then we've averaged the Octobers for those five years, all the critical years in that model period.

And what we see is that the salinity increases for the Boundary 1 scenario in the first six months of the water year and decreases for the Boundary 1 scenario in the last six months of the water year, both of those relative to existing conditions.

We see that salinity is higher in critical years than it is in the long-term average, which is expected. In critical years, we have less inflow to the estuary.

We also know that, if we look at a 95-year period of the hydrologic record, critical years occur 16 percent of the time in that long-term record. In this 16-year model period, critical years occur 31 percent of the time. So critical years are over-represented, if you will, in the short 16-year model period with respect to the longer term model period.

The next slide, slide -- it's Figure 7 from the report, Brentwood 102, at Page 34. It shows the monthly average chloride concentrations in dry years. The dry years were 1981, '85, '87, and '89. And again, the salinity increases the Boundary 1 scenario relative to the existing conditions scenario in the months of October through March. And we can see a pretty significant increase for the Boundary 1 scenario, particularly in the months of October, November, December, and January of dry water years.

It was interesting to us that the Boundary 2 scenario actually resulted in increased salinity in the months of February, March, and April. In general, the salinity for the Boundary 2 condition is lower than for all the other scenarios, but these months are a little bit different.

In the 95-year hydrologic record, dry years

occur 22 percent of the time; in the 16-year period they occur 25 percent of the time. So that's a near match.

The next slide is similar. It shows results for normal water years. Here, we've grouped above-normal and below-normal water years. The above-normal water years in the 16-year period are 1978 and 1980. There's only one below-normal year, that's 1979. Since there were so few, we grouped them together. And throughout this presentation, I'm just going to call those three years "normal years."

Again, we see increases in salinity in the October to March time period. The increases are higher than in the critical years. And one interesting thing is that the Scenario 1 monthly average salinity averaged over these three years exceeds the D1641 250-milligram-per-liter threshold in December and January.

So, again, when you average these three year types together, the monthly average salinity for those two months exceeds the daily D1641 threshold of 250 milligrams per liter.

In the 95-year period of record, normal years occur 33 percent of the time. In this 16-year period, normal years occur 19 percent of the time. So, here,

the normal years are under-represented in the 16-year period relative to the long-term hydrologic period of record that we have.

And the last slide in this series is the next one. This is Figure 9 at Page 36 of Brentwood 102. These are the results for the wet water years, '82, '83, '84, and '86. They show the lowest salinity and the least variability because we have higher inflows to the estuary in wet years. And in the 95-year period of record, wet years occur about 29 percent of the time. In the 16-year period, they occur 25 percent of the time. So, again, a near uniform representation in those two different time periods.

All right. The next four slides -- if we can move to the next one. The next four slides are going to present this information, the same information, in another way. They're going to look at each of those water year types and look at the difference between the monthly average salinity in that year type versus the 16-year-average monthly salinity so we can see how each of those year types deviates from the long-term mean.

Here are results for critical years. Almost all of these bars -- there's one little one that's below, but all of these bars for all of the model scenarios otherwise are above zero, meaning that, in

the critical years, the salinity is higher than it is for the 16-year mean, which is expected. And there's not all that much difference between the individual scenarios.

If we go to dry years, which is the next slide, Figure 11 from the report, Brentwood 102 at Page 39, we see some bouncing around about the mean. So dry years the salinity is sometimes a little better, sometimes a little worse than the 16-year long-term average, but the changes are relatively small. So in other words, the mean monthly salinity in dry years is fairly similar to the long-term 16-year average monthly salinity.

For normal years, things get a little more interesting. Next slide, please.

What we see is that the salinity is significantly higher. The monthly average salinity is higher in normal years relative to the long-term average, particularly in the October-to-March period. Toward the end of the water year, it's the other way around.

MR. ALADJEM: Dr. Paulsen --

WITNESS PAULSEN: Yes, I'm sorry.

MR. ALADJEM: -- this is Brentwood 102, Page 40?

WITNESS PAULSEN: Yes, thank you. Figure 12 of the report Brentwood 102, Page 40. I'm trying.

What we see here is that the difference in the monthly average normal salinity is up to 100 milligrams per liter for scenario B1 in normal years relative to the long-term average.

So if you look, for example, at the bar in January, you can see that in January of dry years, both the existing condition and the no action alternative have simulated salinity levels that are about 45 or 50 milligrams per liter higher than the 16-year average for that month. But the Boundary 1 salinity is about 100 milligrams per liter higher than the long-term monthly average salinity for that month for that scenario.

So again here, in normal years, we see much higher differences in salinity versus the long-term average, and we see a real bump in the Boundary 1 salinity.

The next slide is, again, a little bit boring. This is the wet year summary, the same information. Salinity is generally lower in wet years than long-term average because inflows to the estuary are higher. And what we see is the greatest impacts appear to occur in the normal-year types.

All right. So I'm going to switch now to how I'm presenting this data. The next series of slides are going to present some of the data in a tabular format, so not graphically. And I'm going to focus on the EBC2 existing condition, the no action alternative, and the Boundary 1 scenario. So what I'd like to do now is look at the D1641 objective that the 250-milligram-per-liter chloride threshold for M and I uses --

MR. ALADJEM: Dr. Paulsen?

WITNESS PAULSEN: Sorry.

MR. ALADJEM: This is Table 5 --

WITNESS PAULSEN: Table 5.

MR. ALADJEM: -- of Brentwood 102, Page 59.

WITNESS PAULSEN: Of Brentwood 102 at Page 59. Thank you.

So DWR has presented information on whether or not water quality will comply with the D1641 objectives after the implementation of the WaterFix project. And we've gone into the model results to calculate for those model simulations how often those thresholds would be met in that model output. That's what's shown here.

We're giving this information because I think it's important to be able to see the differences

between the different scenarios, to see the changes that would be caused by climate change and sea level rise and the changes that would be caused by the project.

So if we just pick one line -- let's pick the 1978 year. Again, it's an above-normal water year. That was also one of the years that was shown in that spaghetti plot, the plot of the wiggly lines with the daily average chloride concentrations.

What we see is there are 365 days in that year. In the existing condition scenario, the 250-milligram-per-liter threshold would be exceeded at Plant 1 10 days of the year. For the no action alternative, it would be exceeded 87 days of the year. And for the Boundary 1 scenario, it would be exceeded for 105 days.

So we do see an increase in the frequency that that threshold is exceeded between the existing condition and the no action alternative. But we see an even bigger increase between the no action alternative and the Boundary 1 scenario.

In some years, like 1980, compliance actually improves. In 1980, which is again an above-normal year, that's a leap year, 366 days in the year, 87 would exceed the 250 threshold in the existing

condition; 57 would exceed the threshold in the no action alternative; and 44 would exceed in the Boundary 1 scenario.

If you add all of these numbers just down each column of data, 5,844 days in the simulation period, there are 396 exceedances for existing conditions, 526 days of exceedance for the no action alternative, and 586 days of exceedance for the Boundary 1 scenario.

So if we compare the Boundary 1 scenario to EBC2, we see an increase of about 48 percent in the number of days that would exceed this threshold. For the no action alternative relative to the existing condition, we see and increase of 33 percent. And if you compare the no action alternative to the Boundary 1 scenario, we see an increase of about 11 percent.

So there is an increase in the frequency of non-compliance with the no action alternative, but there's an additional increment of exceedance for the Boundary 1 scenario.

All right. The next slide is Table 6 from the report, Brentwood 102 at Page 60. This takes the same information from the prior slide and just averages over the year types.

What we see is, for dry years in the existing condition, we would have about 19 days of exceedance on

average, the 250-milligrams-per-liter chloride threshold. For the no action alternative in dry years, we'd have 27 days of exceedance. And for the Boundary 1 scenario in dry years, we'd have 46 days of exceedance.

For normal water years, the existing conditions would have 32 days of exceedance; the no action would have 54 days of exceedance; and the Boundary 1 scenario would have 71 days of exceedance.

So relative to the existing condition for the dry years, there's an increase of 142 percent in the rate of exceedance relative to existing conditions.

For Boundary 1 relative to the no action alternative, there's an increase of just over 70 percent in the number of days of exceedance.

For normal year, the Boundary 1 scenario would exceed for about 122 percent more days than the existing condition. And Boundary 1 would exceed for about 32 percent more days than the no action alternative.

So, again, there is an increase in non-compliance or exceedance due to climate change and sea level rise in the no action alternative. But there's an even bigger increase in non-compliance or exceedance for the Boundary 1 scenario.

All right. I'd like to switch. The next slide is just repeating Table 1 -- Brentwood 102, Page 11. I'd like to switch to looking at the 150-milligram-per-liter chloride threshold. Again, that's a sliding scale. The number of days that that threshold is required to be met is dependant upon hydrologic year type. And it's also specified that it must be provided in intervals of not less than two weeks' duration. So we used the model results to evaluate those criteria.

The next slide shows Table 7 from the report, Brentwood 102, Page 61. These results are presented in the number of years that exceed for each of the different year types.

So looking at the top row of the table, we have five years in the 16-year simulation period that are critical years. In the existing conditions, four of those would comply with the 150-milligram-per-liter objective at Pumping Plant 1. In both the no action alternative and the Boundary 1 scenario, three of those years would comply. All right?

So it looks like relatively small changes when you look at this. But when you break out the data -- going to the next slide -- and look at the detail, there's a slightly different story. So this slide --

MR. ALADJEM: Dr. Paulsen?

WITNESS PAULSEN: Yes, sorry.

MR. ALADJEM: Brentwood 102, Page 62?

WITNESS PAULSEN: Table A, yes. Sorry.

The left-hand part of this slide looks at water quality objective compliance. So to the left of the first vertical line. The right-hand side of the slide looks at the change in water quality that's predicted to occur.

So maybe the best way to understand this is just to walk through one year. So if you look at 1977, a critical year, because it's a critical year, this 150-milligram-per-liter chloride threshold would need to be met 155 days. For the existing condition, we just squeaked by; it's about 156 days of that year. For the no action alternative, it would be met 145 days, so it would not be met. And for the Boundary 1 scenario, it would be met 112 days. It would also not be met.

When you look at the two sets of columns in the right-hand side of the chart, that's where we see the change in water quality. So you can see that, when you look at the Boundary 1 scenario, 112 days that that threshold is met and you look at the EBC2, 156 days that threshold is met, there's a difference of 44. So

we would lose 44 days of water that would meet that 150-milligram-per-liter threshold. That's a loss of 33 percent.

And then if we compare the Boundary 1 scenario to the no action alternative in the right-hand side of columns, we would lose 33 days that that threshold would be met so 26 percent of the days.

If you look -- well, in a couple of years, you switch from non-compliance to compliance. So for example, 1980 and 1986, in those years the existing condition scenario does not comply with the requirement, but the Boundary 1 scenario does.

In some years -- 1979 is interesting because that is a year in which all of these model simulations show that we would comply with this criteria. But there's a significant degradation of water quality. So in 1979, that is a below-normal year. The threshold would be required to be met 175 days of the year. For the existing condition, it was met 338 days. We met it with a wide margin.

For the no action alternative, it's simulated to be met 311 days, so it still meets it by a fairly wide margin. The Boundary 1 scenario would meet it for 171 days. So it meets that threshold with three days to spare.

But when you look at the right-hand side, if you compare to Boundary 1 to the existing condition scenario, we would be meeting that threshold 160 fewer days in that year. That's a loss of 62 percent of days.

As Mr. Ehlers testified, that threshold is the threshold at which the City can no longer use water at its intake. If you compare the Boundary 1 scenario and the no action alternative, they would lose 133 days in this time period.

Now, we can go through and, if you add the numbers just down the column throughout the 16-year period, again, for the EBC2 condition, we would find that there are 30 days that exceed this -- the threshold; for the no action alternative, there would be 54 days it would exceed the threshold; and for the Boundary 1 scenario, there would be 62 days. Those numbers seem relatively small.

But then, when you add the numbers in the difference columns, for the Boundary 1 scenario relative to the existing condition EBC2, we would lose 148 days over the simulation period. And for the Boundary 1 scenario relative to the no action alternative, there would be 348 fewer days, almost a full year fewer days where that threshold is met over

that 16-year period.

Okay. So what we see is that the frequency of noncompliance with this 150-milligram-per liter threshold increases. But maybe more importantly, even when the threshold is met, the number of days that meet this threshold declines.

All right. So that concludes the part about the 250- and the 150-milligram-per-liter threshold. The next slide shows the EI, the export-to-import ratio, that has been discussed previously during these hearings.

MR. ALADJEM: Dr. Paulsen?

WITNESS PAULSEN: Yes?

MR. ADAGE: This is Brentwood 102, Pages 12 and 13?

WITNESS PAULSEN: Yes. Sorry. Thank you.

We've gone -- we've calculated this ratio, the E-to-I ratio, two ways. Right now, D1641 defines this ratio as the sum of all exports divided by the sum of all inflows. The first way that we calculated the ratio for with the proposed project is we included the North Delta exports in the sum of all exports and we included all the Delta inflows in the denominator. So that's equation 1.

The second way that we calculated it is shown

in equation 2. And that's the way that the petitioners have proposed to define the E-to-I ratio. That would exclude the North Delta diversions from the export part of the calculation, and it would subtract the North Delta exports from the inflows to the Delta. I don't know how it would be defined in the future. I don't know whether the State Board would specify the definition. So that's why we calculated it both ways.

We also thought it was important to understand the change that would be realized.

So the next slide shows the results of that calculation. This is Table 9 from Brentwood 102 at Page 63. All right. For both the existing condition EBC2 scenario and the no action alternative, we've looked at the number of days that that ratio would be exceed over the 16-year model period. So for the existing conditions, 481 or 8.2 percent of the time; for the no action alternative, it's 349 days, 6 percent of the time.

The calculation is the same for both of those because obviously, for the existing condition and the no action alternative, the North Delta diversions wouldn't exist.

For the Boundary 1 scenario, we did the calculation both ways. If you redefine the

export-to-inflow ratio to exclude the North Delta diversions, there would be 270 days where this ratio would be exceeded. That would be just under 5 percent of the time.

If you don't redefine it and you include the North Delta diversions in both the exports and the inflows, there would be 850 days of exceedance, so just under 15 percent of the time that that ratio would be exceeded.

So the way it's defined does make a difference.

I'm going to wrap up right now this section where we've looked at the standards, and hopefully what I've shown you is that, when you look at the model results looking at the daily average chloride concentrations, you can see that there are simulated to be some exceedances of the water quality criteria. Table 8 showed the frequency of compliance with 150-milligram-per-liter standard, shows that it declines. More importantly, it shows that, even when that standard is complied with, there is a decrease in the water quality at the City's intake.

The report, Tables 5 and 6, address the frequency of compliance with the 250-milligram-per-liter threshold. That declines as

well. This slide shows the frequency that the E-to-I ratio would be complied with, either -- both ways that it could be defined.

So we see a decline in water quality in the Boundary 1 scenario. And we see that the decline in water quality of Boundary 1 is above and beyond the decline that would occur due to climate change and sea level rise alone.

All right. Now I'd I like to move to the source of water at the City's intake. So next slide, please.

The next series of slides goes to where the water at the City's intake has originated, where it entered the Delta.

This is figure 15, Brentwood 102, Page 48.

This slide shows the fraction of Sacramento -- the fraction of water at the City's intake that came into the Delta from the Sacramento River. So for example, this shows the four different water year types that we used to evaluate the data. The lower left shows normal water years; the lower right shows wet water years. And you can see the biggest changes during those water year types in terms of where water at the City's intake flowed into the Delta.

This is important because the Sacramento River

together with the eastside streams, which are smaller flows, are the highest quality sources of water. San Joaquin River water is higher salinity. And, of course, Bay water is saltier than that.

So what you with can see is small changes in critical and dry years. You do see a small improvement, an increase, in the fraction of Sacramento River in part of that time, in the April-May time period of dry water years. But you do see significant changes in wet and normal years.

So, for example, if we look at February of the normal water year type, under the existing condition -- that's the gray line -- we can see that on the order of 65 or 70 percent of the party at the City's intake came from the Sacramento River. For the same point in time with the no action alternative -- that's the pink line -- we can see that about 45 or 50 percent of the water at the City's intake would have come from the Sacramento. But with the Boundary 1 scenario, that falls off to on the order of 30 percent.

So we see a decrease in the fraction of Sacramento River water at the City's intake during a good chunk of the time in normal water years and during an even longer chunk of the time in wet water years.

If we go to the next slide, this is Figure 16

from Page 43 of Brentwood 102.

What we see is that, when we remove -- when there's less Sacramento River water present at the City's intake, much of the water that fills the gap, if you will, comes from the San Joaquin River. So, again, in the month of February, we see with the existing condition scenario, February of normal water years, we see very little San Joaquin River water present in the existing condition. For the no action alternative, that rises to probably just under 30 percent for the Boundary 1 scenario. And then for -- sorry -- for the no action alternative, just under 30 percent for the no action alternative and a slightly higher value, probably on the order of just over 30 percent, for the Boundary 1 scenario.

So climate change and sea level rise result in an increase in the fraction of San Joaquin River water that's present at the City's intake. You can see in normal and, even more striking, in wet water years a much larger increase in fraction of San Joaquin River water under the Boundary 1 scenario.

We discussed earlier a little bit about residence time. One really important feature about these source water fingerprints is that, when the freshwater flows into the Delta decrease, the residence

time goes up. That means that there's less flushing in the interior of the Delta and there's more time for salts and ag drainage -- the return flows from the islands -- to build up within the interior Delta.

So the increases in salinity at Brentwood's intake really can be attributed to two things. One is what we've just shown you here on these figures, a change in the fraction of San Joaquin River water and a decrease in the fraction of Sacramento River water. And the second is an increase in residence time and water quality impacts that result from that.

All right. The next slide, Figure 14 for Brentwood 102 at Page 45.

What we've done here is to plot the amount of water or the flow rate that would be exported from the Delta under each of these model scenarios. So for example -- divided into each of the four different year types.

So look at the -- if you look at October in the top left figure, that shows the amount of water that would be exported on average in the month of October in critical years. For the existing condition EBC2 scenario, that's the bar on the left, the bluish bar, we can see on the order of 6,000 cfs would be exported from the Delta. For the no action

alternative, the amount of water is slightly lower. That's the pink bar. And then the bar on the right shows the total amount of water that would be exported from the Delta with the Boundary 1 scenario operations. And that's a little bit higher.

You can also see that that bar is divided into two colors. The orange color is the amount that would be exported from the South Delta export locations, and then the greenish color at the top is the amount that would be exported from the North Delta diversion points. Okay?

Also plotted on the far right-hand side of each of those plots is the average amount of water that would be exported from the Delta under each of those year types. So, again, if we look at critical years, we can see that the amount of water is actually highest for the existing condition scenario for the critical year types, a little bit lower for the no action alternative, and then intermediate for the Boundary 1 scenario.

So Boundary 1 scenario in critical years would actually export less water from the Delta than the existing conditions, but the opposite is true in dry year types, normal year types, and wet year types. So in all of -- in dry and normal years, the no action

alternative would export a little bit less water on an annual average basis than the existing condition. And the proposed project, under operations scenario Boundary 1, would export more water than both the existing conditions and the no action alternative.

For wet water years, the no action alternative would export more water than existing conditions, and the Boundary 1 scenario would export more water than the no action alternative.

We can see some very big differences in the amount of exports during certain months. This helps explain some of the water quality results that we see. So for example, if you look at May of normal water years -- I don't have a pointer. But if you look at May of normal water years, you can see that both the existing condition and no-action alternative would export on the order of 2,000 cfs.

The proposed project under Boundary 1, the Boundary 1 scenario, would export about 8500 cfs. So that's a four-fold increase in the amount of water that would be exported from the Delta in that month.

We see increases in dry years for the Boundary 1 scenario relative to the no action alternative and the existing condition on the order of a few thousand cfs, as much as about 3,000 cfs, in the

month of March in dry year types.

The reason that the source of water -- that the location at which the water is exported from the Delta is important is that the water that is exported from the North Delta diversion locations is composed almost entirely of Sacramento River water. So in these scenarios, what this information shows is that we are both -- in all year types except critical, we would be exporting both more water from the Delta and more Sacramento River water from the Delta.

So there's some additional detail of that in the report, which is Brentwood 102 at Page 50. The volume of Sacramento River water that would be exported in -- under scenario Boundary 1 is about 56 percent greater, that's the long-term average, than for the existing conditions.

For normal water years -- I'm sorry.

MR. ALADJEM: Are we on the next slide?

WITNESS PAULSEN: It's actually not the next slide yet.

MR. ALADJEM: Okay.

WITNESS PAULSEN: Sorry.

For normal water years, Boundary 1 would export 73 percent more Sacramento River water, for wet water years, 182 percent more Sacramento River water

would be exported for scenario Boundary 1 relative to existing conditions, EBC2.

All right. So what does this mean for the City? The next slide, which shows Tables 2 and 3, Page 52 of Brentwood 102 -- in the interest of time, just focusing on the 150-milligram-per-liter threshold, which is in the top table, that's the threshold that Mr. Ehlers testified that the City uses. That's basically its cut-off point for using water at its intake.

What we see in critical years is that that threshold would be exceeded 172 days for existing conditions in critical years, 159 days for no action alternative -- so an improvement for no action alternative relative to existing conditions -- and then an increase to 140 [sic] days per average for critical year types under the Boundary 1 scenario.

Pardon?

CO-HEARING OFFICER DODUC: 184?

WITNESS PAULSEN: Oh, I'm sorry. 184. Thank you.

For dry water years there would be 104 days that would be below that threshold for the existing condition scenario, 84 days for the no action alternative, 128 days -- I'm sorry -- that would be

above that threshold. 128 days above the 150-milligram-per-liter threshold for the Boundary 1 scenario. So, again, an improvement of the no action alternative relative to the existing conditions, and then a decrease in the number of days water would be usable at the City's intake in dry water years.

For normal water years, conditions get worse for both the no action alternative and for the Boundary 1 scenario. So in existing conditions, there would be 112 days of water above that threshold; the no action, 118 above that threshold; and the Boundary 1 scenario, 162 days above that threshold.

So these are impacts that are caused by the project in addition to climate change and that mean that the City will not be able to use water at its primary intake under those conditions in those year types.

If we move to the next slide -- and I think this is the last slide.

This slide is Table 4 from the report, Page 53 of Brentwood 102. This table shows the change in the average number of days in each year type that salinity thresholds will be exceed. So, again, focusing on the 150-milligram-per-liter threshold, what we see is that, in dry years the 150-milligram per liter threshold

would be exceeded 25 more days per year -- more than three weeks per year -- in that year type relative to existing conditions.

Counter-intuitively, the no action alternative, as we saw in the last slide, actually makes things better. Relative to the no action alternative with climate change and sea level rise, there would be 45 more days that that 150-milligram-per-liter threshold would be exceeded by the Boundary 1 scenario relative to the no action alternative. That's just adding 20 and 25.

In normal water years, the 150-milligram-per-liter threshold would be exceeded by 50 more days for the Boundary 1 scenario relative to existing conditions. That would be more than seven weeks of time. And relative to the no action alternative there would be an increase of 44 days for the Boundary 1 scenario.

Looking at the frequency of occurrence of these year types, in the long-term hydrologic record we see that dry and normal years occur about 55 percent of the time in the long-term hydrologic record. So from this we infer that 55 percent of the time the impacts would be significant. And if we add the number of days lost in critical, dry, and normal years, it would be a

total of 946 days over the 50-year operations time period of the project, so about two and a half years' worth of water that would be -- two and a half years of time over the 50-year period that water would not be usable at the City's intake in the critical, dry, and normal years when it would have been under the existing conditions scenario.

MR. ALADJEM: Dr. Paulsen?

WITNESS PAULSEN: Yes?

MR. ALADJEM: You said two and a half years of time. Is that a comparison of the no action alternative and Boundary 1?

WITNESS PAULSEN: I believe that it is, but I would need to dig into the report and double-check that. I believe that's the case. We can follow up on that.

So if I can briefly summarize, in my opinion, the project has not been adequately defined. All model scenarios have climate change and sea level rise, and it was hard for the City to under that what would mean in terms of their current operations. So that's why we pulled in the existing conditions scenario.

We also tried to tease out the difference between changes in water quality caused by climate change and changes in water quality caused by the

project. And we find that, while climate change does result in an increase in salinity at the City's intake, the increase due to the proposed project scenario Boundary 1 is even greater.

We're concerned that the project operations are quite vague and that, while we evaluated the Boundary 1 scenario, we really don't know where within the operating range provided by DWR -- we don't really know really where the proposed project will operate, and we don't understand how the adaptive management program would be used to change operations once the project is up and running and operations proceed.

We were also concerned that DWR presents a lot of information in terms of long-term averages, whereas the detail on a daily or even sub-daily basis is important for a drinking water operator.

Second, I think we've shown that the WaterFix project as operated, especially to the Boundary 1 scenario, would change the hydrodynamics and water quality inside the Delta substantially, and that would cause water quality impacts to the City.

And then, finally, it's clear both that compliance with water quality objectives is likely to be more challenging in the future with the project and that, even when water quality objectives are met, there

is a substantial degradation in water quality the City's intake. And using that 150-milligrams-per-liter threshold that the City operates to, it appears to me that those are significant effects to the City's drinking water operations that would be caused by the project in the future. Thank you.

MR. ALADJEM: Dr. Paulsen, does that conclude your oral summary of your testimony?

WITNESS PAULSEN: Yes.

MR. ALADJEM: Madam Chair, the witnesses are available for cross-examination.

CO-HEARING OFFICER DODUC: Thank you, Mr. Aladjem.

Thank you Dr. Paulsen and Mr. Ehlers.

Let's go ahead and take our morning break. And during the break, I'll ask the Department to set up for cross-examination, and I'll ask everyone else to think ahead. And when we get back, please give me an estimate, for those who would like to come back for cross-examination of this panel, how much time you believe you'll need.

We will resume at 10:40.

(Recess taken)

CO-HEARING OFFICER DODUC: Gosh, I am three minutes late. I obviously must be sick.

All right. Welcome back, everyone.

Mr. Mizell.

MR. MIZELL: Yes, ma'am?

CO-HEARING OFFICER DODUC: The Department's estimated time for cross?

MR. MIZELL: I'll conducting cross of Mr. Ehlers letters, I would anticipate, no more than 15 minutes.

Mr. Berliner will be conducting cross of Ms. Paulsen. He's estimating 35 minutes.

CO-HEARING OFFICER DODUC: Okay.

Who else would like to conduct cross? Come on up and give me a time estimate, please.

MS. MESERVE: Osha Meserve, for Local Agencies of the North Delta and Others. I anticipate about 15 minutes of cross for both of the witnesses.

CO-HEARING OFFICER DODUC: Okay.

MR. KEELING: Tom Keeling for the San Joaquin County protestants. I anticipate about 15 minutes for Ms. Paulsen.

MS. DES JARDINS: Deidre Des Jardins, and I anticipate 20 to 25 minutes.

MR. HERRICK: John Herrick, South Delta Parties, no more than 15 minutes.

CO-HEARING OFFICER DODUC: All right. That

sounds good.

Any other housekeeping items?

(No response)

CO-HEARING OFFICER DODUC: All right. With that, then, I will turn it over to Mr. Mizell and Mr. Berliner.

MR. MIZELL: Thank you. As I stated, I'll be conducting the cross of Mr. Ehlers. I'm going to focus on the statements about the contract in his testimony.

CROSS-EXAMINATION BY MR. MIZELL

MR. MIZELL: First off, hello, Mr. Ehlers.

WITNESS EHLERS: Good morning.

MR. MIZELL: You're concerned with the impacts of California WaterFix, which, if approved will be constructed in the future; is that correct?

WITNESS EHLERS: Yes.

MR. MIZELL: So you're most interested in future conditions and not the current conditions in the Delta; is that correct?

WITNESS EHLERS: I'm interested in both.

MR. MIZELL: How are the current conditions germane to a project that is not yet constructed and the construction time frame is not in the next couple of years?

WITNESS EHLERS: I'm not quite sure what

you're asking.

MR. MIZELL: Why is it important to you that we assess the current conditions in the Delta, given the California WaterFix is not yet constructed and has no bearing on the current conditions in the Delta?

WITNESS EHLERS: My responsibility day to day is to meet regulatory compliance with water quality for both potable water and wastewater. And the current conditions affect my day to day responsibility.

The future conditions will affect the residents of the City of Brentwood and whoever is doing my job at that time.

MR. MIZELL: Isn't it correct, however, that the currently your day-to-day operations are not affected by the California WaterFix as it as not yet been approved or constructed?

WITNESS EHLERS: Correct.

MR. MIZELL: Thank you. You state in your testimony that Brentwood receives surface water by virtue of a contract with the East Contra Costa Irrigation District via Contra Costa Water District; is that correct?

WITNESS EHLERS: Yes.

MR. MIZELL: Are you appearing on behalf of East Contra Costa Irrigation District today?

WITNESS EHLERS: No.

MR. MIZELL: Are you prepared to testify as to the intentions of the East Contra Costa District -- Contra Costa Water District-DWR contract executed in 1991?

WITNESS EHLERS: I am.

MR. MIZELL: And the amendment to that contract executed in 2000?

WITNESS EHLERS: Yes.

MR. MIZELL: And the surface water supplies to the City of Brentwood under the ECCID agreement via Contra Costa Water District are solely by virtue of the 1991 and 2000 agreements; is that correct?

WITNESS EHLERS: Yes, it is.

Can I add to that? There have been additional agreements with the City and Contra Costa Water for conveyance and treatment associated.

MR. MIZELL: Yes, thank you. Good clarification.

If we could bring up DWR Exhibit 327, please, and Page 2. And looking for Paragraph 2. And if we could see the top of Page 3 and the bottom of Page 2, that would be probably most helpful. Okay.

Looking at Paragraph 2, is this a paragraph of the list of conditions under which DWR consents to the

modification of the ECCID and Contra Costa Water District contracts that allow for delivery of water to Brentwood?

WITNESS EHLERS: Yes.

MR. MIZELL: So if we look at Subparagraph (b), are you asserting in your testimony today that Brentwood is due better water quality than that which is established in the ECCID agreement?

WITNESS EHLERS: No.

MR. MIZELL: And looking at Subparagraph (f), if we might scroll down, are you asserting in your testimony that Brentwood is due more water --

MR. ALADJEM: Objection --

CO-HEARING OFFICER DODUC: Sorry. One at a time, please.

Mr. Aladjem?

MR. ALADJEM: The contract speaks for itself. And if Mr. Mizell is simply going to ask Mr. Ehlers what the contract says, we can stipulate the contract speaks for itself. The legal effect is what the contract is, and then the Department and the City can argue about that in our closing briefs.

CO-HEARING OFFICER DODUC: Mr. Mizell?

MR. MIZELL: I'm only asking for what his testimony was intended to assert, not what the

contractually says. So I can't actually get his intention from the four corners of the document.

MR. ALADJEM: Continuing objection, Madam Chair. I'm not sure how Mr. Ehlers' intent helps us understand the contract provisions or the effects of the WaterFix project.

CO-HEARING OFFICER DODUC: Mr. Mizell, why is intent important?

MR. MIZELL: Because on Page 2 of Mr. Ehlers' testimony, he describes that this is the basis of his right, and therefore, his understanding of the conditions upon that basis of right are important.

CO-HEARING OFFICER DODUC: The contract is his base of right?

MR. MIZELL: That is what he asserts in his testimony on Page 2.

CO-HEARING OFFICER DODUC: Is that your assertion?

MR. ALADJEM: Mr. Emanuel, could you put up Mr. Ehlers's testimony for us to look at?

WITNESS EHLERS: My assertion No. 7 on Page 2 was --

MR. ALADJEM: Mr. Ehlers, could you direct us to which line on Page 2?

WITNESS EHLERS: 15, Number 7.

CO-HEARING OFFICER DODUC: Let's wait until it's up, please.

MR. EMANUEL: What was the exhibit number?

MR. ALADJEM: That was Brentwood 1.

CO-HEARING OFFICER DODUC: All right.

Mr. Ehlers, what is the page and line number please?

WITNESS EHLERS: Starting at 15, Number 7, that paragraph there, I was referring to quantity, volume of water.

CO-HEARING OFFICER DODUC: I'm sorry. I'm not following you. What page are we on?

WITNESS EHLERS: Page 2.

CO-HEARING OFFICER DODUC: Page 2. Oh, we're on the wrong page?

WITNESS EHLERS: Line 15.

CO-HEARING OFFICER DODUC: Line 15?

WITNESS EHLERS: Number 7, that paragraph there. I was referring to the volume of water the City purchased through the ECCID agreement, not the quality.

CO-HEARING OFFICER DODUC: Okay. This is not helping. Okay.

Okay. The quantity.

WITNESS EHLERS: Correct.

CO-HEARING OFFICER DODUC: The quantity that

is specified in the contract?

WITNESS EHLERS: Correct.

MR. MIZELL: And the second sentence reads that it is secured by the terms of the 1981 agreement between ECCID and DWR. Really --

MR. ALADJEM: Madam Chair --

MR. MIZELL: -- this is my last question for this witness, so...

CO-HEARING OFFICER DODUC: All right. Let's let Mr. Mizell wrap up his testimony, Mr. Aladjem -- I'm sorry, his cross-examination.

MR. MIZELL: Go back to DWR 327. And we'd be looking for Page 3, Subparagraph (f).

Is it your testimony today that Brentwood is due more water from the State Water Project than is provided for under the contracts that we discussed?

WITNESS EHLERS: No, the City's not asking for any more water.

MR. MIZELL: Okay. Thank you very much.

MR. BERLINER: Good morning.

CROSS-EXAMINATION BY MR. BERLINER

MR. BERLINER: Good morning, Board Members, witnesses. My name is Tom Berliner. I represent the Department of Water Resources. I'm assisted this morning by Ms. Jolie-Anne Ansley.

I have questions for Dr. Paulsen, and they are in the topic areas of the -- just some preliminary questions on her experience with DSM2, scenarios considered in her analyses, the use of model output regarding water quality, Delta water quality, and historical water quality at Antioch. I'm anticipating about 35 minutes.

CO-HEARING OFFICER DODUC: Thank you. Please proceed.

MR. BERLINER: Just some preliminaries, Dr. Paulsen. It's my understanding that the opinions that you're giving on behalf of Brentwood are the same -- are subsumed within the opinions you're also giving for Antioch, but then you have some additional opinions for Antioch; is that correct?

WITNESS PAULSEN: There are definitely common areas between the two. You know, for example, I'm going to try not to repeat testimony about Delta hydrodynamics and how the Delta works and where inflows and exports are and that kind of thing.

There are some differences. I mean, obviously for Brentwood, we focused on water quality at Brentwood's primary intake and, for Antioch, we focused on water quality at Antioch's intake. So I don't know if that's all the differences, but that's the majority

of them.

MR. BERLINER: That's how I understood it as well, that there are some particulars to each of the two cities but that, in general, your opinions concerning Delta water quality overall, operation of California WaterFix, comparing of EBC2 to the no action alternative and Boundary 1 are all common to both parties.

WITNESS PAULSEN: A lot of the underlying analysis is common, but I do have additional information to present that's specific to Antioch.

MR. BERLINER: Okay. Great. I'm going to be focusing, I hope, as much as possible on the common areas, even though I may have specific mention of -- of either Brentwood or Antioch. But I'm not going to get into the specifics of water quality for Brentwood at this time.

WITNESS PAULSEN: Okay.

MR. BERLINER: You mentioned that you use DSM2, but you don't run it, correct?

WITNESS PAULSEN: No, that was for CalSim. We do run DSM2.

MR. BERLINER: You do run DSM2?

WITNESS PAULSEN: Yes.

MR. BERLINER: And do you run it yourself?

WITNESS PAULSEN: I do it in collaboration with some of my staff. So in particular -- they do the actual "hit go" on the model. But I reviewed input files, output files with them, looked at the routines that are called within the model, all of that.

MR. BERLINER: And when you need to do a CalSim run, who do you have do it?

WITNESS PAULSEN: We don't do CalSim runs in house.

MR. BERLINER: No, I understand. Do you go to somebody -- if you need a CalSim run, do you hire a subcontractor or go to DWR? Or what do you do, assuming that you do need CalSim runs done from time to time on projects that you work on.

WITNESS PAULSEN: Yeah, a couple of things, two parts. First of all, for this, we didn't do any additional CalSim runs. We relied -- for the work that has been presented here, we relied on the work -- both CalSim an DSM2 -- that was done by the Department.

For other projects, separate from this, when we need CalSim II, we've done it a few different ways. Sometimes we go for publicly available studies. Sometimes there's work that is done specific to a given project by another firm, and we'll take that. We've collaborated with other firms on that.

In some instances, we collaborate with other consultants who take and modify existing CalSim runs. There are a number of ways that we've gotten at that.

MR. BERLINER: And have you worked with the modelers over at the Department of Water Resources on DSM2?

WITNESS PAULSEN: I've used DSM2 in various projects for a long time. And I have interacted with some of DWR's modelers at meetings at many times over the years. In general, if we have a specific question about the model or the input data or the technical details, I will usually ask my staff to talk to DWR's modelers directly.

MR. BERLINER: Do you or members of your staff participate in the DSM2 modelers group?

WITNESS PAULSEN: Members of my staff have probably coordinated in recent years more with DSM2 -- sorry, with DWR staff on an individual basis.

We have -- my colleagues and I have attended the -- what's it called now? The CWEMF -- sorry. What's it stand for -- the California Water Environment Modeling Forum, I think. We've attended those meetings and interacted with people there on occasion.

So, you know, there's also a community of modelers out there not associated with DWR. And we

interact with many of those folks on a fairly regular basis as well.

MR. BERLINER: And when you use DSM2, do you find it adequate to accomplish the work that you have -- are assigned to accomplish?

WITNESS PAULSEN: All models have some limitations, and when you work with them over the years, you start to know them. We try very hard not to ask questions that we think the model is inappropriate to answer -- if that's responsive.

MR. BERLINER: Well, I think that's partially responsive. But when you have an assignment that requires you to run DSM2, do you find that the model is such that you get the outputs that you need?

WITNESS PAULSEN: Again, we try hard not to ask questions where we think the models's not a suitable tool. We try to ask questions and use the model in a way that we believe it's suited for.

We have done some specific work in the past to adjust model parameters where needed to, you know, make some adjustments to the model so that it does provide more reliable or better output for us.

MR. BERLINER: And when you're using the model, do you run it over the same 16-year period that DWR does?

WITNESS PAULSEN: We've also run long 82-year simulations using DSM2.

MR. BERLINER: So you've done both?

WITNESS PAULSEN: We've done both.

MR. BERLINER: So looking specifically at your report -- and I'm going to focus mostly on your report rather than your testimony?

WITNESS PAULSEN: Okay.

MR. BERLINER: It's my understanding that you used existing conditions, which you're calling EBC2?

WITNESS PAULSEN: I didn't name it that. The Department named it that. But, yes, that's correct.

MR. BERLINER: Right. Okay. And this morning, even though I didn't pick it up in your report or your testimony, one of the things you mentioned was that you were using EBC2 because the City wanted to know impacts under current conditions; is that right?

WITNESS PAULSEN: Yeah. I think -- I mean, the City understands how it operates now and how water quality varies at its intake now, under current conditions. And so they wanted to take a look at a run that was reasonably close the existing conditions and how they operate now, sort of as a grounding point or a point of comparison, and also because we have, you know, some understanding of how the model operates

under current conditions.

MR. BERLINER: In your discussions with the City over the value of using a current-condition run, did you explain to them that there is, as you mentioned in your report, climate change is expected to impact the Delta, that it may increase salinity? I understand we don't have exactly what the input -- what the results of climate change will be, but did you discuss in general with them that you expect there will be changed conditions in the future?

WITNESS PAULSEN: Yes, and we've discussed that with them for years. You know, for example, with the BDCP model runs, there were two time frames that were simulated, an early long-term with 15 centimeters of climate change -- of sea level rise, excuse me, and the late long-term, which is a later time period with 45 centimeters of climate -- of sea level rise, excuse me.

And, you know, one of the questions that we discussed was which of those two scenarios is appropriate for evaluating a project that's going to operate over a 50-year time period?

We also discussed the impacts that would be due to climate change. And that was part of the reason that the City asked us explicitly to try to figure out

what the impacts would be due to climate -- what impacts would be caused by climate change and sea level rise and what impacts would be caused by the project as two separate and distinct things.

And we had a feeling that this question might be raised as well, and so that's why we presented three scenarios -- the existing condition, the no action alternative, and Boundary 1. And those can be compared to each other -- I mean, there are three different ways to compare those three scenarios one to one.

MR. BERLINER: And in discussing the impacts with the City, did you discuss with them that there are going to be impacts caused by climate change and sea level rise that have nothing to do with the California WaterFix?

WITNESS PAULSEN: Some of those are laid out in this report. Yes, we did.

MR. BERLINER: Now, one of the things that you mentioned was that you don't know of any precedent for using a future conditions analyses -- such as the no action alternative -- as a baseline for evaluating a project like WaterFix; is that a fair paraphrase?

MR. ALADJEM: Objection, misstates the testimony.

CO-HEARING OFFICER DODUC: Let's let

Dr. Paulsen affirm or reject that summary.

WITNESS PAULSEN: In my experience, it's important -- well, and the City asked us -- to compare, you know, as I've already stated, both what are the effects due to climate change and what are the effects due to the project.

The only way that we knew to tease that out with the model runs that we have from DWR was to look at all three scenarios.

MR. BERLINER: Understood. But my question to you related to a statement that you made in your testimony that, in your experience, there's no precedent for using a future condition, such as the no action alternative, in isolation as a baseline for evaluating the impact of a proposed project on other legal users of water. Do you recall that?

WITNESS PAULSEN: I don't think I worded it quite that way.

MR. BERLINER: Actually, I was reading it.

WITNESS PAULSEN: I'm sorry?

MR. BERLINER: I was reading it.

WITNESS PAULSEN: Oh, okay. Then apparently I did say that.

In my experience, I mean, I've worked on a number of projects in the Delta where we've looked at

projects that are proposed changes in existing operations of facilities.

In most of those, we have looked both at an existing condition; we've looked at a future condition which would represent the with project, and we've looked at future without project, again, for the same reason that I've explained here is to try to be able to tease apart the impacts that are caused by the project versus the impacts that are caused by other changes that are going to happen absent the project in the future.

In my experience, that kind of comparison is very informative in terms of understanding the impacts of a proposed project. That's why we did it.

MR. BERLINER: I understand that. I was really reacting to the statement that you made that there was no precedent for using a future condition such as the no action alternative.

MR. ALADJEM: Madam Chair, it appears that Mr. Berliner has a transcript. It might be helpful if we could put that up on the screen and let the witness respond to it directly.

MR. BERLINER: Sure.

CO-HEARING OFFICER DODUC: Is that from her testimony, Mr. Berliner?

MR. BERLINER: From 102, Page 19.

WITNESS PAULSEN: I found it.

MR. BERLINER: About two-thirds of the way down.

CO-HEARING OFFICER DODUC: I think we would like to see it. So 102, Page 19?

MR. BERLINER: Yes.

There's a sentence that starts, "In my experience," which is in the second paragraph, most of the way down.

CO-HEARING OFFICER DODUC: All right. Your question, Mr. Berliner?

MR. BERLINER: So it kind of jumped out at me because you indicated that, based on your experience, you weren't aware of any precedent. And so I wanted to ask you, do you follow changes in California law related to how projects are analyzed?

WITNESS PAULSEN: I'm obviously not an attorney. I follow some of that loosely.

What I meant to convey with this sentence -- and maybe I did it imperfectly. But what I meant to convey is that, in my experience, it's typical to analyze both the current condition and two future scenarios, a with and without project in the future, because there are all sorts of changes -- changes in

land use, changes in hydrologic patterns, all sorts of changes that may occur.

And in the projects that I've worked on, we've evaluated all of those. So what's what I meant to convey.

MR. BERLINER: Okay. I understand that a little differently than your sentence. So it just may have been some drafting that caused me -- or my review of your drafting that caused me a little misunderstanding.

But I take it you are acknowledging that looking at a future no project condition is appropriate if you want to understand what the impact of the future will be when the project is constructed and you're concerned about what the environmental conditions will be at that time and the effect of the project on the environment at that time.

MR. ALADJEM: Again, Madam Chair, misstates the testimony. Dr. Paulsen has said several times that you should look at the future with project and the future without project.

WITNESS PAULSEN: Right. And I --

CO-HEARING OFFICER DODUC: So the answer to Mr. Berliner's question is yes?

WITNESS PAULSEN: That I agree with what he

said?

CO-HEARING OFFICER DODUC: Agree that there should be -- that in analyzing future scenarios, there should be a no project scenario in the future and a project scenario in the future, notwithstanding the fact that you believe there should a third scenario of current conditions.

WITNESS PAULSEN: I didn't understand the question the way you worded it. I think I agree with what you just said.

CO-HEARING OFFICER DODUC: Very wise, Dr. Paulsen.

MR. BERLINER: I will avoid where she went to undergraduate school.

Now, under your existing conditions, the EBC2 scenario, this does not include climate change or sea level rise, correct?

WITNESS PAULSEN: That's correct. And just to clarify, it's not my scenario; it's DWR's.

MR. BERLINER: DWR's.

WITNESS PAULSEN: Yes.

MR. BERLINER: And by "yours," I mean the one that you chose as a point of comparison for your report. So I'm not attributing EBC2 to you, just to the fact that you used that scenario in your report.

And you also indicate in your report that climate change and a particular sea level rise is expected to lead to increase of salinity in the Delta in the future, correct?

WITNESS PAULSEN: Yes, with the caveat that that is true at many times of year. I tried to point out in the testimony this morning places where the no action alternative was actually predicted to have better water quality than the existing condition.

So in general, if you -- for example, when you sum the numbers over those rows or those columns of data, in general, the no action alternative is worse than the existing condition. But there are instances in year types within that modeled period of record where that's not the case, where the no action is actually better than existing conditions.

MR. BERLINER: But just to be clear, in the future, based on what you've said in your report, you expect that there will be climate change, that there will be sea level rise, and that you expect that it will overall increase salinity in the Delta; is that correct?

WITNESS PAULSEN: As a long-term average and based on these model simulations, yes.

MR. BERLINER: And I believe it was -- you

were making a statement that, if you included climate change in the future, that you would be masking part of the impact of the California WaterFix; is that correct?

WITNESS PAULSEN: Within the model results, there are certainly times when that does happen, yes. You can see that, I think, most clearly -- I'm sorry. Give me a minute to find it -- in Figure 4, which is on Page 32 of the report.

MR. ALADJEM: Mr. Emanuel, could you -- excuse me, Mr. Emanuel. Could you pull that up for us, Figure 4, Brentwood 102?

WITNESS PAULSEN: Page 30.

MR. BERLINER: So you understand, I take it, that EBC2, the -- that no action or the existing conditions base case, it was based on the BDCP?

WITNESS PAULSEN: Right. Although, we did dig into the input files for EBC2 and the NAA. And except for the sea level rise and the climate change, I believe most of the model parameters are the same between the two.

MR. BERLINER: Are you aware that EBC2 is based on the 201 version of CalSim?

WITNESS PAULSEN: That may be true. I mean, it is a 20- -- it was a model run that I think we obtained in or around 2013.

MR. BERLINER: That sounds about right. So it was not based on, obviously, the 2015 version of CalSim?

WITNESS PAULSEN: It could not have been.

MR. BERLINER: Are you aware that there are differences in the base code between the 2010 and the 2015 CalSim models?

WITNESS PAULSEN: There very well may be.

MR. BERLINER: But you don't know yourself?

WITNESS PAULSEN: I haven't looked into that issue specifically, and I don't know the extent to which they'd affect, you know, what we're looking at here.

MR. BERLINER: Okay. Were you watching the testimony of Walter Bouret in these proceedings?

WITNESS PAULSEN: I've watched portions of a fair amount of the testimony. I don't believe I saw all of his testimony. But I watched portions of it.

MR. BERLINER: I just asked because it was a very long day of cross-examination, and we spent an awful lot of time talking about the differences between the two models. I won't try to repeat that here.

WITNESS PAULSEN: And I couldn't answer the questions that he can answer. I don't have that level of expertise at all on CalSim.

MR. BERLINER: Understood.

Regarding the Boundary 1 scenario, again, it's my understanding that you chose that extreme end of the range instead of the H3-to-H4 operating range I guess because you felt that there was some level of uncertainty as to the conditions under which the project would be operating.

MR. ALADJEM: Objection, misstates the testimony. Dr. Paulsen said that Boundary 1 was one of the boundaries the Department had said it could operate to and, therefore, she analyzed that boundary condition.

MR. BERLINER: You know, I sort of think the doctor is capable of answering these questions herself without Mr. Aladjem's assistance.

CO-HEARING OFFICER DODUC: Dr. Paulsen, was there any other particular reason why you chose to analyze Boundary 1?

WITNESS PAULSEN: There were at least a couple of --

CO-HEARING OFFICER DODUC: Microphone, please.

WITNESS PAULSEN: Oh, I'm sorry.

There were at least a couple of reasons. One of the reasons -- sorry.

One of the reasons was because it did have

more water quality impacts than the other model scenarios. We also -- I listened to part of the -- of DWR's testimony in this proceeding as well. And I recall testimony that said that Boundary 1 should be analyzed in order to evaluate the proposed project.

We sort of also, I think, anticipated this line of questioning as well. And there are summary results some of the other model scenarios in the appendix to this report.

MR. BERLINER: Yes. I'd like to get to those with you a little further on in our cross-examination.

But focusing on the B1 analysis, I take it you understand that, in choosing to compare scenario B1, it does not include the San Joaquin IE ratio or the existing Fall X2 flow requirement for Delta smelt?

WITNESS PAULSEN: I think there are a couple of other things as well, but those are among them, yes.

MR. BERLINER: And that both the EI ratio and the Fall X2 flow requirement are present under existing conditions? In other words, they are current regulatory requirements?

WITNESS PAULSEN: Right. And, in fact, there were two existing-condition model runs that were performed by the Department in or around 2013. There was an EBC1 and EBC2. One included Fall X2; one did

not. That particular requirement is pretty important to water quality in the Delta.

And I'm sorry. I forgot the thread of your question.

MR. BERLINER: That you understand that there are existing regulations including the IE ratio and the Fall X2 requirement in the existing-conditions base case.

WITNESS PAULSEN: I know it includes Fall X2. I don't remember the specifics about the IE ratio. I was a little confused, to be honest, about the description of Boundary 1 in some of DWR's testimony because there were portions in the testimony where they said that the model scenarios comport with or are consistent with D1641 objectives.

But then it also says that the scenario B1 -- I've got a quote in the report from it at Page 21. "Scenario Boundary 1 does not include additional spring Delta outflow, additional OMR flows, existing I-to-E ratio, and the existing Fall X2 requirement."

So I believe some of those are -- I was a little confused about whether there was a disconnect between all the scenarios comply with D1641 and what was modeled as part of Boundary 1. So I'm not sure how to answer that question.

MR. BERLINER: Okay. Fair enough.

So as I understand it, you are arguing that it would be -- that it's appropriate to make a comparison of impacts that should be based on existing conditions but that does not include climate change or sea level rise but does include the IE ratio and Fall X2 against a project scenario that includes both climate change and sea level rise but does not include the IE ratio and Fall X2?

WITNESS PAULSEN: I do believe it's an appropriate comparison. I believe it's a necessary comparison because we don't have another way to evaluate the existing condition. And with the model runs that DWR has performed, I don't know of another way to try to answer the City's question as to what impacts are due to sea level rise and climate change -- which by definition an existing condition can't include, right? So of course those are uncommon -- and what are the impacts of the project itself.

MR. BERLINER: What does the City do with the information about -- if you've had these discussions with them of understanding that existing conditions don't have a relation to those future conditions in terms of understanding impacts of sea level rise or climate change?

WITNESS PAULSEN: I think there are a number of reasons the City could use that information. I mean, one of them is that the City has to plan for the future. They have to plan for their drinking water operations. They have to plan for rates they're going to charge their customers.

In order to do that, they need information on how water quality is going to change in the future, how much they can use water at their intake, and how often they have to obtain water from other sources.

MR. BERLINER: And so were you able to discuss with them the difference between what the future may hold with sea level rise and climate change as opposed to what the future may hold with the addition of the California WaterFix project?

WITNESS PAULSEN: That's what we've tried to do within the report.

MR. BERLINER: And how did you characterize to the City, in terms of their planning requirements, what they need to understand assuming WaterFix is not constructed?

WITNESS PAULSEN: Again, it's laid out within the report. If they want to know how water quality is anticipated by the Department to change in the future as a result of sea level rise and climate change at a

time Horizon of 2025, that's what we tried to provide with this report, the tables of number of days that water would be of suitable quality, et cetera.

MR. BERLINER: Let me ask this differently. I'm going to guess that the City would be indifferent to changes in water quality if it didn't have an effect on any of their operations.

In other words, the City is looking at this, Mr. Ehlers as a utility manager is looking at this and saying, "Dr. Paulsen, tell me what I need to understand for the future in terms of sea level rise and salinity changes for me to do my job and be prepared for that eventuality."

MR. ALADJEM: Madam Chair, this is not an objection; Dr. Paulsen can answer that question. But we have Mr. Ehlers' here, who's assistant public works director. It might be better directed to him.

CO-HEARING OFFICER DODUC: Is there a reason you're asking Dr. Paulsen instead of Mr. Ehlers?

MR. BERLINER: I would be happy to have Mr. Ehlers answer the question.

WITNESS EHLERS: I think both are of importance to the City for future planning, rates setting. I think the sea level rise and climate change is more of a hypothetical than a physical in the sense

that it's going to be something we can see happening through time and have time to make changes, where the project is the project as given. And I also know that there is the 1641 water quality conditions that the Department has to provide to ECCID.

MR. BERLINER: Does understanding what sea level rise and climate change may hold for the future help guide you in either water treatment plant or wastewater plant operations and the kinds of things you'll be having to plan for in the future?

WITNESS EHLERS: Sure it does.

MR. BERLINER: And are you planning any changes based on information that you have today to either your water treatment plant or your wastewater plant?

WITNESS EHLERS: Not on climate change, no.

MR. BERLINER: What about on changes in salinity in the Delta?

WITNESS EHLERS: There's no current CIP or plan for any type of alternative treatment.

MR. BERLINER: Okay. Thank you. Appreciate that.

Dr. Paulsen, I think one of the other reasons that you identified scenario B1 was because you weren't sure where -- or you contend the DWR has not spelled

out with sufficient clarity where adaptive management will take the different operating scenarios?

WITNESS PAULSEN: I don't have a good enough understanding of that, correct.

CO-HEARING OFFICER DODUC: But was that a factor in your selection of Boundary 1?

WITNESS PAULSEN: Well, I mean, there's a very broad range between Boundary 1 and Boundary 2. And I know operations -- it's been stated that they'll start somewhere in the vicinity of H3 and H4 or H3-plus. I don't know at what point they will deviate from that or under what conditions or what decision criteria.

MR. BERLINER: And are you aware that there are -- that within the proposed adaptive management framework, there would be various triggers as to how adaptive management would be applied based on monitoring results?

WITNESS PAULSEN: I know it's called the adaptive management and monitoring program. There are pages and pages of tables laid out in a couple of the documents, I think RDEIR/SDEIS -- we need a better name for that -- and other places. And some of them, some of the references are somewhat circular. Some of them are references to long fin and Delta smelt primarily.

We spent a fair amount of time trying to

figure that out, to be honest. And I don't feel like I understand yet exactly how those -- not exactly, even generally how those changes will be made.

MR. BERLINER: And do you understand that the adaptive management and monitoring program is primarily aimed at fishery resources?

WITNESS PAULSEN: I read it that way, yes.

MR. BERLINER: Have you reviewed the biological assessment for the WaterFix?

WITNESS PAULSEN: We spent a fair amount of time with the draft BA. I've spent a little bit of time with the final BA. All of these documents are pretty large. I'm not sure if I've reviewed what you have in mind.

MR. BERLINER: Well, I was wondering if you've reviewed the final BA where the adaptive management program is more comprehensively set forth.

WITNESS PAULSEN: I have reviewed bits and pieces of it. I have not reviewed it in depth.

MR. BERLINER: One of the comments that you made in your report was that you did understand that adaptive management would be primarily aimed at fish requirements.

But in terms of project operations, do you also agree that, regardless of fish operations, the

project also has to be operated to meet Delta water quality requirements which includes obligations to meet standards for municipal and industrial use?

WITNESS PAULSEN: I think I'd have two responses on that. I understand that DWR's testimony says that. But as presented here, it looks to me like compliance in the future with the project, particularly under scenario B1, which doesn't include some components of current operation standards, is going to be more challenging.

And, second, I think we've shown that, even when water quality objectives are met, the water quality the City's primary intake is going to degrade, particularly for scenario Boundary 1.

MR. BERLINER: But not so much for H3 and H4, correct?

WITNESS PAULSEN: Right. Boundary 1 definitely shows more impacts or a larger magnitude of impacts.

MR. BERLINER: Do you understand that Boundary 1 and Boundary 2 were included because the Department was requested to show a broad range for purposes of analysis?

WITNESS PAULSEN: I do understand that generally.

MR. BERLINER: And do you also understand that the Department's proposed project, preferred alternative, if you will, is H3-plus?

WITNESS PAULSEN: Yes.

MR. BERLINER: Turning to water quality, you're, as I understand it, making an argument that, in order to understand compliance with water quality requirements, you need to look at compliance on a daily basis; is that correct?

WITNESS PAULSEN: The water quality objectives are expressed on a daily basis, are number of days, so yes.

MR. BERLINER: Do you understand that the work that's been done thus far on the California WaterFix is a planning study?

WITNESS PAULSEN: For a planned project.

MR. BERLINER: And for a planning study rather than an operational scenario, you want to look at trends rather than daily values?

WITNESS PAULSEN: I disagree with that.

MR. BERLINER: I thought you might.

Do you -- are you suggesting that it's an appropriate use of the CalSim and DSM2 modeling capabilities to reduce chlorides to a daily average ?

WITNESS PAULSEN: I'm not sure what you mean

by "to reduce chlorides to a daily average." What do you mean by that?

MR. BERLINER: In general on the -- well, when you're looking at model outputs, as I understand it, you're contending that the model outputs should be reduced to daily values as opposed to a longer time frame?

WITNESS PAULSEN: DSM2 model output is on a 15-minute basis. From that, you can calculate longer term averages. You can calculate a daily average; you can calculate a monthly average; you can calculate a 16-year average.

MR. BERLINER: So when you calculate a daily average -- trying to not make this technical -- could you explain what it is you do to come up with the daily average for, let's say, January of 1979?

WITNESS PAULSEN: The model output will specify the EC concentration that is simu- -- EC level or concentration that is simulated to occur on 15-minute basis throughout the 16-minute period. If I wanted to know the daily average concentration for January 1st, 1970- -- I'm sorry -- '9?

MR. BERLINER: Pick any year.

WITNESS PAULSEN: Whatever year, we would take the 15-minute model output for that day. There will be

24 hours times four values per hour, so that number -- I think that's 96 -- and we would average those.

MR. BERLINER: Now, you would not take that information, would you, and tell a client that, on a specific day of a specific year, you expect water quality to be X, would you?

WITNESS PAULSEN: Well -- especially for a future condition. I mean, we're modeling climate change and sea level rise, not 1979. I think there are -- I think I understand where you -- well, I shouldn't get ahead of you.

I'm not sure I know how to answer that question the way you posed it.

MR. BERLINER: You've taken the model and suggested that you could determine that there are so many days in a given year that there are going to be exceedances of the D1641 standards, correct?

WITNESS PAULSEN: I wouldn't word it that way. I would say that we've taken DWR's model output, we've calculated daily average chloride concentrations and we've compared those to the water quality objectives.

I don't mean to say that water quality on January 1st, 2038 or whatever day you could pick in the future is known. But I think we can use the modeling in a comparative fashion to evaluate how water quality

will change in the future.

And I do think it's appropriate to use DSM2 output and average it to a daily time scale and compare that to water quality objectives that are expressed in the daily -- on a daily basis.

I don't know how else to evaluate what compliance may be. I'm not saying that in a future above-normal year there will exactly this number of exceedances. I'm saying that in a future above-normal year the rate of exceedance, the frequency, if you will, of exceedance is likely to change in the fashion that we've laid out here.

MR. BERLINER: So I originally asked you about looking, rather than at individual days, do you look at trends. And I think you're answering now -- and I don't want to put words in your mouth -- that you're looking for trends?

WITNESS PAULSEN: I think we do in both. I think we're using the daily data to derive some summary statistics and to use those to infer information about how things are likely to change in the future.

I'm a little confused in the way DWR has used these model results. They say in some places that they're using monthly CalSim output to infer compliance and in other places that they're using daily EC output

to assess compliance with D1641.

When we can reproduce some, but not all of DWR's analyses -- I mean, for example, we can reproduce the 16-year average information. But in my mind that is not sufficient to assess whether -- how compliance with water quality objectives is likely to change in the future with climate change and with the project.

MR. BERLINER: Why don't we just take a look at your Table No. 5 on Page 59.

MR. ALADJEM: Mr. Emanuel?

MR. BERLINER: Chair Doduc, I noticed that I'm about to run out of time here. I'm about two thirds of the way through. This is taking longer than I expected. I needed more "yes" answers.

CO-HEARING OFFICER DODUC: All right. This is a complicated issue. Let's go ahead and continue at least until noon. Can you wrap up by noon?

MR. BERLINER: Yes.

CO-HEARING OFFICER DODUC: All right. Let's do that, and we'll take our lunch break then.

MR. BERLINER: So just looking at this table, you've identified the no action alternative, which includes sea level rise and climate change, and you've included scenario B1.

And you have told us that, under those

scenarios, you expect there to be, for example, under the no action alternative for 1986, 26 days where the 250-milligram-per-liter chloride standard will be exceeded, correct?

WITNESS PAULSEN: I'm not saying I expect that. I'm saying that the model results show that.

MR. BERLINER: Okay. Let's be clear. This is not the real world. This is a modeling output, correct?

WITNESS PAULSEN: All of these are model outputs, yes.

MR. BERLINER: So they don't include realtime operations, correct?

WITNESS PAULSEN: I mean, that is correct. The model's running things according to a fixed set of rules.

MR. BERLINER: And they do include modeling anomalies, correct?

WITNESS PAULSEN: To the extent that all models have anomalies, they're included in model results.

MR. BERLINER: So one of the anomalies that was discussed -- let me back up.

Did you hear the testimony of Dr. Nader-Tehrani?

WITNESS PAULSEN: Again, I'm not sure I listened to all of it but I listened to at least part of it.

MR. BERLINER: Were you listening when he discussed the modeling anomalies that occurred in trying to meet water quality standards, for instance, for the month of August?

WITNESS PAULSEN: I don't recall that specifically. I probably did listen, but I don't remember the details of where you're headed here.

MR. BERLINER: Just by way of reminder, he was showing that, if you looked at the modeling output, you would see that there were exceedances for the month of August. And yet he explained that that exceedance doesn't really exist because the standard changes in the middle of the month. But because you have a model that operates on a monthly time step, you can't show that middle-of-the-month change. What you end up showing is an exceedance because that's the only thing the model can do. You understand that?

WITNESS PAULSEN: Well, yeah. And I believe there was also some written testimony along those lines as well.

MR. BERLINER: Do you agree with that?

WITNESS PAULSEN: I know that that's a

phenomenon. I do not agree that it's responsible for the exceedances, or at least not all of them, that we're observing here.

So, for example, the figure that we had up before -- sorry -- Figure 4 on Page 30 of the report, that shows some exceedances of the 250-milligram-per-liter chloride threshold that persists for several months at a time. And they aren't in the month of August. So I don't think that that explanation can account for the modeled salinities that we're seeing here.

CO-HEARING OFFICER DODUC: And why is that, Dr. Paulsen?

WITNESS PAULSEN: If I understood Mr. Berliner's question correctly, he's talking about some -- when water quality standards change within a month or it -- CalSim output is on a monthly basis; there can be a step function. I think there was also some testimony about the smoothing of that step function when you convert CalSim output into DSM2 model input.

Those things, those -- a change of standards within the course of a month or the smoothing function, where you're smoothing out that step function in between a month, I think that those would account for

anomalies, if you will, on the order of a few days or a month. I don't think a smoothing function, as you move data from one month into the next, could account for exceedances that last for -- I don't remember the number of days but more than a hundred days at a time.

And I know it's been stated that operations changes can fix some of the exceedances that are seen in the modeling. I haven't seen any quantitative demonstration of that, particularly for exceedances like this that are very long and persistent. I think there are two ways that an operator could fix an exceedance like this. One would be to reduce the amount of water that's removed from the system via exports; the other would be to increase inflows or some combination of those two things.

I haven't seen any adjusted model runs that attempt to do that, to avoid these kinds of simulated exceedances, show what would be required to avoid them.

MR. BERLINER: Mr. Emanuel, maybe we could flip to DWR 5, Pages 71 and 72.

Let's start with Page 72.

CO-HEARING OFFICER DODUC: You mean 5 errata.

MR. BERLINER: 5 errata, correct.

Dr. Paulsen, have you seen this graphic before?

WITNESS PAULSEN: Yes, I have a copy of it in front of me.

MR. BERLINER: This graphic shows -- the way this graphic is read is the D1641 150-milligram-per-liter chloride objective is met at Contra Costa as long as the lines on the top half of the graphic don't cross over into the blue area. So what we see that 1977 was a problem.

In all other years, under all other water conditions during the period of this modeling exercise, it shows that the standard was met. Do you understand that?

WITNESS PAULSEN: I understand that that's what the graph says. We tried a number of different ways to reproduce the information in this graphic, and we were not able to do so. I don't know why.

MR. BERLINER: Did you reach out to DWR to ask?

WITNESS PAULSEN: No.

MR. BERLINER: Okay. Let's go to the prior page Mr. Emanuel. It's Page 17.

This is for the 250-milligram-per-liter standard. This takes a different approach than what you took. This is an exceedance chart, and it shows that roughly about 7 percent of the time under

Boundary 1, which would be the gray line, it exceeds the no action alternative, but all other scenarios fall below the no action alternative. Do you see that?

WITNESS PAULSEN: I'm trying to tease out which line is the no action alternative. I'm sorry.

MR. BERLINER: The black one.

WITNESS PAULSEN: The black one. So it's -- if you look from the left along the zero axis line, it's the second one?

MR. BERLINER: So if you go to the far right, it's easiest to see where the black line sticks out. And just above the black line is a gray line, which is the B1 scenario.

WITNESS PAULSEN: Okay. Right.

MR. BERLINER: So this approach is a little different than the approach you took, correct?

WITNESS PAULSEN: This approach aggregates the data in -- basically, it's in a Thomas plotting position. I mean, they took all of the daily average salinity data and ordered them from the lowest to the highest and counted the number of times, presented that in a probability fashion, counting the number of times that that 250-milligram-per-liter threshold was exceeded. That's my understanding of this.

MR. BERLINER: I think that's a fair

understanding.

And what we see here is, rather than breaking it down by years, they've looked essentially at the trend and said, "Well, under B1," or whichever scenario you pick, "we would expect there to be exceedances of this amount"?

WITNESS PAULSEN: Over the long-term 16-year average, right.

MR. BERLINER: Yes. So this is more of a trend analysis, correct? In other words, the trend is at some point you're going to start to run into trouble?

WITNESS PAULSEN: I don't think of it as a trend analysis at all. I think of it as a probability distribution. Trends usually look at how things will change over time with some change or another. And I don't see that as presenting this other than presenting differences between the scenarios.

I mean, again, this is a way of aggregating a lot of information into, in essence -- this isn't a long-term average but a long-term view of how often it will be exceeded.

You know, one of the questions that we talked about with the City was how useful this information was to them in terms of their day-to-day operations. And

it wasn't because they can't tell from information presented in a summary aggregated way like this how long a water quality exceedance will persist, when it will happen, any of that information.

MR. BERLINER: Let's move on.

In your testimony, you indicated that as far as Delta water quality is concerned, that agricultural return flows are a source of salinity and other constituents in the Delta. Do you recall that?

WITNESS PAULSEN: Yes.

MR. BERLINER: Among those constituents, you identified fertilizers that are used in the Delta. Do you recall that?

WITNESS PAULSEN: Fertilizers are used in the Delta. I don't recall calling it out, but that's certainly true.

MR. BERLINER: Do you have an idea what the contribution is to the salt load in the Delta from within-Delta agriculture?

WITNESS PAULSEN: I've never tried to quantify that. I did work as part of my Ph.D. when we were characterizing the different sources of water to the Delta. And one of the things I was curious about when I was doing that work was whether you could -- whether ag return flows looked different than other flows and

whether we could create a fingerprint for them. And we collected some samples, just, you know, at return locations that we found when we were out doing -- when I -- I did it myself -- when I was out doing sampling. And we couldn't really create a distinct fingerprint for it. It looked, at least at that point in time 1990s, it looked a lot like San Joaquin River water looked.

MR. BERLINER: So you could not disaggregate it?

WITNESS PAULSEN: Not in the sense of having it be mathematically separate or distinct from San Joaquin River flow. You know, and I think there's probably at least in part a reason for that the water that is diverted from Delta channels is applied to crops, and some fraction of that is put back.

The salts that are in the original water that's diverted will be concentrated, and additional salts from the soils will be picked up. So it wasn't surprising to me that they looked somewhat similar.

MR. BERLINER: I did promise you we could take a look at the appendix -- work in the appendices that you had done on H3, H4, and B2. Maybe we can do that now.

Mr. Emanuel, could you go back to Brentwood

102 to Page 5 of Appendix A.

So for purposes of following the way you did your analysis, looking at Table A1, this is a table that shows chloride concentrations above 150 milligrams per liter. And Table A2 is the same but for 250 milligrams per liter, correct?

WITNESS PAULSEN: That's correct.

MR. BERLINER: So looking across the chart, as I look at the numbers that you computed, generally speaking, doesn't it show that, whether you compare existing conditions or the no action alternative, both H3 and H4 result in less days per year where the average daily concentration is above either the 150- or 250-part standard?

WITNESS PAULSEN: I'd need to go through it line by line.

I should make a clarification as well. It doesn't say that these results are for Pumping Plant 1. So just so we're talking about a consistent location.

MR. BERLINER: I'm sorry. I -- you're -- I might have missed what you said. Could you just repeat that?

WITNESS PAULSEN: I'm sorry. I just realized that the location of where the data was taken for these tables isn't labeled correctly. And I'm pretty sure

it's Pumping Plant 1. So I just wanted to make that clear.

I think your question was whether or not the number of days that would exceed are fewer in H3 and H4 than that they would be for either EBC2 or the NAA in all of these. And I believe that --

MR. BERLINER: Oh, there's an exception, I believe.

WITNESS PAULSEN: Yeah, exactly. I believe that's generally true except for dry years in the 250-, I think. I haven't reviewed them all.

MR. BERLINER: Yes. In the dry years --

WITNESS PAULSEN: But I think that's right.

MR. BERLINER: In the dry years, between existing conditions and H3/H4, you go from 19 to 22 or 23.

WITNESS PAULSEN: Correct.

MR. BERLINER: That's the only instance that I could find.

WITNESS PAULSEN: I think that's right.

MR. BERLINER: So in terms of meeting water quality requirements based on your analysis, H3 and H4 perform better than the no action alternative or B1, correct?

WITNESS PAULSEN: Perform better if you mean

by that that there are fewer exceedances of these chloride objectives, that's the case.

MR. BERLINER: Yes, that's exactly what I meant.

CO-HEARING OFFICER DODUC: Mr. Berliner, is there a question?

MR. BERLINER: Yes, I'm getting -- I think I'm really close to the end here.

Since we're going to be having Dr. Paulsen up again relating to Antioch, I have a very few questions related to Antioch. And I'll hold those until that point. And so I'm finished for now.

CO-HEARING OFFICER DODUC: All right. Thank you, Mr. Berliner. Well, we finished early.

Ms. Meserve, I believe you had requested 15 minutes. Hopefully we can get through your cross-examination and then take a lunch break.

MS. MESERVE: What I was wondering, Madam Hearing Officers is whether, since we're going to have Ms. Paulsen here subsequent to Antioch, if I could just reserve my questions for her and ask her all at once.

And I just had a couple of questions for Mr. Ehlers, and I could ask those now.

CO-HEARING OFFICER DODUC: Any objections to that?

(No response)

MS. MESERVE: If I can just conglomerate together?

CO-HEARING OFFICER DODUC: Does anyone else have questions just for Mr. Ehlers?

(No response)

CO-HEARING OFFICER DODUC: Seeing none, all right. I appreciate the constructive suggestion, Ms. Meserve.

CROSS-EXAMINATION BY MS. MESERVE

MS. MESERVE: Good afternoon. Osha Meserve for Land and Other Protestants. I guess it's still morning. I just had a couple of quick questions for Mr. Ehlers about -- in his work as the water treatment operator.

If you were -- Mr. Ehlers, if you were -- if it was necessary to use lower quality water at your intake for the City, what would that lead to in terms of your operations in costs?

WITNESS EHLERS: Ultimately it would lead to a change in treatment technique, reverse osmosis. We've done a couple studies on RO, and the annual O and M was somewhere to the tune of a million or two a year just in off-haul of brine, not to mention the additional expense for power, pumps.

MS. MESERVE: So if you had to do those types of things, then would the rates for your residents have to go up?

WITNESS EHLERS: Oh, significantly. One of the other options we would have would be to -- to pump more water through CCWE conveyance, and that doubles our pumping costs.

MS. MESERVE: Why does that double your pumping cost?

WITNESS EHLERS: The City currently owns a portion of the Contra Costa Canal. So our pumping cost through the portion that we own is about 50 percent of pumping direct through CCWE conveyance, via Old River.

MS. MESERVE: Now, is it your understanding that, when you divert water from the City's diversion that, in large part, the water is coming from the San Joaquin River, or are you aware of the source?

WITNESS EHLERS: I get daily a water quality report and can follow some trends. But I couldn't tell you exactly if it was coming from San Joaquin or North Delta.

MS. MESERVE: Just generally as a water treatment operator, is it your opinion that the water coming from the Sacramento River is of superior quality?

WITNESS EHLERS: Yes. And to add to that, just a recent trend, prior to the recent rains, chlorides at Rock Slough were up 180, where this week they're all the way down to 60, day to day.

MS. MESERVE: So, again, as an operator, if -- theoretically, if you could have all Sacramento River water, would that be better for the City?

WITNESS EHLERS: Absolutely, no question.

MS. MESERVE: Back on the costs of treatment, would be you concerned about people in your community being able to pay for increased water bills if you're treatment costs went up?

WITNESS EHLERS: Very much so.

MS. MESERVE: No further questions.

CO-HEARING OFFICER DODUC: Thank you.

Any other questions for Mr. Ehlers?

Ms. Des Jardins.

MS. DES JARDINS: Yes.

CROSS-EXAMINATION BY MS. DES JARDINS

CO-HEARING OFFICER DODUC: How many questions?

MS. DES JARDINS: My name is Deirdre Des Jardins. I'm a principal with California Water Research.

And I wanted to pull up --

CO-HEARING OFFICER DODUC: Ms. Des Jardins,

how many questions? What topic areas? How much time do you expect?

MS. DES JARDINS: I'm just going to ask about salinity intrusion in the Delta and what would happen depending on how the requirements for salinity control were interpreted because that is an issue.

And I don't anticipate taking more than ten minutes.

CO-HEARING OFFICER DODUC: All right. Please proceed.

MS. DES JARDINS: Okay. So can you pull up, I believe it's Exhibit DDJ-98, which is Decision D990. Yep. And go to Page 49, bottom of the page.

So this is a section. There's two different interpretations of project. Okay. Stop.

So bottom of the page, there's two different interpretations of the Bureau's requirements for salinity control in the Delta in the future. And this is from the original decision granting the Bureau's permits that are -- this change is sought.

This says, "Thus it's clear the protection of the Delta from the salinity incursion constituted a material part of a consideration for which the State of California assigned to the United States the applications which it had filed to provide adequate

water for the project. This protection was intended to accomplish two purposes: First, to provide the agricultural lands in the Delta with water of a quality suitable for irrigation, and second, to provide a reasonably accessible source of supply to meet the industrial and agricultural requirements along the south shore of Suisun Bay and Contra Costa County."

CO-HEARING OFFICER DODUC: Hold on, Ms. Des Jardins.

Mr. Mizell?

MR. MIZELL: Yes. I would like to know if the witness is even familiar with the original federal permits and how he became familiar with those permits because I don't think that foundation has been laid. We might object to his expertise in interpreting these permits as well.

CO-HEARING OFFICER DODUC: Mr. Ehlers, are you familiar with this?

WITNESS EHLERS: I'm familiar with them just through the project and the State Water Projects. But have I read it recently? No.

CO-HEARING OFFICER DODUC: Let's allow Ms. Des Jardins to ask her question, and you're free to answer that you don't know.

MS. DES JARDINS: Yeah. So it's just if -- if

part of the Bureau's project purpose in the future, even under conditions of sea level rise, is to provide this water supply for industrial uses, is that important to the City of Brentwood?

WITNESS EHLERS: Very much so.

MS. DES JARDINS: Yeah, okay. So let's go to Page 50, and then stop. In contrast to the federal plan, the Bureau as operator of the project now contends that its only obligation is to provide to its contract customers water of suitable quality at the intakes of the Delta-Mendota and Contra Costa Canals.

Under this change, the Delta-Mendota Canal could be completely isolated from the Delta water and just use water taken at Hood, and the Contra Costa Canal could just take water at Freeport.

So if the Bureau interpreted that its salinity obligations were only to provide water at the Delta-Mendota and Contra Costa Canals in the future under sea level rise, would that affect your municipal supply?

WITNESS EHLERS: It would. But just to correct you, it would be -- Contra Costa Canal is Rock Slough. And it physically won't connect to Freeport.

If the Freeport connection happens with Contra Costa Water District, it would be either pump it back

from Bethany Forebay or from pumping directly from Middle River and a connection to the project.

MS. DES JARDINS: Would the Freeport project potentially give Contra Costa Canal a water supply that is completely isolated from Rock Slough and is not affected by the salinity at Rock Slough if there was salinity intrusion?

WITNESS EHLERS: No. It's a different physical location. The Freeport tie-in wouldn't be at Rock Slough. That's what feeds the Contra Costa Canal.

MS. DES JARDINS: Yeah. Isn't Freeport north of Hood?

WITNESS EHLERS: Yes.

MS. DES JARDINS: Yeah. So that would give Contra Costa a supply taken from north of Hood?

WITNESS EHLERS: Right. But just so you know, it wouldn't be through the Contra Costa Canal. It would be through the pumps that pump through Los Vaqueros. It's a different pipeline. It's further south.

MS. DES JARDINS: Okay. So can we go to DDJ-8, please. And this is -- Mr. Ehlers, you talk about your challenges in recent years.

This is a picture of the extreme salinity intrusion in the Delta on January 28th, 2016. It's a

map that is done from DWR salinity data.

Do you have any recollection of the salinity intrusion in January of 2014?

WITNESS EHLERS: It's been high through the last few years of drought.

MS. DES JARDINS: Yeah. Was it a problem for you?

WITNESS EHLERS: We had to alternate source. So the City's water agreements with Contra Costa water, it's about that thick [indicating]. And part of the City limits is overlapped by CCWD; so we call that the overlap area.

So the City is allowed to get just shy of 2,000 acre-feet a year from Los Vaqueros. So we try and run the plant in such a manner that will blend, if necessary, to meet acceptable limits of chloride.

MS. DES JARDINS: But that 2,000 acre-feet a year, is that sufficient if you had to rely on that?

WITNESS EHLERS: No, no. It's very shy of sufficient.

MS. DES JARDINS: What would happen if, during an intrusion like this, the projects had the North Delta intakes and started just diverting from the North Delta intakes and not releasing sufficient water to repel salinity? How would that affect you?

WITNESS EHLERS: Well, it would impact potable water quality. You'd be drinking salt water. And it would put it in violation of our waste discharge requirements.

MS. DES JARDINS: What would happen if the Bureau said, "We don't have any obligation to provide salinity control for you"?

WITNESS EHLERS: We'd be forced to go to alternative treatment.

MS. DES JARDINS: Okay. Can I go to -- let's see. I've got -- go back to my list of exhibits. I need to go to Decision D1275. And scroll down just a minute.

Oh, I believe it's DDJ-96. And then can we go to Page 30. I've got a section highlighted.

There we go. Zoom in on the highlight part.

So it says -- this refers to sections of the Water Code. This is part of the considerations under which -- the permit to the Department of Water Resources. This is Exhibit DDJ-1275 [sic] which is the -- the Decision 1275 which is -- granted the permits to the Department of Water Resources which the Department of Water Resources seeks to change.

And at Page 30 it states, "Sections 11460 to 11463 prohibit the Department from depriving a

watershed or area wherein water originates or an area immediately adjacent thereto which can conveniently be supplied with water therefrom of the prior right to all water reasonably required to supply the beneficial needs of the watershed or area."

Are you adjacent to the Delta?

MR. ALADJEM: Madam Chair, I'm going to object to this line of questioning.

MS. DES JARDINS: Okay.

MR. ALADJEM: This is a legal question as to the effect of the area of origin statutes. Mr. Ehlers is a project operator. He's not a lawyer. If we're going to be talking about area of origin, that's not an appropriate line of questioning.

MS. DES JARDINS: Okay. I will stop.

CO-HEARING OFFICER DODUC: Thank you. Thank you.

If there are no objections, I think we will follow Ms. Meserve's excellent efficient procedure, and after the lunch break, we will ask Dr. Paulsen to present her testimony on behalf of Antioch. And then we will resume cross-examination, first by the Department and then the other parties who have designated their intent to conduct cross-examination.

Actually, I'm sorry. Before we do that, do we

have redirect for Mr. Ehlers?

MR. ALADJEM: Madam Chair, I was going to ask whether it was the Chair's pleasure to do that now or to wait until after all of the cross-examination was complete.

CO-HEARING OFFICER DODUC: All right. Is Mr. Ehlers willing to stay?

WITNESS EHLERS: I'm here at your pleasure.

CO-HEARING OFFICER DODUC: All right, because I was hoping to dismiss him. But if he is willing to stay, then we will be happy to have his presence after lunch.

Mr. Brodsky, do you have an update for us on North Delta CARES' remaining witness?

MR. BRODSKY: Yes. North Delta CARES has determined to rest on the testimony that's been given so far, so we won't be calling Mr. Marshal. So we're done presenting witnesses. So -- is this on?

North Delta CARES will rest on the witnesses we've already presented, so we won't be calling Mr. Marshal. And I assume, then, we should submit our exhibit into evidence, say, a week from yesterday?

CO-HEARING OFFICER DODUC: That's correct, noon a week from yesterday.

MR. BRODSKY: And then also I would like to

request a half an hour to cross-examination Ms. Paulsen with the time comes.

CO-HEARING OFFICER DODUC: All right. And I will make a note that this is what happened when I threatened counsel with presenting the three general announcement. His clients withdraw their witness.

MR. BRODSKY: I can still come tomorrow morning just to make the statements.

CO-HEARING OFFICER DODUC: Thank you, Mr. Brodsky.

With that, we will take a lunch break. We resume at 1:15.

(Whereupon, the luncheon recess was taken at 12:08 p.m.)

AFTERNOON SESSION

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(Whereupon, all parties having been duly noted for the record, the proceedings resumed at 1:19 p.m.)

CO-HEARING OFFICER DODUC: All right. Good afternoon, everyone. I'm really slipping on my timing today.

All right. I see people lining up already. Ms. Suard?

Ms. Suard, is your microphone on?

MS. SUARD: There we go. Nikki Suard with Snug Harbor. I drove here to say that I would like to ask questions of Ms. Paulsen, maybe 15 minutes' worth.

CO-HEARING OFFICER DODUC: All right. Timingwise, let me do a check.

Mr. Berliner, Mr. Mizell, how much time do you anticipate needing for cross-examination?

MR. MIZELL: For the Antioch portion of Ms. Paulsen, ten minutes.

CO-HEARING OFFICER DODUC: All right. How much time do you anticipate for direct, Mr. Emrick?

MR. EMRICK: I talked to Ms. Paulsen, and we think it would definitely be briefer than Brentwood, so we're anticipating about 35 minutes.

CO-HEARING OFFICER DODUC: Okay. And your other witness? I'm trying to anticipate, to see if we can finish today.

MR. EMRICK: Oh, other witness? Probably about 10 to 15 minutes.

CO-HEARING OFFICER DODUC: We will try. I think it's going to be challenging, but I assume there's no objection if we're able to wrap up today, at least wrap up with Dr. Paulsen today, at a minimum.

Could you check with our Webcast personnel to make sure that that's not a problem?

We may have to stay a little bit after 5:00, but to the extent that we could at least finish with Dr. Paulsen today, that would be great. To the extent that we could finish completely today so that I might rest tomorrow, that would be even better. But in any case, we will proceed. And we will turn now to Mr. Emrick to conduct his direct.

MR. EMRICK: Thank you. Matthew Emrick, City of Antioch. Good afternoon, Board.

I will start off with a very brief -- very brief opening statement. We've provided -- City of Antioch has provided, I think, what is a very thorough opening statement of our positions and would definitely recommend that -- spend the time to read it today.

I think what I would like to do prior to Ms. Paulsen's testimony is tell you a little bit -- some of the following things that are going to be a little different about Antioch than, say, the City of Brentwood or from some of the other protestants you've heard from today.

City of Antioch has existed in one form or another since 1850. The City's taken water or folks in the City have taken water since 1850. Antioch is actually located downstream of most of the 1641 compliance locations. So the City is downstream of Rock Slough, downstream of Emmaton.

And I think the significance of that is, if you look at the graphic that was put on the board -- I think it was by Ms. Des Jardins. The significance of that is that, if there is increases in salinity at Rock Slough at Emmaton, it's going to be worse at Antioch.

Again, DWR has the option under D1641 to operate at Rock Slough, which is where CCWD and Brentwood take their water, or at Antioch. But during the cross-examination Mr. Leahigh, he testified that DWR does not currently operate D1641 for Antioch and has no plans to do so in the future.

The only -- presently the only form of mitigation or water quality control at Antioch is a

1968 agreement that was entered into between Department of Water Resources and Antioch. That agreement -- under that agreement, DWR reimburses Antioch for one third of the cost of purchasing substitute water when it has to under a certain set of conditions, generally when water quality gets over 250 parts per million. But there's other conditions triggering that too. Those are set forth in the agreement.

Antioch was able to extend that agreement in 2013 and that agreement extended the fixed term to 2028. So the fixed term of Antioch's agreement will end in 2028, which, according to the testimony, will be prior to the operation of the WaterFix project, the twin tunnels.

So I'm going to now transition to Dr. Paulsen. Dr. Paulsen has prepared testimony regarding the potential impacts to City of Antioch from the WaterFix project. And with that, I'll conclude my opening remarks and go on to Dr. Paulsen.

DIRECT EXAMINATION BY MR. EMRICK

MR. EMRICK: Good morning.

WITNESS PAULSEN: Good afternoon.

MR. EMRICK: You're still sworn; is that true? Do we have to -- good afternoon.

Do we still have to swear her, or is she still

sworn?

CO-HEARING OFFICER DODUC: No she has already taken the oath.

MR. EMRICK: Oh, great.

And you've also stated your name.

CO-HEARING OFFICER DODUC: I'm assuming Dr. Paulsen hasn't changed her mind about telling the truth during lunch.

MR. EMRICK: And you're prepared today and here today to provide testimony on the impacts of the WaterFix project or the potential impacts of the WaterFix project to the City of Antioch; is that correct?

WITNESS PAULSEN: Yes.

MR. EMRICK: And Exhibit 200 -- Antioch's presented some exhibits. Exhibit 200, that is a true and correct copy of your written testimony with respect to the WaterFix project as to Antioch?

WITNESS PAULSEN: Yes.

MR. EMRICK: And Exhibit 201 is a true and correct copy of your qualifications with respect to your testimony today with respect to Antioch?

(Protestant City of Antioch's Exhibits 200 and 201 identified for the record)

WITNESS PAULSEN: Yes.

MR. EMRICK: And we don't need to go over your qualifications, again?

Is -- Chair, is that true? We don't need to have Ms. Paulsen go over her qualifications again today?

CO-HEARING OFFICER DODUC: No, especially her undergrad work.

MR. EMRICK: And then Exhibit 202 is a copy of a report you prepared on behalf of Antioch relating to the effects of the WaterFix project on the City of Antioch; is that correct?

WITNESS PAULSEN: Yes.

MR. EMRICK: And that report is incorporated into your written testimony?

WITNESS PAULSEN: Yes. The intent of the report was just to sort of provide additional information to supplement the information in the testimony and explain it.

MR. EMRICK: And then if I could have you look at Exhibits -- Antioch Exhibits 203 to 233, the list.

WITNESS PAULSEN: Yes.

MR. EMRICK: Those are true and correct copies of documents that you relied upon, at least the part, in preparing for your testimony today with respect to the WaterFix impacts on the City of Antioch?

WITNESS PAULSEN: Yes.

MR. EMRICK: And Antioch Exhibit 216, that is a document that refers to salinity in the Delta; is that correct, historical salinity in the Delta?

WITNESS PAULSEN: Yes.

MR. EMRICK: And that was prepared by CCWD?

WITNESS PAULSEN: They're listed as the authors of that report, yes.

MR. EMRICK: Did you help in preparing that report?

WITNESS PAULSEN: I did. Specifically, we worked with CCWD. We saw some early drafts of the report. We commented upon them. We checked and redid, supplemented a handful of the analyses in the report. We wrote some sections concerning historical salinity at Antioch that were used in the report. We reviewed a final draft of the report.

So, yeah, I helped coauthor it, really.

MR. EMRICK: Yes. And you're actually -- your name is actually in the acknowledgements; is that correct?

WITNESS PAULSEN: As is yours.

MR. EMRICK: And for your testimony today, you've prepared a PowerPoint that summarizes the impacts that you've identified with respect to the

WaterFix project on Antioch; is that correct?

WITNESS PAULSEN: Yes.

MR. EMRICK: And then for the purposes of this afternoon, we are going to -- I'm going to rely on you to try to call out those portions of your testimony that are different or particular to Antioch and different than what you've testified to this morning.

WITNESS PAULSEN: Okay.

MR. EMRICK: To the extent you can.

WITNESS PAULSEN: Yes.

MR. EMRICK: Okay? So why don't we go ahead and have Antioch Exhibit 234 errata. And then I will turn it over to you to make the presentation.

Thank you.

WITNESS PAULSEN: Okay. Thank you. I will try to just talk about what's new, what we didn't already talk about.

If we move to the next slide, please.

With respect to qualifications, obviously my qualifications are the same as they were this morning. The one thing that I would add is that I have worked with the City of Antioch for about ten years on issues related to water quality. I've reviewed a range of historical documents, historical data, historical reports, data describing their operations and water

quality. And I have assisted with evaluating the 1968 agreement and the technical issues in terms of how it is implemented and has been interpreted. And I did help during the process of extending the agreement term with the revised -- the amendment to the agreement that was executed in 2013.

I've also worked with the City of Antioch in the Delta flow criteria proceedings. And we've previously submitted information to the Board. Some of it is appended to the testimony today.

The next slide.

In terms of -- there are six primary opinions that we submitted on behalf of the City of Antioch. I'll describe in a moment, briefly, what parts of those are sort of common with Brentwood and what's new.

But first, there are sort of three key differences in my mind between Brentwood and Antioch that will distinguish the testimony for the two parties. One is the location, obviously. We'll look at a map, but Antioch is farther to the west in the Delta. It's near the 160 bridge. And because of this and as Mr. Emrick stated, it's affected by sea water intrusion sooner than other locations in the Delta and to a greater extent than other locations in the Delta.

The second thing is there does exist an

agreement between the City and the State which reimburses the City of Antioch for one third of the water that it must purchase when water quality at its intake is too salty for it to use. And there's a specific formula in the agreement that spells out how that occurs and how that's assessed.

And the third thing is -- I think we talked about it briefly, but we'll talk about it again more here. The water quality objectives in D1641 are applied differently or evaluated differently at Antioch than they are at Brentwood. Specifically, they're not much evaluated at all at Antioch.

The 150-milligram-per-liter D1641 objective specifies that it can be evaluated either at Pumping Plant 1, which is what we looked at this morning, or at Antioch's intake. And practically speaking, it's always been evaluated and probably will be evaluated in the future at Pumping Plant 1 and not at the City's intake. But we'll show some water quality data to show you what it would look like if it were implemented or evaluated at the City's intake.

All right. With respect to these opinions, Opinion No. 1 for Antioch is that water was historically fresh at Antioch. That was not covered in the Brentwood testimony. There's a lot of detail in

the report and the attachments to the report. And I won't go into that level of detail at all, but I would like to give you an overview of that.

Second, we already covered my opinion that DWR's evaluation of the proposed WaterFix project is inadequate. And I won't touch on that very much again.

The third opinion is that the WaterFix project will result in substantial changes in Delta hydrodynamics and the composition of water in the Delta. I won't cover the background; I'll just show you some results specific to Antioch's intake location.

The fourth opinion is that WaterFix will result in increased salinity at Antioch's intake and will increase the number of days that Antioch must purchase water from other sources. And I will describe that in detail.

The fifth part I will mostly skip over. It has to do with compliance with water quality objectives. The one thing I would like to show you is what it would look like if the 150-milligram-per-liter objective were evaluated at Antioch's intake.

Six is just a wrap-up opinion that it's been difficult, given the information provided with the petition, to assess the expected impacts of the project to Antioch, but we do expect water quality degradation

to occur, and we do expect it to affect the City's operations.

All right. If we can skip forward two slides, please.

This map is in the report. We submitted this PowerPoint. There's one revision to it, but we've submitted this PowerPoint. We submitted it when the rest of the testimony was due. So I will represent to you that, unless I tell you otherwise, this information is in the report and is also in the exhibit -- in the PowerPoint submitted as a pdf on the same date.

So this map shows, again, the statutory boundary of the Delta. And the location of the City of Antioch near the western edge of the Delta. What I can tell you is, because of the City's location in the Western Delta, salt water is present more frequently and for longer durations of time now than it was whether the City first established its intake at this location in the late 1800s.

Marked increases in salinity were first noted in 19-teens and the 1920s. There are a couple of reports that have been submitted, historical reports from I believe 1924 or 1928 and 1931 that go through the salinity increases seen in the vicinity of Antioch and the western Delta in a tremendous level of detail.

Salinity intrusion and the impacts to Antioch's intake also increased during the 1940s with construction of the Central Valley Project. And then again in the 1960s, salinity increased with the construction of the State Water Project.

So we have a condition where water at the City's intake in the late 1800s and the very, very early 1900s was essentially fresh at pretty much all times of the year and under most hydrologic conditions. It was only in the driest periods of dry years on some portions of the tide that salinity intruded to a point where Antioch could not use its intake.

In the late 19-teens and the 1920s, there were large diversions of water upstream of the Delta that affected the amount of water that entered the Delta. There have been also been a wide range of other changes in the Delta -- loss of tidal mash, change in the channel morphology, other factors that have affected the distribution of fresh water and saltwater within the Delta.

And the 1920s and the 1930s are a time period when salinity intruded into the Delta farther and to a greater extent than it had ever prior. And when you look at those historic reports from the late 1920s and early 1930s, they were written for that reason --

because there was an increased intrusion of saltwater to the Delta to an extent that had never been witnessed before, and it was a problem.

Subsequent to that, now, currently, the State Water Project and the Central Valley Project, as we discussed, pump water out of the southwestern portion of the Delta. And that does have the effect of drawing fresher water into the interior Delta at times when it might not have happened that way historically.

So we have historically fresh. It degraded significantly in the teens, the 20s, the 30s. And it got somewhat better when the projects came online, but it did not go back to historical conditions.

The reason we're presenting this information is because we believe that there are some statements in DWR's testimony that might be a bit misleading with respect to the historical salinity condition. And we'd like to set the record straight and provide that information for the State Water Board to consider.

One major differences, too, that is due to the location of the City of Antioch versus the location of the City of Brentwood is that the export of water from the southwest Delta via the CVP and the SWP does cause some freshening at some times of the year in the interior Delta. That impact is generally not felt at

the City of Antioch. Rather the city -- salinity at Antioch's location, because it's on the western edge of the Delta and subject to the strong tidal influence, is more of a general balance between freshwater from the rivers and saltwater from the Bay. And there is less of a freshening effect due to pulling Sacramento River water into the Southwest Delta at Antioch than there is at other locations. So Antioch, by virtue of its location, is affected more by salt water intrusion.

I believe that Mr. Bernal's going to talk about the 1968 agreement, so I'll skip over that for now.

All right. The next slide we've seen before, a couple of times. It talks -- probably more than a couple of times. I've showed it to you a couple of times.

This is the D1641 water quality objectives. The first row, the 150-milligram-per-liter objective -- which is a sliding scale, again, dependent on year type -- can be evaluate either at Contra Costa Canal at Pumping Plant 1 or at Antioch. And we've heard lots of testimony that practically speaking it's evaluated at Pumping Plant 1 and not at Antioch. So this level of water quality is not expected to be met at Antioch's intake.

The next slide has to do with the export to inflow ratio. We can skip this. And then the next slide, I'd like to go into a little bit more detail about water being historically fresh at Antioch's intake.

There's a lot more detail in Antioch 218, which is prior submittals that I've helped prepare that have been submitted to the Water Board and then also in that historical salinity report prepared by CCWD but with some assistance from others. And that's the Antioch 216. Sorry.

The next slide -- and this is the only graphic I want to show about salinity at Antioch's intake. Antioch's agreement provides a fundamental baseline of 208 days. And that's based upon a specific time period within the year and the expectation that historically fresh water would have been available during that time period which was 208 days long.

Practically speaking, we know that now it is not available for that length of time except during wet years and sometimes during above-normal years. So this graphic shows the average number of usable water days at Antioch. And I should explain, too, that the 1968 agreement defines useable water as a day has usable water if the salinity that's measured at the intake two

hours after slack -- at slack current, which is two hours after higher high tide, if at that point of time in each day the salinity that's measured is less than 250 milligrams per liter chloride content. Okay?

So I'm going to talk about salinity in a couple of different ways. One is as it's defined in the agreement, which is what this is showing, and another way is just looking at the salinity and the use of the intake irrespective of how the agreement defines it.

So this figure is Figure 2 from the report. It's the average number of usable water days at Antioch as determined using the agreements formulation -- so using the salinity level that's measured two hours after higher high tide -- for the years of 1969 through 2015. And the agreement was entered into in 1968, so this is what water quality has looked like since that agreement was initially entered into with the City.

What we can see is then, in wet years, on average there are about 225 days of usable water for this definition. In above-normal years, that falls closer to 200. And there's some variability about that. In below-normal years, it's on the order of 150. In dry years, it's on the order of 120 or so. And in critically dry years it's fewer than 50 days on

average.

Also labeled there's an "N equals 16 years," "N equals 7 years." That's the number of years of that hydrologic year type classification that have occurred in that same time period. So what we did was we took the number of days for each of those years, calculated the mean, and then calculated the standard deviation about that mean. And that's what's shown here.

What we can see is that, in contrast to the historical condition in the late 1800s, early 1900s, when water was available under almost all conditions, there are certain year types and certain conditions in which water is rarely available or less frequently available than it was historically. So there's already been a very significant impact to the water quality at Antioch that's occurred to date.

I think the only thing I may have forgotten to say is that there's a graphic in some of the prior testimony in Exhibit 218, Antioch-218, which I think is instructive. It shows that Antioch was able to use water at its intake under that historical condition that existed in the late 1800s and very early 1900s for most of the year in all year types. Only at high tide during late summer and early fall of dry or critical years was water quality unsuitable for use.

In contrast now, water quality is suitable for use in critical years on the order of 50 days per year. So that's a big difference.

All right. Opinion 2 has to do with DWR's evaluation of the proposed WaterFix project. That's -- sorry. The next slide.

I would just echo back to the testimony provided for Antioch that we don't understand the operations or the adaptive management program well enough to really know how the project's going to be operated or what the impacts will be.

In the next slide, which is Figure 3 from the report, this slide compares the existing condition, which is the EBC2 run, which we talked about earlier, and the no action alternative. And, again, both of these are model runs performed by DWR, and we're just taking their model output and plotting it and analyzing it.

What you see here is the results summarized by the different year types. Again, "normal" means above normal and below normal. And you can see where the red rectangles and the red boxes are, you can see that salinity is expected to be higher in the no action alternative than in the existing condition. So this is an increase in salinity that would be caused by climate

change and sea level rise.

You can see that most of that increase occurs when salinity is already high. And we did the same kind of analysis -- we found that, in the first six months or so of the water year, we see greater impacts than we do in the latter six months of the water year. That's what's shown here.

The next slide is a repeat of the figure from Brentwood. We can, I think, skip over this.

The next slide is a divider slide talking about the changes in the Delta hydrodynamics and the composition of water in the Delta. This figure is identical to the figure presented for Brentwood. So I think we can skip over this.

Just to remind you what it showed, it showed that, except in critical year types, the project is operated to scenario boundary 1 will export more water from the Delta than the other -- than the existing condition and no action alternatives and will export water directly from the Sacramento River. So it will end up exporting more Sacramento River water so more water overall and more Sacramento River water in particular.

All right, the next slide, this slide -- sorry, back one.

This slide shows the fraction of water at the City's intake that would have flowed into the Delta via the Sacramento River. What we can see here is that, there are some pretty big changes to the composition of water at the City's intake in dry, normal, and wet water years. So here the EBC2 condition is a blue line; the no action alternative is a pink line; and the Boundary 1 operations scenario is an orange line.

So the biggest changes occurred during the fall months October-November of dry water years.

In normal water years, we see changes and we see a reduction in the fraction of Sacramento River water at the City's intake, simulated, in the months of October through about April. And in wet water years, we see that in most months of the water year, the fraction of Sacramento River water at the City's intake would be on the order of 10, 20 percent less with the Boundary 1 scenario than it would have been with either the existing condition or the no action alternative activities scenario.

So, again, in -- the changes are smaller in critical years, but in dry, normal, and wet water years, we're seeing a reduction in the amount of Sacramento River water present at the City's intake as a result of implementation of Boundary 1. In normal

years, that reduction is by as much as 30, 40 percent.

The next slide shows the fraction of San Joaquin River water at the City's intake for these different year types. It's very low in critical and dry years, and in normal and wet water years, it's much larger.

We can see between, say, February, March, and April of normal years -- the lower left panel -- that the fraction of San Joaquin River water is significantly greater for the Boundary 1 scenario than for either the existing condition or the no action alternative. And then in wet water years, the existing condition and the no action alternative are very similar, but the Boundary 1 scenario shows through most months of that year a significantly higher fraction of San Joaquin River water at the City's intake.

So we're losing Sacramento River water during some of these year types and we're gaining San Joaquin River water, which has an overall impact on water quality.

The other big determinant of water quality at Antioch's intake -- if we go to the next slide -- is the fraction of water present at that intake that has entered the Delta from the Bay. That water has higher salinity than the other sources in all but very wet

conditions. And salinity at some times can approach that of sea water.

What we see is an increase in the fraction of water at the intake that arrives from the Bay in the fall months of critical years; in the fall months of dry years; in fall months, April-June, and then toward the end of normal water years; and in wet water years, in the April-May time period and in the September time period.

So the bottom line, Sacramento River water is removed from the Delta. It's replaced with water from lower quality sources, specifically, mainly, the San Joaquin River and inflow from Martinez.

And there's a simple mass balance going on here. When the water from these lower quality sources comes in, the water quality at the City's intake is degraded.

All right. The next slide is just a divider slide for Opinion 4. I would like to talk about this in detail because I think almost all of it is specific to Antioch's intake location.

If we go to the next slide, here, we're going to look at the chloride concentration as evaluated at the time period specified in the 1968 agreement. So here we looked at the difference between the average,

the monthly average chloride concentration as measured at slack current after higher high tide for Scenario Boundary 1 relative to the existing conditions. And the results are shown by water year type. Where there's a negative value, there are I think just two entries in the table with a slight negative value -- January of wet years and I believe it's June of critical years.

That means that the Boundary 1 scenario will actually improve water quality at Antioch relative to the existing condition. But in all of the other months of all of the other years -- most months, all but those two months of those year types, water quality at Antioch's intake will be degraded.

And some of increases in salinity are quite significant. So the largest occurs in October of dry water years, when we see an increase of 1895 milligrams per liter chloride. And, again, these are based on DWR's model results.

One of the questions we asked ourselves and discussed with the City is a lot of these changes are occurring when water quality at the City's intake is already pretty poor, when the salt concentration's already pretty high. So does this actually matter to the City's ability to use its intake?

And what we can see is that it does. If you look at the next slide, this is Table 3 from the report. This is the number of days per year when water is not usable at the City's intake. And, again, per the metric of the 1968 agreement, that means when the chloride concentration measured two hours after higher high tide is above 250, that's a day of not usable water. This counts up those days based on the simulation results.

So if we look at an example in 1976, the top row of column -- top row of the table, that's a critical year. For the existing condition, there's a chloride concentration higher than 250 milligrams per liter 332 days of the year. So there's approximately one month of that year when water quality would be usable per the definition in the agreement.

For the no action alternative, there are 340 days in that year, 1976, when the chloride concentration would be above 250. And for the Boundary 1 scenario, there are 361 days where the chloride concentration at that time would be above 250. So there would be four days of usable water under Boundary 1 versus approximately 30 or 33 days of usable water under the EBC2 existing conditions scenario.

If you look at 1979, you can see that's a

normal year -- actually, it's an above-normal year.

You can see that the number of days under both the existing condition and no action alternative are 220 days when the water quality would be -- chloride concentration would be above 250. For the Boundary 1 scenario, it's 261 days. So that's an increase.

And then for 1984, you can see the same effect in wet years. For 1984, there would be 131 days where the chloride concentration is above 250 for the existing condition, 114 for the no action alternative, and 180. So water quality in that year, the simulation shows that it would actually get a little bit better under the no action alternative, but it would be worse than the existing condition and worse than the no action alternative for the Boundary 1 scenario.

Now, if we add the values in these columns -- we've already established they're 5,844 days in the simulation period. For the existing condition 3,966 days would have a chloride concentration greater than 250, for the no action alternative, 3,876 days would have a chloride concentration greater than 250, and for the Boundary 1 scenario 4,306 days would have a concentration greater than 250.

If you look at the difference in the number of usable days between the existing condition and

Boundary 1, that's 340 days. If you look at the difference between the no action alternative and Boundary 1, it's 430 days.

So once again, we do see an impact due to climate change and sea level rise, but we see an even greater impact due to the proposed project as operated to Scenario B1.

And this 330 and 430 days don't sound like a whole lot in a 16-year period, but when you consider how infrequently water is available at Antioch's intake, that's a very significant increase in unavailable or unusability of that water.

The next slide, thank you, shows Table 4. And, again, this is the slack current after higher high tide. This just aggregates the results from the prior slide by water year type. And in all water year types, we see an increase in the number of days that will be above the 250-milligram-per-liter threshold for Scenario Boundary 1 relative to existing conditions and also relative to the no action alternative.

You may recall that, when we talked about water quality at Brentwood's intake, it actually seemed to get better when with the Boundary 1 operations in the proposed project for wet years only. For other years, it got worse. Here, we see that, at Antioch's

intake, water quality is getting worse in all year types.

All right. And if we go to the next slide this is Table 5. This shows the decrease in the number of the days, the number of days that are lost relative to existing conditions averaged by water year type.

So what we see is that in wet years, which is 32 percent of the historic record, Antioch would lose 31 days of usable water for Boundary 1 relative to existing conditions. Normal years are about 33 percent of the historic record, and the City would lose 21 days for Boundary 1 relative to existing conditions. Dry years, 21 percent of the record, Antioch would lose 25 days. And in critical years, which is 14 percent of the record, Antioch would lose 11 days of usable water.

And, again, the -- these changes, the changes due to the project are greater than the changes due to sea level rise alone.

All right. The next figure is Figure 9 from the report. This gets specifically to the question of whether these increases occur only during high salinity periods. In other words, does it make any difference that salinity is getting greater at Antioch?

If you look at the daily chloride concentrations at slack current after higher high tide

in the April-May-June time period, you can see that, under the existing condition scenario, which is the blue line, the salinity is always below 250. But for the Boundary 1 scenario, the salinity flirts with that 250 line, and it crosses that 250 line in -- mainly in the month of May.

There is a conversion, essentially, if you will, shown in the model results, from usable water to nonusable water. So this salinity increase is very pronounced at high salinity times of year, but it also occurs during times when water is expected to be usable at the City's intake. So I should have said this is a plot averaging those -- that information for normal water years. So we see that conversion from usable to nonusable as a result of Boundary 1 in normal water years.

All right. The next slide -- I'd like to switch at this point. All of the prior slides, I believe, I've talked about water quality as measured at slack current after higher high tide. There's another way of looking at this too. Since flow in the vicinity of Antioch's intake is so strongly tidal -- water sloshes in and sloshes out on each tidal cycle, and the water quality changes over the course of a tidal cycle.

So, again, we ask ourselves, so what if it's

different at slack current after higher high tide? Does that really affect usability of water in a more general sense?

And what we did was we looked at the hourly chloride concentration, again, from the model results, and we calculate -- we added up all of the hours where the salinity -- where the chloride concentration, excuse me, was less than 250 milligrams per liter. We added all of those hours together and then just converted to an equivalent numbers of days over a year and then looked at that by year type.

So what we can see here is that the average equivalent number of days per year -- let's take the critical condition for example. In the existing condition, there are 63 days' worth of time when water would be below 250 at the City's intake. For no action alternative, there would be 66 days of time, a slight improvement, where water would be usable.

But then for the scenario boundary B1, there would be 44 days of equivalent time when water would be below 250 milligrams per year.

For all of these year types, we see a decrease for the Boundary 1 scenario relative to existing conditions in the equivalent amount of time that water would be below 250 milligrams per liter chloride at the

City's intake.

The results for the no action alternative are a little bit more mixed. In some years it gets better; in some years it gets worse. What is clear is that there is some impact in some year types from the no action alternative -- so, sea level rise. There is an impact beyond that due to project operates to scenario B1.

Okay. We used the information in this slide in Table 6 to calculate how much money the City can expect to pay to buy replacement water. And we made a series of very conservative assumptions. The next slide shows the result of those -- that calculation.

So what we did, we did this -- practically speaking, Mr. Bernal I think will explain that the way the City operates is, when the chloride concentration's above 250, they use 100 percent replacement water. They can't use that water. When the chloride concentration is between 100 and 250, they use some water from their intake, but they blend it with lower salinity water purchased from elsewhere. And then when the chloride concentration is below 150, they use water exclusively from their intake.

So we analyzed, given the water quality data from the modeling, how much water they would have to

purchase given those rules. And we made some -- some simplifications. We assumed, for example, that, if water quality was between 100 and 250, they would purchase 50 percent of their supply. In reality, it's probably more of a sliding scale.

We also assumed that the operators would have the ability to switch from one source to another almost instantaneously. In reality, those operations are manual, and I think Mr. Bernal will explain that as well. So they don't have the ability to respond on a dime and switch on and off.

We also made some fairly conservative assumptions about the price of water and how that would increase in the future. And if we compare the assumptions we make here to what's historically happened, the price of water has increased a lot more than the standard inflation rate. So these are all probably low conservative estimates for that reason.

We calculated both in terms of the 2028 dollars, when the project would be expected to go online -- that also, coincidentally -- or might go online -- that's the time frame when Antioch's agreement, the fixed term of Antioch's agreement stops. All of these calculations are assuming no reimbursement under the agreement, okay, to be really clear.

What we see is that the present value of the water purchased over a 50-year period given the existing condition water quality in the simulation would be, in 2016 dollars, on the order of $305 million. For the no action alternative, it would be on the order of $322 million. And for the Boundary 1 scenario, it would be on the order of $352 million.

So you can see that the City will be paying more to buy replacement water due to sea level rise and even more due to the operation's Boundary 1 scenario.

All right. Opinion 5, the next slide, has to do with compliance with water quality standards. And we can skip the next slide, which is Table 8 from the report. We can also skip the next slide, Table 9, and -- exactly, thank you -- go to table 10.

What I wanted to show you here is what things would look like if that 150-milligram-per-liter standard were evaluated at Antioch's intake. Again, it's a sliding scale. The number of days that that standard must be met varies by year type. And it can be met either at the City's intake or at Pumping Plant 1.

I think this shows why it is not evaluated at the City's intake. There's no compliance for existing

conditions, no action alternative, or Boundary 1 for critical years, dry years, or normal years. There are four wet years in the simulation period. For the existing condition, three of them would have been in compliance with the 150-milligram-per-liter had it been evaluated at Antioch's intake.

For the no action alternative in the Boundary 1 Scenario, one of 16 years in this simulation period would have been in compliance.

I think we can skip over the next slide and the next slide. And that just shows what happens to compliance when it's evaluated at Pumping Plant 1. We went through that this morning. And Table 13 has to do with the export-to-inflow ratio. We also covered that this morning.

All right. In summary, it's my opinion, based on the modeling and the analysis that we pulled out of DWR's modeling, that there will be water quality degradation at the City's intake. And it occurs not only in times of high salinity, when the salinity is already too high for use, but it also occurs in times when salinity is low enough currently for water at the intake to be used.

As we've already discussed, there's a wide range in potential operating conditions. The adaptive

management plan is not very clearly defined, and so we don't really know where within that broad operating range that DWR has defined operations will actually occur.

Nonetheless, we -- our analysis shows that there will be significant deterioration of water quality at the City's intake as a result of the project. That -- Boundary 1. That impact is above and in addition to the degradation that would occur as a result of sea level rise. And it will affect the City's operations, including the amount of water that must be purchased from other sources.

Wow. Thank you.

CO-HEARING OFFICER DODUC: Thank you, Dr. Paulsen.

MR. EMRICK: No further testimony from Dr. Paulsen, so I'm ready for cross.

MR. OCHENDUSZKO: Mr. Emrick, if you wouldn't mind moving the microphone just a little bit closer to your mouth.

MR. EMRICK: I might turn it on, too.

MR. OCHENDUSZKO: Thank you very much.

CO-HEARING OFFICER DODUC: All right. Let's ask the Department to come up and conduct their cross-examination of Dr. Paulsen.

CROSS-EXAMINATION BY MR. BERLINER

MR. BERLINER: Good afternoon. Tom Berliner for Department of Water Resources. I only have a few questions for Dr. Paulsen. And they're on Antioch water quality.

Dr. Paulsen, you put up some information about water quality prior to roughly about 1920 for the City of Antioch. You indicated that, prior to that time, water quality was -- and my words, not yours -- was substantially better prior to the 1920s than it has been since that; is that correct?

WITNESS PAULSEN: Yes.

MR. BERLINER: You know neither the State nor Federal water projects were in existence at that time, correct?

WITNESS PAULSEN: Yes.

MR. BERLINER: Was the decline in water quality during the 1920s and thereafter, before the projects came online, in part a product of upstream development?

WITNESS PAULSEN: Upstream agricultural development. There were diversions for agricultural use, probably for other uses as well.

MR. BERLINER: Would those be both on the Sacramento and San Joaquin Rivers as well as the

east-side streams?

WITNESS PAULSEN: I'm most familiar with the historic record as it pertains to the Sacramento River. For sure there were large diversions there. There probably were diversions in other places. I just don't recall the magnitude of them.

MR. BERLINER: Do you have the a sense as to what the magnitude of diversions was in the Sacramento Basin?

WITNESS PAULSEN: I believe that there's information in here. I didn't review it before coming in today, and I don't remember the number off the top of my head. It is substantial.

MR. BERLINER: And are you aware of -- strike that.

You also mentioned that there was development in the Delta prior to the 1920s. Are you aware of how -- of the volume of withdrawals that occurred in the Delta prior to the '20s?

WITNESS PAULSEN: No. Again, I don't have those numbers at my fingertips.

MR. BERLINER: You also mentioned that changes in geomorphology in the Delta had an impact on changes in salinity. Can you qualify that?

WITNESS PAULSEN: No, I don't think I can put

straightforward numbers to all of these causes. What I can say -- I mean, our analysis has looked at the overall impacts of those aggregate causes. It's looked at the decline in water quality that occurred from a range of factors, including some of the ones you just named.

MR. BERLINER: You're not contending, are you, by making this comparison back to the 1920s, that DWR and Bureau of Reclamation should be solely responsible to return water quality back to historical conditions, are you?

WITNESS PAULSEN: I don't think anybody thinks that we can go back to historical conditions.

MR. BERLINER: In terms of what did exist under those historical conditions, meaning pre-1920, as a practical matter, they really don't have relevance other than sort of as a point of interest, do they, as far as impacts of WaterFix on legal users of water?

WITNESS PAULSEN: I think they're relevant to understanding the historical context that we're in, to understanding the historical condition of the Delta.

In my opinion, there was some information in DWR's testimony that was misleading with respect to historical salinity. And I just wanted to make sure that the Board was informed regarding those statements

and as to what historical salinity conditions in the Delta were.

MR. BERLINER: And by "misleading information," are you referring to the section in your report where you were talking about historical water quality and you were discussing the reports that DWR started to compile back in about 1917 or so that started compiling salinity information?

WITNESS PAULSEN: I'm sorry. Could you restate that?

MR. BERLINER: Sure, I'll rephrase it. Yeah.

In your report, you mentioned that DWR started collecting salinity data in about 1917. And you made the statement that there may have been some misleading information coming from DWR.

And what I'm wondering is is the information that you are referring to the reports that DWR started issuing, 1917 through the '20s and continuing, is that the source of the -- of what you're contending is misleading information?

WITNESS PAULSEN: No.

MR. EMRICK: What is it then?

WITNESS PAULSEN: I don't have any reason, I don't think, to doubt the historical salinity measurements that were made in that time period, the

'20s and the '30s. Rather, there are a handful of statements in the testimony -- I can point you to, I think, a couple of those -- where it left me with the impression that the historical baseline was the saline condition, and I don't think that that's accurate.

So there was some statements specifically in DWR 53 that said that, prior to the implementation of the State Water Project and the Central Valley Project, salinity intruded well into the interior of the Delta during the irrigation season.

That statement is true,but I don't think it's complete because it doesn't talk about what happened prior to that. Let me see. There are also figures that were generated from those salinity measurements that you mentioned that show isohaline lines of salinity intrusion in the Delta by year. I think you probably know -- I'm not sure I have I have a citation for those.

And there was a statement in some -- some of DWR's testimony that comparison of two figures illustrates an incidental benefit to significant portions of the Delta provided by SWP and CVP reservoir storage releases.

There were statements that, quote/unquote, "Historical salinity was at times greater than current

conditions." Those were in DWR's testimony in this matter. And to me, they left me with the impression that DWR was contending that the salinity intrusion that occurred in the '20s was a historical baseline or a natural condition. And I didn't want to leave that impression because I don't think it's correct.

MR. BERLINER: But DWR didn't say that that was the full historical analysis of salinity intrusion into the Delta, correct?

WITNESS PAULSEN: No, but at the same time, they didn't discuss historical salinity prior to 1921 at all.

MR. BERLINER: Understood. Understood. So your suggestion of something misleading is by omission rather than commission, correct?

WITNESS PAULSEN: I don't know if I even want to go that far. I'll just say that I had a very strong impression when I reading DWR's testimony that it was misleading with respect to what the historical natural condition would be.

MR. BERLINER: Okay. I have no further questions. Thank you.

CO-HEARING OFFICER DODUC: Thank you, Mr. Berliner.

Ms. Meserve.

For the court reporter's information, we have the room until 6:00 o'clock. So let's take two short breaks in the afternoon, and we'll try to take a break around 2:40, 2:45. Okay.

CROSS-EXAMINATION BY MS. MESERVE

MS. MESERVE: Good afternoon. Osha Meserve for Land. And then just a point of clarification, we'll be hearing from Ron Bernal later. Yes. Okay. Thank you.

So I have questions about climate change modeling, the operational rules embedded in the modeling, the period of record. And that's pretty much it.

CO-HEARING OFFICER DODUC: How much time do you anticipate needing?

MS. MESERVE: 20 minutes should be sufficient. Thank you.

CO-HEARING OFFICER DODUC: Let's give you the time, since it was your efficient idea to begin with.

MS. MESERVE: Let's see if I can keep up my good graces here.

Good afternoon, Ms. Paulsen -- Dr. Paulsen. Now, in your work as a modeler, that includes modeling future scenarios under climate change; is that correct?

WITNESS PAULSEN: For this work, just to be

clear, we used -- we relied upon DWR's modeling of future climate change and sea level rise scenarios.

MS. MESERVE: Yes. And do you believe, in your work generally, now, I'm talking, is it possible to make predictions about conditions many years into the future? Is that something that you guys are able to do at your company?

WITNESS PAULSEN: There are certainly other people at my company who look at climate change in a very detailed fashion in terms of weather patterns and global models and things like that. I do not do that.

I have read a fair amount of literature with respect to climate change and impacts in California and in the Delta area. Does that answer your question?

MS. MESERVE: Sure. I guess what I wanted to dig into a tiny bit was the no action alternative, in the case in chief presented, it appears it's either 2025 or 2030. Do you know what year it's keying off of?

WITNESS PAULSEN: I don't know specifically. My recollection, though, is that the 15 centimeters of sea level rise corresponded to a 2025 condition at least in the BDCP model runs.

MS. MESERVE: Would -- in your -- do you recall that there used to be a late long-term modeled

scenario that was part of BDCP?

WITNESS PAULSEN: I do. We've commented on it in the past. I think there's some of that in this record.

MS. MESERVE: Do you know why the late long-term wouldn't be part of the analysis that we'd be looking at here, today, for this petition?

WITNESS PAULSEN: I don't. I wondered that myself.

MS. MESERVE: So do you know why the late long-term part of the analysis seems to have dropped out of this project proposal?

WITNESS PAULSEN: I don't.

MS. MESERVE: And then maybe just to follow up, you looked at the present conditions in your analysis in order to try to determine the difference between the with project and the without the project for your client; is that right?

WITNESS PAULSEN: Right. We looked at three scenarios. We looked at an existing condition, which is I believe representative of the way operations are conducted today and without climate change and sea level rise. And the with -- the existing condition scenario that we selected to look at also has Fall X2, so it's a with Fall X2 scenario.

Then we looked at the no action alternative, which I believe incorporates climate change and 15 centimeters of sea level rise.

And we looked at the project scenarios. We focused mainly on Boundary 1 here, but we did look at the results for all of them.

MS. MESERVE: Does it strike you that 2025 is only nine years away, and do you think that the predictions within that assumption are likely to be true in only nine years, based on your experience?

MS. MESERVE: Well, with respect to your earlier question about the late long-term, I've wondered about the different time horizons because I don't believe the project will be online by 2025. And I think that additional sea level rise is expected beyond that point.

I'm not sure I have the thread of your question. But I don't know why that change was made.

MS. MESERVE: Do you think this proceeding would be further informed by looking at other time periods for purposes of climate change and sea level rise?

WITNESS PAULSEN: I know I'm interested in it. You can ask them, but I believe that our clients are probably interested in that as well. I mean, they did

ask us to look at that when we had the BDCP model results for the larger amount of sea level rise.

MS. MESERVE: All right. Okay. I had a couple of questions about operations.

Are you aware in your work of the old middle river reverse flow restrictions on pumping that are in the BiOps governing the operation of the current project in the South Delta?

WITNESS PAULSEN: I am generally aware of them.

MS. MESERVE: Do you know how those OMR restrictions are incorporated into the modeling, and could you explain that at all?

WITNESS PAULSEN: I can't. I'm sorry. I think that's probably in the CalSim side of things, and I don't have expertise there.

MS. MESERVE: But your analysis -- or your representations of water quality in your report under the EBC2 assumed existing Federal and State restrictions; is that correct?

WITNESS PAULSEN: Yeah, I'd have to look back. I have a summary table that details the assumptions that were in that. We did get that model run directly from DWR.

I believe it's -- I believe that most of the

major assumptions in DSM2 with respect to gate operations and Head of Old River gate or barrier, those things are the same between the EBC2 and the no action alternative.

MS. MESERVE: Are you familiar or have you heard about the WRDA bill just adopted by Congress and now signed by the President last week that would change, potentially, the operations of the projects that we're talking about here today?

WITNESS PAULSEN: I am aware generally of the existence of the WRDA bill. I do not know how it would affect operations.

MS. MESERVE: Would you be concerned that model run results that might show worsened water quality impacts if the operational rules at the South Delta pumps were more aggressive in the future in terms of diversion of water?

WITNESS PAULSEN: Are you asking if I think if there's more diversion in the South Delta if there will be water quality impacts due to that?

MR. ALADJEM: I think you need explain --

MS. MESERVE: Yes. Yeah, sorry. That's probably not clear.

My question is if for this proceeding we're assuming that the -- except for otherwise in the model,

but for purposes of the EBC2 let's say -- that the current restrictions apply, however, as I just noted there's possible federal law that may change restrictions, would you be concerned that the water quality results would be different if --

Go ahead.

MR. ALADJEM: Madam Chair, the witness has said she has not yet looked at the legislation. This is a complicated system. Obviously, if Dr. Paulsen can answer the question, she's free to do so. But we're trying to speculate on how the operations might go forward. I'm not sure how that helps us, but...

CO-HEARING OFFICER DODUC: Ms. Meserve, do you wish to withdraw? Because I don't think she can answer.

MS. MESERVE: I'll withdraw that question.

CO-HEARING OFFICER DODUC: Thank you.

MS. MESERVE: Okay. Additionally, are you aware that there's a Water Quality Control Plan update underway right now?

WITNESS PAULSEN: Yes. Again, I'm generally aware of that.

MS. MESERVE: And if the water quality standards in the -- that we've been discussing today in relation to the areas you were focused on, if those

were reduced -- those standards were lessened in the future plan, would you be concerned about worsened water quality, for instance, for Antioch or for Brentwood?

MR. ALADJEM: Madam Chair, same objection. Again, the witness can answer if she so pleases.

CO-HEARING OFFICER DODUC: Well, I have complete confidence in Dr. Paulsen's technical abilities and her ability to answer the question if she knows and to say no if she doesn't.

WITNESS PAULSEN: Yeah, but I -- I'm not sure specifically how to answer that. I will --

I think without greater specificity in the question, that's hard to answer. I think in general, the projects operate to the water quality standards and to requirements imposed by the biological opinions.

If those are going to change, I would expect changes in the operations. And we'd have to look specifically to see which -- what changes would produce what reaction.

MS. MESERVE: So just to follow up, in general, those changes could make the use of water more difficult or expensive by the users that you've been looking at in particular; is that correct?

WITNESS PAULSEN: If the changes were such

that salinity could intrude farther into the Delta than it does currently, then, yes.

MS. MESERVE: Now, on the modeling period used, you're aware that some of the modeling by petitioners uses a 16-year period of record and other modeling uses an 82-year period of record?

WITNESS PAULSEN: Yes.

MS. MESERVE: Can you tell us what the benefits of looking at the longer, 82 period of record might be?

WITNESS PAULSEN: First, my understanding is the CalSim runs used an 82 period of record and the DSM2 runs used a 16-year period of record.

If DSM2 had been run for a full 82-year period of record, it would have characterized the water quality over that longer 82-year period of time, and we wouldn't be talking about the fraction of year types in the historical record versus the 16-year period of record. So that would be one difference.

In the past, my colleagues and I have run DSM2 for an 82-year period of record, in part because we believe that that characterizes conditions over the longer time period.

MS. MESERVE: Are you aware that the BA used an 82-year period of record as well?

WITNESS PAULSEN: I believe it does, yes.

MS. MESERVE: So in your opinion, do you think that the parties to this proceeding would have benefited from modeling of that longer period of record in order to understand the possible implications to water quality?

WITNESS PAULSEN: I would say that, if an 82-year period of record would have been modeled, it would have been more representative of the historical hydrology that occurred over that 82-year period than the 16-year period which is a subset of that 82-year period. I guess that's and issue of representativeness.

MS. MESERVE: And in your analysis, did you look at all -- or were you asked to look at whether harmful algal blooms would be more common in the -- in the either Brentwood or Antioch?

WITNESS PAULSEN: We did not look at that specifically. For Brentwood and Antioch we focused primarily on chloride. I believe we talked about bromide a little bit. But we did not develop any opinions regarding algae.

MS. MESERVE: Are you aware of models that are available to help determine whether algal blooms would occur under specified conditions?

WITNESS PAULSEN: That's a good question. I know there was some nutrient modeling done using DSM2. And I believe that there -- I don't know if you'd call it modeling or just analysis, but I believe that there are other people who have looked at those questions.

I'm not up to speed on the state of the science there.

MS. MESERVE: And are you aware of any of the problems with harmful algal blooms and municipal water supplies?

WITNESS PAULSEN: I'm aware generally that harmful algal blooms and cyanobacteria can cause problems for municipal supplies. I know -- I was -- I learned through listening to some of the testimony in this hearing that they've occurred in the Delta to a greater extent in recent years.

So I've done some general reading. I have a very general knowledge of it. But I don't have expertise in that area, at least I haven't looked at it in detail yet.

MS. MESERVE: In your work for these two protestants, you chose to use petitioner's modeling for your analysis. Is there a reason you didn't conduct your own modeling of the water quality -- comparative water quality between the different scenarios you

looked at?

WITNESS PAULSEN: I think there are a couple of reasons. One is just limitations in time and resources. The second is that, to really understand what the petitioners were proposing with this project, we wanted to first dig into their model results and see if we understood what was going on, you know, how the projects would be operated and what the impacts would be.

So I think it was primarily a limitation in resources, but also, if we would use the information that they had provided to do an evaluation, that's what we wanted to do at this point in time, given the limitations and conditions that we had, the time we had.

MS. MESERVE: Having reviewed petitioner's modeling, are you at all concerned that it may understate the water quality impacts to water users such as Brentwood or Antioch?

WITNESS PAULSEN: I have a lot of concerns. I'm concerned about how operations will proceed in the future. I'm a little bit concerned because all of the model runs that DWR put forward -- the no action and the project scenarios -- had climate change and sea level rise. And I don't have the expertise to know

whether the operations modeling that was done in those scenarios is right or wrong, but it's certainly different than what we know now.

I listened to some of the testimony earlier in the hearing about remodeling of some of the scenarios without the climate change and sea level rise, and I haven't looked at those in detail yet. But I'm curious to know what they show. There are a lot of things that could be done.

MS. MESERVE: Did you have any concern about the sticking with -- given that the review for this project has been going on for nearly a decade now, was there any concern on your part that some of the techniques used were outdated and should be updated and weren't?

WITNESS PAULSEN: And by "techniques" you mean?

MS. MESERVE: I guess the versions of the models or other things such as that?

WITNESS PAULSEN: I haven't given much thought to that. You know, in some sense, DWR uses -- I know they say that they use the models in a comparative sense. And I think the assumptions are relatively uniform between all the scenarios that we looked it. I mean, obviously, some have sea level rise and some

don't -- climate change, some don't. But all the model runs are performed using the same modeling tools.

I'm sorry. What was your question again?

MS. MESERVE: It was whether you were concerned that some of the modeling information could have been become outdated that was still being relied upon for the case in chief of the petitioners.

WITNESS PAULSEN: I haven't given much thought to the outdated question.

MS. MESERVE: In your testimony in the analysis of the Boundary 1 scenario, the number of days of the increased salinity as compared to the no action alternative in normal and wet water years was -- was where we saw the most impact; is that -- I believe I'm thinking of the Brentwood testimony.

WITNESS PAULSEN: And I was just going to say, I think that that's probably right for Brentwood. I'd have to look back to make sure. But I think that's right.

MS. MESERVE: Would the -- and to me, that was a little bit, you know, counter-intuitive, that you're changing the wet years, and the normal years are where you're seeing the biggest impact.

And I wonder, would that make those normal years more like drought years for water users such as

Brentwood and the Delta?

WITNESS PAULSEN: I don't know if they'd be more like drought years. I haven't thought about that question specifically.

I'm looking back at the testimony now. I think we do see the biggest impacts at Brentwood in dry and normal years. I think that might be counter-intuitive because I think a lot of people expect the biggest impacts to occur in critical years, just because there's less water available.

So that's part of the reason that we dug into and created the bar charts of the amount of water exported under different scenarios. And for critical years, we actually see that less water would be exported on average for scenario Boundary 1 relative to existing conditions. So I think that explains the fact that the change is smaller there.

And by contrast, especially in some months for dry and normal years, the amount of water exported from the Delta will go up, plus of course most of the water that is exported will consist of Sacramento River water.

MS. MESERVE: Going back to my question, would that make it a little bit -- those, quote, "normal years" more like what might occur in a natural drought

year if the project was operating?

WITNESS PAULSEN: It certainly makes water quality in the normal years worse. I'd to have spend a little bit more time with the numbers.

I think I understand what you're asking. A lot of what we presented is terms of differences, although we did present for individual years. I'd have to pick through the tables one by one to answer that.

What we can say is that the increase in the number of days that water would not be usable or it would exceed standards I think is greater in normal years than it is in the other year types. That may be somewhat counter-intuitive.

MS. MESERVE: Thank you. I have no further questions.

CO-HEARING OFFICER DODUC: Thank you, Ms. Meserve.

Let's go ahead and take a short break, and resume at 2:45.

(Recess taken)

CO-HEARING OFFICER DODUC: All right. It is 2:45. I'm on time for the first time today.

Welcome back, and I'm on time just time for Mr. Herrick to conduct his cross-examination.

Mr. Keeling, I'm going in a group number

order, so you are next.

CROSS-EXAMINATION BY MR. HERRICK

MR. HERRICK: Thank you, Madam Chair. John Herrick for South Delta Water parties.

I'm going to cover the assumptions and logic underlying the conclusions, how those conclusions might be applicable to other areas, the climate change issues slightly, and the averages used by the Department of Water Resources in their presentation, and a couple of cleanup questions.

Thank you, Dr. Paulsen.

CO-HEARING OFFICER DODUC: I'm sorry, Mr. Herrick. How much time do you anticipate needing?

MR. HERRICK: It won't take more than 20 minutes, it's probably less than 15.

CO-HEARING OFFICER DODUC: All right. I always depend on you to be succinct.

MR. HERRICK: I will be extremely succinct.

Dr. Paulsen, I'd like to step back a little bit. You're an expert in the hydrodynamics in the Delta; is that correct?

WITNESS PAULSEN: Right.

MR. HERRICK: And as part of that -- is your thing on?

WITNESS PAULSEN: Oh, yes. I think it is.

Sorry.

MR. HERRICK: All right.

WITNESS PAULSEN: Thank you.

MR. HERRICK: And as part of that, you're familiar with and have provided testimony on how various water source contributions affect water quality in the Delta, correct?

WITNESS PAULSEN: Yes.

MR. HERRICK: And so if we step back and we say we're examining a project that proposes to take water that normally would go through the Delta and not let it go through the Delta, then that might have effects, correct?

WITNESS PAULSEN: Yes, and I tried to say that. You know, under operation scenario Boundary 1, there would be more water taken out of the Delta in all the critical year types on average. And because of the location of the North Delta diversion points, there would be more Sacramento River water diverted.

MR. HERRICK: So whether or not the models are correct to any degree, the logic informs us that, if you have a project that decreases the flow of fresh water from the Sacramento to the Delta, there should be some sort of effects, correct?

WITNESS PAULSEN: Right. Exactly. We would

expect a response when we changed one of the inputs or the major important parameters that governs the system.

MR. HERRICK: So the question then becomes what degree of change or changes occurs, correct?

WITNESS PAULSEN: Right. And within the Delta, that can vary based on location. Right? I mean, we saw some differences today between Brentwood and Antioch.

MR. HERRICK: And for purposes of all the parties, what we have to try to determine those, the magnitude of those changes or those affects are the modeling that we've been provided with or that we do ourselves, correct?

WITNESS PAULSEN: Right. We relied upon DWR's modeling in this case.

MR. HERRICK: So in this case we've -- excuse me. You've used the modeling that DWR prepared, whether it was for the EIR process or for this process, but that's the modeling that's been used, correct?

WITNESS PAULSEN: Yes.

MR. HERRICK: And so it's correct to say, then, that DWR provided the boundary conditions for Boundary 1 and Boundary 2 as well as for the H3 or H4 scenarios, correct?

WITNESS PAULSEN: Oh, right. We didn't

redefine those scenarios. We just used what they had done, exactly.

MR. HERRICK: So do you have any understanding that the petition before the Board, the reason we're here, is that there's a change of point of diversion petition pending?

WITNESS PAULSEN: I do understand that, at least generally.

MR. HERRICK: And do you know whether or not the petition asks for an approval of an H3 scenario or H4 scenario? Do you know whether that's the case?

WITNESS PAULSEN: I don't know if I'm making legal conclusions, but I can tell you I read it more broadly than that. I read it as a proposal for a large project that may operate within the bounds of Boundary 1 and Boundary 2.

MR. HERRICK: And that was exactly what the intent of my question is. So what we've been asked to do as part of this proceeding is to see what the potential effects might be between those boundary conditions, correct?

WITNESS PAULSEN: Yes.

MR. HERRICK: And that is what you've done, highlighting the effects of Boundary 1 condition based upon your analysis, correct?

WITNESS PAULSEN: Yes, exactly. Boundary 1 for both Brentwood and Antioch was the scenario that had the most impact.

MR. HERRICK: And your conclusions deal with, specifically for the Antioch and Brentwood, the changes in -- this is very general -- the changes in days that a certain chloride standard may or may not be met, correct?

WITNESS PAULSEN: Right. That was one of the metrics that we used to evaluate whether there would be impacts or not.

MR. HERRICK: And do those conclusion that you arrived at about those changes in days, do those conform with your -- the logic we just went through, which is if there's less Sacramento water flowing through the system, then there should be effects?

WITNESS PAULSEN: Yeah, indeed. I mean, we did go back -- part of the reason that we produced the plots of the amount of water exported from the Delta in the different months of the different year types and, you know, dug into it even beyond that was to try to figure out the cause and the effect and to make sure that what we were seeing comported with our general understanding of how the Delta functions.

MR. HERRICK: And as a general rule, your

conclusions about how the change in inflows from one source affect the areas around Antioch and Brentwood, as a general rule, would that apply throughout the Delta? In other words, if you've changed inputs to the system, you would expect there to be effects in the system?

WITNESS PAULSEN: Definitely. I mean, when you change the inputs, you would expect there to be effects. The degree of effect, the magnitude of effect, sometimes even the direction of the effect can vary from place to place -- yeah, if you change the inputs to the system, the system is going to respond.

MR. HERRICK: You wouldn't expect less water flowing through the system to improve water quality, would you?

WITNESS PAULSEN: In general, no. I say "in general," and I sort of caveat that a little bit because the source of water obviously matters. And there's the potential that you could change the distribution of water within the system by some of these changes.

In general, the more freshwater flow there is into the system, the more flushing you have within the system. And especially if you're able to get higher quality, lower salinity Sacramento River water into the

interior of the system, that generally improves things.

MR. HERRICK: Sorry. Lost my train of thought. Short trip.

You had questions regarding the -- dealing with climate change. Do you recall those?

WITNESS PAULSEN: I do.

MR. HERRICK: And it was your testimony that you were actually able to tease out the difference between the effects of a climate-change-included scenario with just the project; is that correct?

WITNESS PAULSEN: Well, that was the purpose of comparing the existing condition to the no action and then, again, those two scenarios to the Boundary 1 scenario. It was try to figure out, based on DWR's model run, what the impact of sea level rise primarily would be, climate change and sea level rise, and then to look at the difference between the no action alternative and the Boundary 1 scenario to try to figure out on top of that what the impact to the project would be.

MR. HERRICK: And you did that because, if we don't separate out the difference in impacts from climate change and just the project, then we don't really know what the impacts attributed to the project alone are, correct?

WITNESS PAULSEN: That's exactly correct, yeah.

MR. HERRICK: Would you agree that DWR's presentation and their testimony, they didn't tease that out; they just presented us with modeling results that included both climate change and the project or climate change without the project, correct?

WITNESS PAULSEN: Yeah. And the model runs that they provided for WaterFix and that we downloaded, there were five model runs -- the no action, Boundary 1, Boundary 2, H3, and H4.

In the past, obviously, for BDCP, they had modeled two different existing condition scenarios; they modeled other operations as well.

But for this proceeding, we downloaded those five -- no action plus those four project scenarios.

MR. HERRICK: And you were asked a number of questions questioning the -- or challenging the appropriateness of the existing condition scenario that you referenced. Do you recall that?

WITNESS PAULSEN: I do.

MR. HERRICK: Now, you may not know the answer to this, but do you know the difference between, say, the requirements for modeling under CEQA as opposed to the requirements for modeling or examining effects

under a change petition like this?

WITNESS PAULSEN: I don't want to get into legal territory. So from a legal point of view, I don't know exactly the perspective.

I can say that from, you know, my perspective as an engineer, as a professional, we wanted to look at those three scenarios to tease out those specific things. So from my perspective from a technical point of view, it was appropriate; it was necessary to do those things.

I don't want to cross over and to say what's required from a legal perspective, if that's fair.

MR. HERRICK: Absolutely. Would you agree, then, that by checking out that existing condition and the other modeling runs you did, that's the way to determine whether or not the project itself might cause harm to somebody rather than the project and climate change might cause harm to somebody?

WITNESS PAULSEN: Yeah. Again, it was our -- the best way that we knew how using the model runs we had available from DWR to try to tease out the effect of one thing versus another, climate change and sea level rise versus the project.

MR. HERRICK: Your testimony --

WITNESS PAULSEN: Also -- I mean the other

reason -- sorry.

The other reason that we did that was to be responsive to the questions that we were asked by the cities, which is, "How is this going to affect the way we operate, based on our knowledge of our current system and the way we operate now," so try to tie it back, I don't know, to an anchor point in a way.

MR. HERRICK: You also gave testimony that one of your exhibits showed the exports under various scenarios and whether or not the export would be from the North Delta diversion or the South Delta diversion. Do you recall that?

WITNESS PAULSEN: Yes.

MR. HERRICK: Would it be correct to say that, under the project, there would be less diversions from the South Delta because now they have a North Delta diversion that would be used sometimes?

WITNESS PAULSEN: Yes, that is accurate. I think that's true on all the scenarios. I think in all of them -- let me just confirm. Water is exported from both export points. Right. Even in the critical condition, when they're exporting slightly less water than under existing condition, slightly more water than under the no action alt- --

(Reporter interruption)

WITNESS PAULSEN: I'm sorry. I'm so surprised you haven't asked me that already today.

Even in the critical condition, when the Boundary 1 exports are lower than the exports would be under existing conditions, they are using both the South Delta diversion point and the North Delta diversion point. You can see the proportion.

It -- the proportion's different in different year types. So the fraction of water that's exported from the North Delta diversion points appears to be larger in wet years than it is in normal years and larger in normal years than in dry years, and larger in dry than in critical.

MR. HERRICK: So the modeling scenarios don't suggest that South Delta exports will stay the same and any increment above past exports will only be the North Delta diversion, correct? That's not what they say?

WITNESS PAULSEN: I think that's right. I mean, basically, what they show has been in all year types the total amount of exports is going to go up on average, except in critical years.

So in -- let me be very clear.

In dry and normal and in wet years, the total amount of water exported under scenario Boundary 1 will be greater than the total amount of water exported

under existing conditions in the no action alternative.

And there's a fraction of that water, just eyeballing it, it looks to be on the order of 20 percent for the dry scenario, probably closer to 40 percent for the normal year scenarios, and probably 50 percent or a little bit more for the wet year scenarios that would be from the North Delta diversion points and then the remainder from the South Delta diversion points.

MR. HERRICK: So if we have less diversions from the South Delta diversion points, would you anticipate there would be water quality effects in either the central and/or South Delta from that change?

WITNESS PAULSEN: I do, for two reasons. First, if the total amount of exports goes up, the residence time will also go up. Let me think about that. Let me not say that.

We're going to be changing the residence time of water within the Delta. That change, I believe, will preferentially affect water quality in the -- "preferentially" -- deferentially, negatively affect water quality in the South Delta. Because, again, I think there will be less flushing in the South Delta and a higher residence time as a result of the factors we've just discussed.

MR. HERRICK: And without getting too far afield in predictions, does that mean that water quality at the South Delta intakes for CVP and SWP, they might also experience decrease in water quality if operations are as per specified in the model?

WITNESS PAULSEN: Looking at the Boundary 1 scenario, I think that's probably true with the caveat we haven't quantified that, we haven't looked at that explicitly but I think that would generally be true.

MR. HERRICK: So, again, without getting too far afield in your expertise, would you then say that, if we institute a project that decreases the water quality or it worsens it at South Delta diversion points, that creates incentive to use those diversion points less?

WITNESS PAULSEN: I don't want to get into operations.

MR. HERRICK: The answer is yes. Just kidding.

CO-HEARING OFFICER DODUC: Did you just move to object to your own question?

MR. HERRICK: Objection, inappropriate.

Let me move on.

Dr. Paulsen, we had some -- you had some discussions regarding the standards that apply at

either the Contra Costa intake or Antioch. Do you recall those?

WITNESS PAULSEN: Yes.

MR. HERRICK: Are you aware of whether or not there's a federal standard regards to chlorides at Rock Slough?

WITNESS PAULSEN: All I can tell you is that what we've looked at for this analysis were those D1641 150- 250- objectives. I honestly don't recall. I'd have to go back and look that up.

MR. HERRICK: No problem. Dr. Paulsen, in some of the charts or graphs that you presented, there were instances where the modeling indicated an improvement, a bettering of water quality at certain places or at certain times. Do you recall that?

WITNESS PAULSEN: Yes.

MR. HERRICK: You're familiar with, generally the inputs to the models that were used to produce these results, correct?

WITNESS PAULSEN: I'm generally familiar, yeah. We've reviewed the inputs. I don't know that that I can answer specific questions about minute details.

MR. HERRICK: Are you aware of any proposal in the project that says, "We propose to improve water

quality at Antioch"? I mean, is there any input that says, "Let's increase outflow for the purposes of improving water quality at Antioch"?

WITNESS PAULSEN: I'm not aware of any of those statements, with the caveat that I haven't read the thousands and thousands and thousands of pages of paper that are out there.

There are a couple of the scenarios, Boundary 2 in particular, that does increase the amount of outflows and you do see improved water quality at Antioch's intake under that scenario.

MR. HERRICK: But those times of improvement are due to increased fishery obligations or proposals; they're not due to the operation of tunnels, are they?

WITNESS PAULSEN: As I understand it, both Boundary 1 and Boundary 2 would have the tunnels in place, and the North Delta diversions in both of those scenarios, the diversion points in the North Delta would be used.

I believe that I've read that the State Water Board requested Boundary 2 scenario. I don't know all the details for exactly why.

MR. HERRICK: That's all right. I'm not trying to tax you on things that may not be within the area you've covered. But the reason that there are

improvements in the modeling -- excuse me.

The reasons there are improvements at certain locations according to the modeling is not because somebody operates a tunnel. But it's because somebody requires more water for fish at certain times; is that correct, as a general --

WITNESS PAULSEN: There's certainly less water exported in the Boundary 2 scenario. I can't opine whether that's for fish or not. I really am not a fish expert.

MR. HERRICK: I have to ask this question. Throughout the discussion, both of yours and the testimony you referred to from other people, there's the assertion by the petitioners that they will operate to meet the D1641. Do you recall that?

WITNESS PAULSEN: Yes.

MR. HERRICK: Would you agree that that certainly doesn't include operating to meet the South Delta salinity standards, correct?

WITNESS PAULSEN: I have not looked at that. Again, we looked at the M and I and the export-to-inflow ratio, those three components of D1641 in great detail. I don't recall the others.

MR. HERRICK: That's fine. That was almost an objectable question on my part, too, but I let it

slide.

I'm almost done. Let me just check this.

Dr. Paulsen, you testified just now about the -- I'll say the choice as to whether or not to meet the chloride standard at the Intake No. 1 for Contra Costa or at Antioch. Do you recall that?

WITNESS PAULSEN: Oh, yes. For the 150-chloride standard, it can be met at one location or the other, yes.

MR. HERRICK: Now, meeting the standard at the point of diversion for Contra Costa is certainly a different scenario than meeting it at Antioch; isn't it? It would require different flows?

WITNESS PAULSEN: Yes, they're very different. I think we showed that in terms of the number of years that comply with that requirement at both those locations under the current conditions, well, and the future conditions, all three of the scenarios we evaluated.

MR. HERRICK: So a standard that gives someone the choice of which to use necessarily means that the standard will probably never be met at Antioch; it will always be met at the diversion point for Contra Costa, correct?

WITNESS PAULSEN: I think there was testimony

by DWR to that effect as well, yes. I mean, practically speaking, that's what has occurred. And I think there was testimony by DWR to that effect.

MR. HERRICK: So would you speculate that that's some sort of error in a water quality control plan if they chose an option -- if they provide an option that means water quality will not be maintained at one place?

CO-HEARING OFFICER DODUC: I think Mr. Berliner just objected.

WITNESS PAULSEN: I will not speculate --

MR. HERRICK: Overruled. I'll leave it at that. Thank you.

CO-HEARING OFFICER DODUC: Mr. Herrick, you were doing so well.

MR. HERRICK: It's just -- I'm so old, and it's so late in the process. Sorry.

CO-HEARING OFFICER DODUC: There probably won't be another John Herrick day after this.

MR. HERRICK: There shouldn't -- there should not be.

One last line here. Sorry.

Dr. Paulsen, you -- at some point in your testimony, you did reference the issue of the potential effects of TUCPs on any actual scenario -- operational

scenarios. Do you recall that?

WITNESS PAULSEN: I remember mentioning TUCPs. We thought about TUCPs.

MR. HERRICK: In your opinion, is there any reason why we couldn't model extreme conditions and make assumptions about the allocation of the limited supply of water such that the modeling for this process could include dry conditions without just an assumption that things will change?

WITNESS PAULSEN: I'm not sure I understood that question. Can we try --

MR. HERRICK: Yes. It wasn't very well constructed.

MR. HERRICK: In the -- I'll be real quick. Sorry.

In the presentation by the petitioners, they do reference or did reference that temporary urgency change petitions might be used during certain extreme conditions. Do you recall that?

WITNESS PAULSEN: I do, yeah. I mean, I think we wrote in the Brentwood report, if I recall correctly, about some of the language they used surrounding those, that the recent years were statistical outliers or -- there was language along those lines in DWR's testimony.

MR. HERRICK: Is there a reason we cannot model those type of years that have extreme conditions to see what will happen under any specific project operations?

WITNESS PAULSEN: That is one of the things that I've been very curious about actually. We've had a greater frequency of very dry years recently than we have in the historical record.

DWR's testimony asserted that those -- I'd have to look up the language to get it right -- but those are statistical outliers or -- I forget what the other word was. But it implied that they were relatively rare. And I was very curious about the basis for that assertion.

We certainly can model the Delta under a range of scenarios, including the situation, the conditions, the flows that have occurred in recent years.

MR. HERRICK: And it is certainly possible that operations with twin tunnels might affect these specific conditions in those, as they label it, outlier years, correct?

WITNESS PAULSEN: Frankly, I would think that DWR would want to know how this proposed project would operate if years like we've had recently recur in the future.

MR. HERRICK: And that might actually give us instructive information on whether or not other parties might be harmed, correct?

WITNESS PAULSEN: I would certainly be curious to know how the project would be operated under those conditions. We don't have those conditions in the 16-year model period that we've been talking about a lot today.

MR. HERRICK: Thank you very much. That's all I have. Thank you.

CO-HEARING OFFICER DODUC: Thank you, Mr. Herrick.

Mr. Keeling.

CROSS-EXAMINATION BY MR. KEELING

CO-HEARING OFFICER DODUC: I would never confuse Mr. Herrick for anyone else.

MR. KEELING: Thank you, Madam Hearing Officer.

Tom Keeling for the San Joaquin County protestants. And I have very few questions for Dr. Paulsen, one on the EI ratio and a couple questions on adaptive management and one or two on water quality in the Sacramento River.

CO-HEARING OFFICER DODUC: About 15 minutes?

MR. KEELING: At most.

Dr. Paulsen, you testified about DWR's proposed exclusion of Sacramento River water, which is to be diverted by way of the North Delta diversion, from the export-to-inflow requirement, ratio requirements of D1641. Do you remember that?

WITNESS PAULSEN: Yes.

MR. KEELING: Is it fair to say that excluding those diversions from the ratio masks the actual effects of the proposed project with respect to D1641 compliance?

WITNESS PAULSEN: I mean, the way you define the E-to-I ratio affects the way you interpret the E-to-I ratio. So I would say the way you define it affects that. I don't know the extent to which redefining the E-to-I ratio would affect other -- compliance with other water quality standards.

MR. KEELING: I'm talking about compliance with D1641.

WITNESS PAULSEN: Well, and that's one component of D1641. So I guess what I'm trying to say is I don't know how the State Water Board will define the E-to-I ratio in the future.

We've provided two ways of calculating it, one that, you know, in my opinion is consistent with the current definition of total exports divided by total

inflows and another that is the proposed definition by the petitioners that would subtract the North Delta diversion -- the water diverted from the North Delta diversion points from the inflows and would not include it in the amount of water exported.

I mean, one way to think about it -- I don't know if this would happen or not, but if all water were to be diverted from the North Delta diversion point and none from the South Delta export points, the value of that ratio would be zero. So it wouldn't -- it wouldn't govern or restrict exports from the Delta any longer if -- in that sense.

MR. KEELING: That's -- now you're -- that answers my question. That's what I'm getting at. Perhaps I used the word "masks" which has perhaps a qualitative, normative connotation. And you've put it in more rigorous terms.

If you know, what was DWR's rationale for excluding the water to be diverted at the North Delta diversion from the ratio?

WITNESS PAULSEN: I don't know if this will answer it or not, but we can include a quotation. It may take a minute to find.

The quotation from the draft BA where they talk about the redefinition of that quantity reads as

follows. And this is on the bottom of Page 12 and flowing over onto Page 13 in the Brentwood report.

MR. OCHENDUSZKO: Dr. Paulsen?

WITNESS PAULSEN: I'm sorry. Yes?

MR. OCHENDUSZKO: I apologize. We couldn't hear you through the microphone.

WITNESS PAULSEN: I'm so sorry. I'm not very good with microphones.

Okay. I was going to -- I'm not sure if this will answer the question or not, but I was going to read a quotation from the draft BA. It's in the report which is labeled Brentwood 102 at the bottom of Page 12 and flowing over into Page 13.

And it reads, "The D1641 export-to-inflow, E-to-I, ratio calculation was largely designed to protect fish from South Delta entrainment. For the PA," I think meaning the preferred alternative, "Reclamation and DWR propose that the NDD be excluded from the E-to-I ration calculation. In other words, Sacramento River inflow is defined as flows downstream of the NDD, and only South Delta exports are included for the export component of the criteria."

That quote implies that it has to do with fish and entrainment in the South Delta.

MR. KEELING: The word "it" in the sentence

means their decision to propose this change in the way the ratio is calculated?

WITNESS PAULSEN: I have lost the thread of this, and it's late. I apologize.

That quotation to me implies that they believe the change would be related to the protection of fish in the South Delta. Did I answer the question?

MR. KEELING: I think. Do you agree with the statement you just read from DWR?

WITNESS PAULSEN: It's going to take me a minute to find it. I know I have it here. I did look up part of the basis for where that number came from in the first place, why we have an E-to-I ratio. And it's from one of the BiOps.

And I don't have my finger on it now, but I Know it's here. Would you like me to spend some time and look for it?

MR. KEELING: Well, I think I would incur the ire of the hearing officers if I said "yes." Perhaps we can deal with this later in other ways.

CO-HEARING OFFICER DODUC: But your point in asking this question, perhaps we could get a direct answer?

MR. KEELING: The point in asking the question is simply this: The proposal to change the E-to-I

ratio is a way of disguising the detrimental effects of this project on both environmental and legal users of water in the Delta. That was my point.

CO-HEARING OFFICER DODUC: And your question to Dr. Paulsen would be whether she had an opinion one way or another.

MR. KEELING: In your opinion, does that decision to change the P -- the EI ratio disguise the detrimental effects of this project with respect to water quality?

WITNESS PAULSEN: Well, right now, the way it's currently defined and interpreted, it serves as a limit on the amount of exports. The exports are limited to a certain fraction of the inflow to the estuary.

As redefined, that limit is changed and made less restrictive. More water would be able to be diverted if you use the North Delta diversion point before you hit those 65 percent, 35 percent thresholds of that E-to-I standard.

I think that might answer your question.

MR. KEELING: That does answer my question.

CO-HEARING OFFICER DODUC: And in a much more diplomatic way. Thank you.

MR. KEELING: Dr. Paulsen, you testified

earlier that DWR's adaptive management and monitoring program is undefined, to use your term, and thereby I infer you meant deficient in that respect, right?

WITNESS PAULSEN: I would certainly like to see more detail in order to understand how it would operate.

MR. KEELING: You mentioned in passing that you have experience with other adaptive management programs in connection with other projects. Can you expatiate a bit on that?

WITNESS PAULSEN: Most projects are managed. The way they operate is managed. And those operations are -- I mean, if we're paying attention, they're adaptive. If we're paying attention, we learn from what we do, and we make changes in operations to avoid an impact or to improve something. There's usually a reason for a change in operations.

But if we're paying attention, we're open to doing that. And so as a fundamental principle, you know, most things are adaptively managed.

I'm not sure this is exactly responsive, but let me try.

One of the things that I've worked on in the Delta is the operations of the Freeport Regional Water Authority Project, the diversion point that's in the

Sacramento River. And we helped develop an operations plan for the operation of that intake because it's a tidal estuary, and sometimes the Sacramento River flows upstream; the flow reverses when the net river flow is low at that location.

And there were concerns about water quality from a downstream discharge if and when the river did reverse flows. So we took a very long modeled record -- I believe we used DSM2 -- to calculate hourly flows in the Sacramento River and to simulate the upstream transport of the discharge from downstream at that diversion point upstream and to develop operating rules in response to that detailed analysis.

Some of that I think is in the record here. East Bay MUD exhibits include a description of that operating rule.

That's the level of detail that I'm used to seeing when we talk about operating rules. And I don't see anything close to that here. And I don't understand, based on the description of the adaptive management plan that I've read, how the operations of this WaterFix project might be changed in the future and in response to what variables or what conditions.

So I'm not sure that's exactly responsive, but I'm trying to answer your question.

MR. KEELING: Well, it tells me that answer is "yes" to the question, the implicit question: Have you had any experience with adaptive management plans you regard as well designed and successful? And I take it that the answer is yes as to the Freeport project?

WITNESS PAULSEN: Yeah, the work we did was to help them with the initial operations I don't believe there have been major changes to that operating plan since that project went into operation. But yes, I worked in a great level of detail on those operations.

MR. KEELING: Based on your experience with that and other adaptive management plans that you regard as more successful, what components of an adaptive management plan would you expect to see in a proper or sufficient, well-designed adaptive management program for this project? In other words, what is DWR missing?

CO-HEARING OFFICER DODUC: And is it different than what you've already answered, based on the experience that you just brought up?

WITNESS PAULSEN: What I personally would like to see here, I would like to have an understanding of the guidelines or the parameters that are going to be evaluated in considering a change in operation.

So we know that operations are going to start

at what they call H3-plus or between H3 and H4, in that range, right? I don't know under what conditions or why or when the operations would deviate out of or away from that.

And I would like to have some understanding of what parameters or conditions might occur in order to drive operations in one direction or another because then we would have some sort of a filter or a framework for evaluating how operations might change in the future and for having a little bit more certainty in terms of the impacts of this proposed project on our clients -- if that's responsive.

MR. KEELING: It is.

WITNESS PAULSEN: Okay.

MR. KEELING: Thank you. And Dr. Paulsen --

CO-HEARING OFFICER DODUC: Your microphone, Mr. Keeling.

MR. KEELING: Dr. Paulsen, referring to your exhibit Antioch 200, which is your written testimony, at Page 5 Line 23 --

WITNESS PAULSEN: Yes.

MR. KEELING: You discuss, quote, "high quality Sacramento River water," end of quote. And I believe one of your points in that discussion is that the proposed WaterFix project would result in a lower

amount of high quality Sacramento River in the Delta itself; is that correct?

WITNESS PAULSEN: Right. If you take it out of the Delta before it has a chance to flow into the Delta it's not going to flow -- that portion that you've removed isn't going to flow into the Delta.

MR. KEELING: And by the same reasoning, a greater amount of the high quality Sacramento River water would be exported from the Delta, correct?

WITNESS PAULSEN: That's correct.

MR. KEELING: And you testified, as I recall, that Sacramento River water is higher quality -- I'm using your term -- because it contains lower levels of salinity than is contained in other sources of water for the Delta?

WITNESS PAULSEN: Right. And I think I also said that the eastside streams generally have comparable water quality. So the Sacramento River and the eastside streams are generally the lowest salinity sources of water in the Delta. The Sacramento River flow is much bigger than the others. So --

MR. KEELING: But the quality of the water from Sacramento River is higher than that generally from the San Joaquin River?

WITNESS PAULSEN: Lower salinity, that's

right.

MR. KEELING: My question is very simple. Other than lower salinity, are there any other qualities of these water that lead you to characterize Sacramento River water as higher in quality than San Joaquin River water?

WITNESS PAULSEN: Oh, boy. The short answer is yes, and the longer answer is I'm really not prepared to be quantitative about that. I think I did testify earlier that San Joaquin River water and agricultural drainage have some similarities. They resemble each other. One resembles the other to a certain extent.

And that's based on work that I did in the 1990s as part of my Ph.D. work where we did look at that. It's certainly true for salinity.

MR. KEELING: Well, you're not prepared to be quantitative about that, and I understand that. Can you be qualitative about that?

WITNESS PAULSEN: Well, again, San Joaquin River water and ag drainage are fairly similar. So the things that you might find in agricultural drainage water -- probably higher nutrient concentrations, things like that -- you would find also in San Joaquin River water.

As part of my thesis, one of the things that I did was to try to look at the natural fingerprints of the Sacramento River versus the San Joaquin River and look as to whether they are different. And they are.

And in large part, that's just because of the geology of the basins that they flow through. So the Sacramento flows through a granitic kind of a system. And the San Joaquin, the southern part of the Central Valley is more of a marine-shale-based system. And so as the water flows through those systems, it picks up different proportions of different elements.

So the Sacramento River water in general had a different quality than San Joaquin River water. The San Joaquin River had -- this isn't going to be relevant, I don't think, to your question, but it had higher concentrations of things like the rare earth elements -- molybdenum, vanadium, uranium -- than the Sacramento River water.

And it is that difference in the quality of the two waters that just sort of occurs naturally by virtue of the soils that they flow over and through that makes them look different for the purposes of fingerprints.

MR. KEELING: Dr. Paulsen, thank you very much. That is all I have.

WITNESS PAULSEN: Thank you.

CO-HEARING OFFICER DODUC: Thank you, Mr. Keeling.

Mr. Brodsky.

For Dr. Paulsen's information, after Mr. Brodsky will be Ms. Des Jardins and Ms. Suard. And that completes the list of cross-examination.

CROSS-EXAMINATION BY MR. BRODSKY

MR. BRODSKY: Thank you. Good afternoon, Dr. Paulsen. Michael Brodsky on behalf of Save the California Delta Alliance and other protestants.

And could we take a look at SWR- --

CO-HEARING OFFICER DODUC: Mr. Brodsky, before you do, your topic area that you will be questioning her on?

MR. BRODSKY: I want to go on a little more detail about the change in the mix of Sacramento River water versus San Joaquin River water and how that will come about. I want to take a look at some of her conclusions and quickly compare those to some conclusion of some other experts that we have in the record regarding that same topic, and, if there is time, then I would go in a little bit about the salinity testimony. But I'll save that for last.

CO-HEARING OFFICER DODUC: And you had

requested 20 minutes.

MR. BRODSKY: I requested a half hour, but I'll try to do it in 20 minutes.

CO-HEARING OFFICER DODUC: I heard 20.

MR. BRODSKY: Okay. So if we could take a look at SWR-CVP Figure 7-27.

Okay, Dr. Paulsen. So you described that there will be a worsening of water quality in the interior Delta because high quality Sacramento River water will be diverted before it has a chance to flow through the Delta; is that correct?

WITNESS PAULSEN: For some of the operating scenarios, scenario Boundary 1 in particular.

MR. BRODSKY: Okay. So I'd like to just go into the physical, how that looks a little bit.

So maybe could we blow this up just a little bit more? So, yes. Thank you.

Up at the top there, we see the three proposed diversion points. And then downstream from those diversion points, we can see the towns of Walnut Grove and Locke. And then we see where Georgiana Slough connects to the Sacramento River. Are you able to follow that? Do have do you have a monitor in front of you?

WITNESS PAULSEN: I don't, but I think I can

see it.

MR. BRODSKY: Then also at the town of Locke, there's the Cross Delta Canal. It doesn't show on the map there, but I believe you're familiar with that. And that's operated by USBR. And it has a set of gates on it. When those gates are open, it allows the Sacramento River water to flow into Mokelumne River; is that correct?

WITNESS PAULSEN: Yes.

MR. BRODSKY: So high quality Sacramento River water travels through that Cross Delta Canal and then down both branches of the Mokelumne River into the Central Delta and mixes there with San Joaquin River water, correct?

WITNESS PAULSEN: Yes.

MR. BRODSKY: Then it also travels down Georgiana Slough into the Central Delta and mixes with San Joaquin River water?

WITNESS PAULSEN: Yeah, I believe that's true.

MR. BRODSKY: Okay. And the proposed intakes are upstream of both the Cross Delta Channel and of Georgiana Slough; is that correct?

WITNESS PAULSEN: Yes.

MR. BRODSKY: And so the basic physical operation of this is, if we take that Sacramento River

water out of the river by those intakes before it has a chance to take its route that we described into the Central Delta, there will be less of it in the Central Delta?

WITNESS PAULSEN: Yes. And, I mean, you're getting into some detail in terms of the flow path that it follows, but, yes, that's one way.

One interesting thing about Locke, when I was doing my Ph.D. work, I had one of my samplers out in the Sacramento River at the boathouse at Locke. And we used that as the point that was representative of characterizing Sacramento River water because that location is Sacramento River water. These intakes are, you know, clearly north of that point.

MR. BRODSKY: Okay. Thank you very much. In your testimony -- and I believe Mr. Keeling may have just looked at this -- Antioch 200 on Page 5, at Lines 19 to 25, you describe, you know, "By removing both more water and more high quality Sacramento River water from the Delta, the WaterFix project would change the composition and quality of water within the Delta and increase the residence time of water quality in the Delta resulting in degraded water quality."

That's your testimony. And so part of that degraded water quality would be because we have a

higher percentage of San Joaquin River water; is that correct?

WITNESS PAULSEN: Yeah. When you pull -- I mean, because the Delta channels are, for the most part, below sea level, when you remove one source of water, water is going to flow into those channels and make-up the difference. And yeah, the fingerprinting work that we looked at in these two analysis showed exactly that.

I mean, we expected it, and it sort of proofed up what we expected. You know, as you remove more high quality Sacramento River water, it's not going to flow into the interior of the Delta because you've pulled some fraction of that river water out before it has a chance to get there, and other water sources are going to make up the difference.

MR. BRODSKY: Okay, good. And you -- at Page 5 there, your bold heading, you've characterized this as "substantial change in Delta hydrodynamics," correct?

WITNESS PAULSEN: (Nods head affirmatively)

MR. BRODSKY: Okay. And so I'd like to take a look also at Page 7, Lines 14 to 15 of your testimony. And there you say that, "DWR's model results show that the proposed WaterFix can be expected to lead to

increased difficulty in complying with water quality inflow criteria in the Delta."

And I understand that to mean that it's going to be more difficult to operate the system to comply with D1641 after WaterFix is in place.

WITNESS PAULSEN: Yes. Specifically, I mean, the detailed analyses that we did of the operations scenario Boundary 1 and B1 showed that -- I think we talked about it at length today -- that the number of days it will be in compliance with these standards is going to decrease relative both to the existing condition and the no action alternative with that operation scenario.

MR. BRODSKY: Okay. Thanks very much.

CO-HEARING OFFICER DODUC: Mr. Brodsky, I don't think you were here when Dr. Paulsen presented her detailed testimony in the beginning. But all the questions that you've asked so far have been covered.

MR. BRODSKY: All right. I'm going to -- thank you very much, but I'm going to move away. That was just kind of a recap.

And then if we could take a look at SCDA-34.

CO-HEARING OFFICER DODUC: For future cross-examination conductors, recap is not necessary I'm not that ill.

MR. BRODSKY: Okay. Thank you.

So this is a letter from US EPA commenting on the WaterFix project dated October 30th, 2015. And then if we could take a look at Page 3, and the second paragraph there, second part. It says, "If the proposed project operation contributes to the general increase in salinity in the Delta, the flexibility that Reclamation and DWR have to operate the system to ensure that water quality criteria are met will be seriously diminished, and the two agencies will have little room for error in operating the system to effect beneficial uses and achieve the co-equal goals."

So I understand that to mean that, with WaterFix in place, there's going to be less margin for error, it's going to be more difficult to operate the system to comply with water quality standards. And is that -- do you agree with that?

WITNESS PAULSEN: I think generally I do. There are some assertions in DWR's testimony that they will have greater flexibility to operate in the future. I guess by virtue of having a different -- a separate, a new intake location.

But, again, when we look at the modeling results, we see that it's likely that these salinity standards -- or at least the M and I standards that we

looked at, the 150 and the 250, will be exceeded with greater frequency. And the E-to-I ratio, too, we looked at that one. If it's not redefined, that will be exceeded more frequently.

I mean, the flexibility that they would have -- and I think I talked a little bit about this before as well -- would be either to increase inflows or to reduce exports or some combination of the two.

MR. BRODSKY: And they have that flexibility now, though?

WITNESS PAULSEN: In theory, they do. They're operating under multiple demands of people who want water.

MR. BRODSKY: Okay. All right. Let's move on to SCDA-26. And that's an August 26, 2014 EPA comment letter. If we could go to Page 2, and the second paragraph.

It says, "While we note" -- while CM1," which is the tunnels, "would improve the water quality for agricultural and municipal water agencies that receive water exported from the Delta, water quality could worsen for farmers and municipalities who divert water directly from the Delta." Do you agree with that?

WITNESS PAULSEN: I do.

MR. BRODSKY: Okay. And this was written in,

I think, August 26, 2014. There have been some changes in the project description since then. But as far as this statement and your most current assessment of the project with the most recent description, you still agree with that statement?

WITNESS PAULSEN: Well, I mean, with the caveat that I don't know that the Boundary 1 scenario that we showed has the most severe impacts is equivalent to CM-1. But certainly the Boundary 1 scenario results in water quality degradation at some locations within the Delta.

MR. BRODSKY: Okay. Then I'd like to move on to -- just to verify, so I'm not repeating, that you testified that in several places, the operations of WaterFix at this point are ill defined, that it's not clearly described.

WITNESS PAULSEN: We have a very broad operational range. And we know they'll start out in the H3-H4 side of things. But we don't understand yet the guidelines or criteria by which they will deviate from that and veer to one end or the other.

MR. BRODSKY: All right. So I'd I like to look at SCDA-34, that's that first EPA letter.

Sorry to jump back and forth.

MR. OCHENDUSZKO: Mr. Brodsky, is there a

microphone muffler in front of you that you might be able to put over that microphone? Thank you so much.

MR. BRODSKY: Is that better?

MR. OCHENDUSZKO: Yes, thank you.

MR. BRODSKY: Thank you for remind minding me.

And then at Page 2, the last paragraph, it says, "As has been discussed throughout the development of this project, the most essential decision for achieving the desired balance between water reliability and restoration of the Bay-Delta ecosystem is how freshwater flows through the Delta will be managed. This key decision is not described in the SDEIS and is instead deferred to future processes."

This was as of October 30th, 2015. Is that still consistent with your current understanding that how this thing is going to be operated is not clearly defined?

WITNESS PAULSEN: Yeah. Again, as I testified earlier, I really don't understand how we know where within that broad range of operating scenarios we'll find ourselves at any given point in time.

MR. BRODSKY: The reason I'm asking these questions is that Mr. Berliner and I have sparred over these two documents multiple times. And one of the State's contentions is that, "Well, those are old, and

now the project's been updated, and it no longer applies. So that's why I'm trying to ask you if certain statements in here are still accurate to the best of your knowledge.

Okay. Could we take a look back at the map again. That's Figure 7-27. And scroll down.

So can you see -- is it large enough there for you to see the location of Discovery Bay at the southern end of the Delta near the export pumps?

WITNESS PAULSEN: Yes.

MR. BRODSKY: And is it correct that we would understand the North Delta diversions diverting the Sacramento River water before it flows through the Delta that we would have a higher proportion of San Joaquin River water at this location as well as throughout the Central and South Delta?

WITNESS PAULSEN: Yeah. Again, under Boundary scenario -- Boundary 1 operating scenario, I think that would be the case, just based on the general information that we have and the results that we have at Rock Slough, which is to the north or northwest of Discovery Bay. So for that scenario, yes.

MR. BRODSKY: Okay. And is it your understanding -- you may not have gone into this in your work for Antioch and Brentwood because it may not

be relevant to them. Is it your understanding that the San Joaquin River water generally has a higher nutrient load than Sacramento River water? Or if you know?

WITNESS PAULSEN: Yeah, I can't be quantitative. I believe that it does. But, again, I can't be specific about that.

MR. BRODSKY: Okay. Thank you.

And then I'd like to just go to Antioch 216. I don't believe I gave the projector operator that one in advance. Sorry about that.

Are you familiar with this report?

WITNESS PAULSEN: I am.

MR. BRODSKY: Did you participate in the preparation of this?

WITNESS PAULSEN: I did.

MR. BRODSKY: Okay. And so you testified earlier, you referred -- you thought that some of the statements in DWR-53 were not as clear as they could have been. I believe that was the written testimony of Ms. Sergent, if I remember correctly.

WITNESS PAULSEN: I think that's right. That was hers.

MR. BRODSKY: Okay. And so I asked Ms. Sergent if she was aware of this report, and she said she was not. DWR and CCWB have sparred back and

forth about historical salinity in the Delta for some time, haven't they?

WITNESS PAULSEN: I have heard rumor of that, yes.

MR. BRODSKY: Okay. Would you think somebody at DWR familiar with the Delta and the various positions and people would have known of this report and should have at least referred to it in a historical salinity discussion?

CO-HEARING OFFICER DODUC: I believe an objection is forthcoming, Dr. Paulsen.

MR. MIZELL: I object.

MR. BRODSKY: I can -- go ahead.

MR. MIZELL: You can rephrase it if you like, but I object to the idea that Ms. Paulsen has the expertise to opine upon whether or not the staff members of DWR should or should not be aware of a report produced by Contra Costa Water District.

CO-HEARING OFFICER DODUC: Fair enough.

Restate your question, Mr. Brodsky.

MR. BRODSKY: In the relatively small community of experts who deal with salinity issues in the Delta, is this report fairly well known?

WITNESS PAULSEN: I can tell you that, of course, I've been aware of it since well before 2010,

when was issued.

I believe that, as part of the submittals by Antioch to the State Water Board in the past, we've provided to the Board in the past.

I'm fairly sure that I've discussed a number of the details that are presented in this report before the State Water Board in the past.

I don't know how to answer your question.

MR. BRODSKY: I think you've done so. And I won't ask further about what somebody should or shouldn't have known when they wrote a report about salinity.

You testified that there were going to be substantial changes in Delta hydrodynamics. I can represent to you that the Biological Assessment produced by Petitioners also says there will be major changes in Delta hydrodynamics and major changes in circulation.

The Aquatic Science Peer Review that was produced on the BA also talks about major changes in Delta hydrodynamics.

When I asked Mr. Leahigh, who testified on behalf of operations for the State, whether he agreed there would be substantial changes in Delta hydrodynamics, he said no, he didn't agree with that.

Does that trouble you that someone who's going to be operating the project doesn't understand the dramatic effect this is going to have on the Delta?

CO-HEARING OFFICER DODUC: You may decline to answer, Dr. Paulsen.

WITNESS PAULSEN: I don't know how to answer that.

MR. BRODSKY: Okay. Let's leave it at that. Thank you.

CO-HEARING OFFICER DODUC: All right. Let me check with Dr. Paulsen and the court reporter, Debbie.

Are you okay with proceeding? Or do you need a break?

THE REPORTER: I'm okay.

CO-HEARING OFFICER DODUC: All right. I believe Ms. Des Jardins requested 20 minutes, and Ms. Suard requested 15.

MS. SUARD: She said I could go first.

CO-HEARING OFFICER DODUC: Well, you may request to go first.

MS. DES JARDINS: I request for her to go first.

CO-HEARING OFFICER DODUC: Thank you.

Ms. Suard?

And assuming Ms. Suard takes the 15 minutes,

why don't we take a short break after that then.

CROSS-EXAMINATION BY MS. SUARD

MS. SUARD: Is this the one that was being used? Okay.

I did ask for some slides to be brought up. Page 3 of that, please. Whoops. Okay.

Hi. My name's Nikki Suard. I'm from Snug Harbor, which is a marina in the Delta. And I'm not a computer modeler per se, but I'm pretty aware of flows and impacts. And Snugg Harbor is actually in the North Delta region, but I'm very familiar with down in Antioch and all that.

So this slide that you're not seeing -- okay. There you go.

There are -- every year, there's updates to all the different models and all that. And this one's from Aaron Blake with USGS. And he said that for modeling, "garbage in, garbage out." As a modeler, would you agree with that statement?

WITNESS PAULSEN: I mean, all models have -- have their quirks. And you certainly want good quality geometry and inputs to a model.

MS. SUARD: Okay. So on -- thank you -- baseline modeling, what you used for your analysis, you were handed that information from DWR, USBR, which one

or both?

WITNESS PAULSEN: The WaterFix model runs I believe we downloaded from the FTP site once they were posted there. One of the reports has the date on which we downloaded them. But anyway, that's where those came from.

And then I don't have the exact date when we received the EBC2 model run. But we received that as part of the BDCP proceedings I believe from DWR directly.

MS. SUARD: Okay. Thank you. So I am concerned about salinity -- the extremes, you know, that low flows resulting in higher salinity.

And can we go to SHR-104 Page 5.

So I -- this is a -- it shows a map that shows farmers' intakes and including -- it could be blown up, and you could see that they're down by Antioch and Pittsburg and all that.

And, actually, I'm aware of some farm stands that sell to the public in Antioch and Pittsburg. And I believe they're on wells rather than the City water. Were you provided with any baselines data of the impacts to the drinking water wells from the WaterFix operations?

WITNESS PAULSEN: No, I did not look at that.

I believe that Mr. Bernal may have some information on the City's municipal water source and whether they have been or are or will be on well water.

MS. SUARD: Okay. So that was all an analysis of City water rather than the drinking water wells?

WITNESS PAULSEN: We looked at the City's municipal supply. Right. I did not review information from wells in the Antioch area.

MS. SUARD: Okay.

(To Mr. Bernal) Does the City use any wells, as well, to mix, to freshen up?

CO-HEARING OFFICER DODUC: No, you cannot answer because you have not taken the oath and you have not testified.

MS. SUARD: Okay. Sorry. So I'll just withdraw that. I just had thought of that question.

So then my next question is -- can we go to SHR-40 F, Page 3, please. Or did I just do that? Sorry. SHR-39 WF.

So I believe you had a very similar graphic, and that's from DWR-5, Page 10. And then I just put on that DSM2 map some of the detail about DSM2. So does that look familiar to you?

WITNESS PAULSEN: The base map does. I don't know what the white --

WITNESS PAULSEN: Okay. The white circle part. Okay. So that white circle part, that is an area called the Yolo Bypass.

And can we go to now SHR-20, Slide 12.

Okay. So that DSM2 model, are you -- do you know if that was recalibrated to include the Liberty Island Reservoir? I think that's what it was called, something like that.

We can go down to the next slide as well. Oops. Just -- it's a very large body of water. This is a drone photo of it. And it's -- I estimated it's 40,000 acre-feet, something like that. It's very large. Do you know if DSM2 included a recalibration of this?

WITNESS PAULSEN: I don't actually remember the details. There has been at a minimum discussion about that, if not a full-on recalibration. I know this area of the Delta somewhat well because we've done some stud dye studies for the City of Vacaville, traced dye injected at their discharge point through the Cache Slough area. I mean, you're right it's large. There's a lot of water there. I just don't remember the details of the calibration.

MS. SUARD: As a DSM2 -- sounds like you're very familiar with that. Would the hydrodynamics of

this amount of body of water affect the flows and hydrodynamics in other parts of the Delta particularly, even down by Antioch?

WITNESS PAULSEN: It certainly can. It really depends on the degree of interconnection between that body of water and surrounding bodies of water. I know when I worked on the dye study for the City of Vacaville, we used the DSM2 model to try to simulate the fate of dye in Cache Slough, which is right adjacent to this Liberty Island area. And, you know, we found that the model performed reasonably well in that area.

MS. SUARD: Okay.

WITNESS PAULSEN: It was a number of years ago. I don't remember the exact time frame.

MS. SUARD: Okay. Could we go down another slide or two, please. Another one. There we go.

Okay. So another project that's ongoing that I believe is impacting hydrodynamics and water quality as well, this is -- it's Prospect Island. We call it the water hyacinth nursery because this water is shallow and it just grows water weeds.

And are you -- have any idea if DSM2 is -- has -- was updated and include the water impacts from -- the hydrodynamic impacts from this type of an item?

WITNESS PAULSEN: I don't know, and I don't have the materials with me to figure that out.

MS. SUARD: Okay.

CO-HEARING OFFICER DODUC: Are you aware of any specifics regarding the calibration and updating, whether any particular projects were included?

WITNESS PAULSEN: You know, I have a lot of that information in my office. I'm leery of going too far in terms of the specifics because I don't remember the fine level detail.

CO-HEARING OFFICER DODUC: That's fine. And that was not part of your analysis for the City of Brentwood or Antioch?

WITNESS PAULSEN: No, and we didn't look in detail at the DSM2 model grid in this -- well, really at all. We didn't make any adjustments to that model grid. We just used the model results that DWR provided to the public.

CO-HEARING OFFICER DODUC: That's very kind of the two cities to make your expertise available to all parties to take advantage of.

Please continue, Ms. Suard.

MS. SUARD: One more question, basically.

In DSM2 and to your knowledge, which waterway is the one that is where the intake is so that the City

of Antioch can take the water out?

WITNESS PAULSEN: I can point you to it on a map. It's -- and I think Mr. Bernal will probably describe the location. It's in what is called the San Joaquin River channel. But most of the water that's diverted from Antioch's intake is actually Sacramento River water.

MS. SUARD: Okay. Do you know how deep that is or what the DSM2 model -- does it -- has it a specific depth for that waterway or --

WITNESS PAULSEN: Well, it will have the geometry to describe the channel in that location, but, again, I don't remember the fine-level details there.

MS. SUARD: Okay.

WITNESS PAULSEN: It will have, you know, essentially a width and the depth that describe the channel.

MS. SUARD: Okay. So if DSM2 described a channel depth of 20 feet deep and made the assumption for modeling that you would be getting a certain amount of flow and water quality that goes with that flow and in reality it was ten feet deep, how would that affect that model outcome?

So what I'm saying, in real life it's 10 feet, but the model says it's 20 feet.

WITNESS PAULSEN: I think all I can say is that in general the -- well, no, I can't even say that; it depends on where you are.

What I was going to say was that, in general, the amount of flow is proportional to the size of the channel, but that's not true because it's also the forcing function between the two. It would depend --

(Reporter interruption)

WITNESS PAULSEN: I'm sorry. A forcing function. You look at the head difference from one end of the channel to the other and the size of the channel, and that will determine how much water flows through that.

There's a very good tidal range in the area of the Delta where Antioch's intake is located.

CO-HEARING OFFICER DODUC: I appreciate your helpfulness, but a simple "I don't know" is sufficient.

WITNESS PAULSEN: I don't know exactly.

CO-HEARING OFFICER DODUC: Thank you.

MS. SUARD: Okay. If there was a barrier across the channel leading to the intake and it blocked the lower half of the flow, would that impact flow receipt at your intake or water quality?

WITNESS PAULSEN: I'm not -- I don't -- I don't how to answer that specific to the intake because

a channel or a barrier specific -- right at the location of the intake would affect only water quality -- or water flows, excuse me, very, very locally.

We do routinely simulate the presence of barriers in Delta channels. You know, the South Delta barriers for example, that can be simulated. The reason those barriers are put in place is because they do alter flows and water levels at least in part; that's part of the reason.

So that can be analyzed. I don't know how to answer the question generically.

MS. SUARD: Okay. Could we go to the very last slide, please.

It's going to -- it has to be blown up so you can see the bottom of the slide. And you have to kind of -- yeah, make it go down.

So it's more of a site profile visual here. This is the result of side-scan sonar on one of the waterways. And this is Sutter Slough. And you can see where there's that yellow highlight.

Can you see where it -- it goes from actually about ten meters down to two meters. Do you -- I don't know -- it's hard to see over on the left, the ten-meter mark. But you can see on the right that it's two meters, right, depth?

WITNESS PAULSEN: I don't see a meter mark, but --

MS. SUARD: Oh, gosh. It has to be -- yeah. It's brighter in mine.

WITNESS PAULSEN: I mean, it does look like there's a -- the picture looks like it's trying to show a bump in the channel bottom.

MS. SUARD: Yes, yes. So if flow is coming from the left and then it basically has something that's stopping the flow, and -- would you believe that the -- below that there is less flow?

WITNESS PAULSEN: By "below," you mean in the bed?

MS. SUARD: To the right.

MR. ALADJEM: Madam Chair, we've been sort of going down a long road about DSM2 and channel bottoms and everything. I'm frankly -- I don't see the relevance to Dr. Paulsen's testimony or to the WaterFix project.

MS. SUARD: Okay. I'm going to withdraw on this particular questioning. But the relevance on --

CO-HEARING OFFICER DODUC: Ms. Suard, that's fine. You withdrew. Anything else?

MS. SUARD: I'm not withdrawing my questions regarding DSM2. I believe that the --

CO-HEARING OFFICER DODUC: That's fine. That's fine, Ms. Suard. It's in the record. So move on.

MS. SUARD: Okay. No, that's it. Thank you.

CO-HEARING OFFICER DODUC: All right. Thank you.

Let's take a short break and return at 4:05.

(Recess taken)

CO-HEARING OFFICER DODUC: It is 4:05. We're back in session.

Ms. Des Jardins, before you begin, you and I have had issues when you've conducted cross-examination in the past. And I'm almost afraid to sic you on Dr. Paulsen, given how passionate I know you are about modeling.

But I look forward to a productive exchange of technical discussion. But I will remind you and I would give you the same reminder, I will give everyone the same reminder, regardless of time. And that is to please be direct and succinct and relevant in your questions to Dr. Paulsen. Okay?

MS. DES JARDINS: I will endeavor to be very focused.

CO-HEARING OFFICER DODUC: Thank you.

Have at it. You're up, Dr. Paulsen.

CROSS-EXAMINATION BY MS. DES JARDINS

MS. DES JARDINS: So, Dr. Paulsen --

CO-HEARING OFFICER DODUC: Hang on. Before you jump in, topic areas.

MS. DES JARDINS: Okay. So my topic areas are Title 23, Code of Regulations 794, CalSim as inputs to DSM2, the DSM2, a couple questions on model calibration, just a few pages from the calibration report.

CO-HEARING OFFICER DODUC: I am so shocked that you would bring that up.

MS. DES JARDINS: Route operations and some things about the planning studies that Dr. Paulsen referred to that were done in the '20s for Antioch, relevant information in the permits.

CO-HEARING OFFICER DODUC: All right. Let's go.

MS. DES JARDINS: So this is an exhibit of SWRCP -- sorry, DWR-324, which was how they were going to provide the information required. So there is some current information on diversion, release, and return flow schedules.

Can we zoom out a little or scroll down? So we go down -- yeah.

MR. OCHENDUSZKO: Ms. Des Jardins, can you

please identify what we're looking at.

MS. DES JARDINS: Zoom out.

This is DDJ-112, which is just an excerpt, yeah, of DWR-324 with some highlighting, or it's the document with some highlighting.

So let's scroll down further, please, to the next page. Down, down. Okay. That's good.

So basically they refer to -- they said they've provided the existing release and return flow schedules. It sounded like you needed some current flow information for your work; is that correct?

WITNESS PAULSEN: And I'm sorry. What flow information are you talking about?

MS. DES JARDINS: Well, let's scroll back up.

They said it was in -- the Board mandated they provide it. They said it's supposed to be in Exhibit DWR-71, which was the testimony of Mr. Munevar. I don't know if you looked at that.

WITNESS PAULSEN: I -- let's see. They're talking about some changes in the stream flow regime within the Delta. I assume -- maybe I shouldn't assume. But I'm assuming that this talking about flow rates in Delta channels and whether those would change with the North Delta diversions. Is that --

MS. DES JARDINS: This is just basically a

requirement for information that's being given for change petitions. And it seemed like there was a question about whether the future conditions were sufficient. And there's actually a requirement that some current information be given. So it's okay.

WITNESS PAULSEN: I'm sorry. I'm not sure what the question is. I think that the Delta models would simulate the flows that would occur in the Delta with the changes, so...

MS. DES JARDINS: So you were sort of relying on the modeling to provide the flows that would occur in the Delta. That's fine.

Let's go to Brentwood 102, Page 15. That's your DSM2 slide. And from what I understand, the CalSim flows are inputs into DSM2; is that correct?

WITNESS PAULSEN: Yeah, for this study that's true.

MS. DES JARDINS: Yeah, so you had, like -- so let's look here. So, like, the big blue arrow is Sac River, tributaries, the red diversion arrows, those are sort of CalSim inputs to DSM2? Do those sort of derive from the CalSim modeling?

WITNESS PAULSEN: For this study, I believe that those were. The purpose -- the reason I included this slide was just to describe the Delta sort of

generally. But yes, the river inflows to the system, into the DSM2 modeling of the system, came from CalSim.

MS. DES JARDINS: And so to the extent you used the existing biological conditions, no action alternative and with project, that was getting CalSim -- CalSim output to drive these -- these inputs that are sort of graphically represented?

WITNESS PAULSEN: Right. Those inputs would be different for each of the model scenarios and would have come from the CalSim runs for the inflows to the system. So...

MS. DES JARDINS: Do you know if the DSM2 version is different between the 2010 diversion model that you got with the 2013 DEIR/DEIS and the WaterFix version, or are they the same?

WITNESS PAULSEN: To be perfectly honest, I don't remember. We did look at many of the model assumptions that we made between the -- those -- the run that we used from 2013 was the EBC2 run.

And we compared many of the model parameters and inputs, the specifications that drive the model between the EBC2 and the no action alternative. And we found that, in most respects, they were identical.

MS. DES JARDINS: Okay. So to the extent that you don't have appropriate information on current

operations to drive the DSM2 model, it's because there was a different CalSim version that provided the flows -- that EBC2 basically provided the flows that were required to be provided, or there wasn't --

WITNESS PAULSEN: I don't know how to answer that question because I think you started by saying to the extent we don't have the information we need.

MS. DES JARDINS: Oh, well --

WITNESS PAULSEN: And I think --

MS. DES JARDINS: Let's say to the extent there's an argument that the 2010 version is not appropriate, then -- is that, then, you know, it's because there wasn't a WaterFix version, case version for no climate change, no future demand.

MR. ALADJEM: Madam Chair?

CO-HEARING OFFICER DODUC: Do you even agree with that statement?

WITNESS PAULSEN: I'm not sure I understand that statement. We wouldn't expect an existing condition model run to have climate change or sea level rise, I mean, just by definition.

MS. DES JARDINS: No, I'm just saying if you'd been given a WaterFix model version with that.

MR. ALADJEM: Madam Chair, if I might object here. I believe that the witness has testified she

took the CalSim modeling that was done by the Department. She then took the DSM modeling. And her analysis of the results of that DSM modeling, Ms. Des Jardins can go into the details, but I believe that Dr. Paulsen has testified a number of times that all she did was take the DWR modeling and analyze it.

So if we want to go talk about the details of how the Department did that modeling, she's more than free, but I'm not sure we're getting much farther in terms of --

MS. DES JARDINS: I'll stop. Okay.

Let's just -- I did want to go into Brentwood 105. You did provide a copy of the DSM2 calibration report. And I wanted to go to Page 16. So did you -- you did -- you reviewed this; is that correct?

WITNESS PAULSEN: I did review it.

MS. DES JARDINS: My understanding was that to calibrate it they used actual gauge data as input. Is that your understanding as well?

WITNESS PAULSEN: I will have to dig back into this to remember the details.

Typically, when you calibrate a model, you use measured data, and you simulate the same conditions, the same inflows, the same exports, et cetera, that would have occurred during the time period when those

measurements were collected. So that's sort of the definition of what a calibration exercise does.

CO-HEARING OFFICER DODUC: Dr. Paulsen, during the course of this hearing, Ms. Des Jardins had raised a lot of doubt and questions about the calibration of the models being used by petitioners in this case.

Given your experience in modeling, do you have any thoughts on the calibration of those models?

WITNESS PAULSEN: I don't have thoughts on the calibration or the running of CalSim.

We have looked at calibration data or verification data where we haven't been trying to tune the model, but we've been comparing model output to measurements. And I have a whole lot of thoughts on that. I don't know the extent to which they're helpful here.

CO-HEARING OFFICER DODUC: Does any of the thoughts you have on the calibration, would it have any impact on the analysis that was conducted by petitioners for this matter?

WITNESS PAULSEN: One of the concerns that I have and that many others in the modeling community have about DSM2 is its ability to simulate salinity in the interior of the Delta. And there's a wide range of opinions as to why that may be.

My belief is that at least one factor in that is the way the model simulates DICU, Delta Island Consumptive Use, because it uses a repeating pattern of flow rates and salinity for the most part. Precipitation comes in and adjusts that. But for the most part, other than precipitation, it is largely a repeating pattern.

And we know that the world doesn't necessarily operate that way, that the amount of water diverted, the amount of return flows, things like that probably have changed over time and probably do change.

But that's the condition of a known model imperfection. In that case, we don't know exactly what the right inputs are because we don't measure Delta Island Consumptive Use directly. So we have a sense for where that might introduce some deviation from measured data, and we believe that that impact, for example, is probably responsible for some of the differences that we see between modeled and measured salinity, particularly in the South Delta.

We're all aware of that, to a certain extent. And we know that that feature, the way DICU is modeled is the same in most of almost all the model runs we do. We very rarely make adjustments to that parameter.

CO-HEARING OFFICER DODUC: Are you able to say

whether that inadequacy tends under overestimate or underestimate the result?

WITNESS PAULSEN: Quit frankly, it depends on the location and it depends on the condition. Sometimes it's over; sometimes it's under.

In general, the model simulations of salinity at Antioch are better than they are at the interior Delta. And I think we've got some information indicating that in the record here.

That's because, especially at times of high salinity, most of the salinity at Antioch's intake is derived from the Bay; it comes in on the tides. And that is very well understood, and the model is able to capture and characterize that very well.

So no model is perfect, but hopefully with experience, we start to understand the -- where it is less accurate than other places or in other quantities and incorporate that into the analysis and the way we use those model results.

There was some questioning earlier about whether the model is suitable for the questions that we're asking it. And I felt like my answer was a little bit flippant in that, you know, I said we try not to ask the model questions that it's not capable of answering.

So I guess what I'm trying to say is that no model is perfect, but we're aware, I think, of at least some of the areas where it doesn't reproduce modeled values -- measured values, excuse me, perfectly. And we try to incorporate that knowledge into our interpretation of model results.

CO-HEARING OFFICER DODUC: Does there exist -- are there existing modeling tools that would better serve the needs and the questions being asked as part of this petition?

WITNESS PAULSEN: I think the DSM2 is probably one of the best tools, if not the best tool, to answer some of the questions that we're asking about water quality and about flows. It is -- it's been around for a while. We understand how it works and where it compares well the measurements and where it doesn't.

There's been a lot of work over the years to refine the bathymetry, to refine some of the model parameters. And I think, you know, we understand those things fairly well. So again, no model is perfect, but we're dealing with a quantity -- a model that's relatively well understood.

CO-HEARING OFFICER DODUC: And is that the extent of your thoughts with respect to model calibration that you believe would be relevant to this

proceeding?

WITNESS PAULSEN: I'm sure I have more thoughts on model calibration. That is all I can think of now.

CO-HEARING OFFICER DODUC: All right.

MS. DES JARDINS: Ms. Doduc, I'm very glad for you to jump in and have some questions, but I'd like to have that not come off of my time.

CO-HEARING OFFICER DODUC: That was very pleasant. But go ahead.

MS. DES JARDINS: Okay. Thank you.

CO-HEARING OFFICER DODUC: And my urging to you is to move on.

MS. DES JARDINS: I do want to ask this. I actually had some specific pages I wanted to ask her about that will go into this very clearly. And since I am a modeler, I wanted to ask those questions.

I'd like to go to Page 70 of the calibration report because here's some very specific things about your estimates that are relevant. Okay.

So I'm particularly interested here -- this is the root mean squared error in net flow. "RSAC 101" is Rio Vista. And I notice it looks like it's pretty high. It's above 3,000 cfs. And Cache Slough looks like it's 5,000 cfs.

Did you look at these? I mean, I just -- that seems like pretty high, particularly since Rio Vista is below the intakes.

WITNESS PAULSEN: I did not give a whole lot of thought to this in terms of predicting water quality at Antioch and Brentwood's location. They're in a different region of the Delta, which doesn't mean they're unconnected, of course. The system is all interconnected.

But I have not thought in depth about these specific calibration results.

MS. DES JARDINS: Let me just hit one more, Page 73, very quickly.

CO-HEARING OFFICER DODUC: And then move on, please.

MS. DES JARDINS: Yes, absolutely. I wasn't planning on spending that much time on this.

So that just -- this is RCN-018 is Jersey Point, and that also looks really high, considerably above 1,000 cfs. And, you know, it's outflow at Jersey point; if there's that kind of error, could this affect how well the model models salinity intrusion in, like, low-flow conditions?

WITNESS PAULSEN: So answer your question, I'd really to have dig into the detail of this report.

The thing about the Jersey Point area, the Carquinez Strait area is that the flows, in both directions during the course of the tidal cycle, are very large, which can make resolving the flows on a fine time scale challenging. But in general, the outflow is captured by the model reasonably accurately.

I'm not sure that's responsive, but I don't know how to answer this.

MS. DES JARDINS: That's fine. That's all I wanted.

WITNESS PAULSEN: Okay.

MS. DES JARDINS: So the other thing I'd like to do is go to -- just a sec -- the DDJ-58, Page 8. So this is a -- there's a San Joaquin River Restoration. Are you familiar with that? And that's -- there potentially is an increase in inflows to the Delta from the San Joaquin River.

And this wasn't included in the no action alternative, but it shows there could potentially be significant inflow. This is long-term monthly.

Let's just scroll down the next few slides, Page 9. That's wet years. Go down the next one. Page 10 and above normal.

So under the -- there's different scenarios. But would this affect the base salinity? And if so,

how? If you have these kind of inflows from the San Joaquin River?

WITNESS PAULSEN: I'm not sure, frankly, what the different colors represent, what these scenarios are.

MS. DES JARDINS: Red is, I believe, the State Water Board alternative for San Joaquin River, DFG is DFG. Blue is the San Joaquin River Restoration Program. I'm just -- there are specific alternatives about inflows under these different alternative --

CO-HEARING OFFICER DODUC: Mr. Berliner?

MS. DES JARDINS: -- regulatory scenarios.

MR. BERLINER: Ms. Des Jardins has not laid any foundation for this document. So we don't know where it's from, who prepared it. So if we could have some foundation --

MS. DES JARDINS: Yeah. This is the -- let's scroll -- go up to the first page, please, Page 1.

This is the Bay-Delta Conservation Plan Steering Committee document with evaluation of the BDCP operation, sensitivity to a range of San Joaquin inflows.

CO-HEARING OFFICER DODUC: Are you familiar with the document, Dr. Paulsen?

MS. DES JARDINS: Yeah.

WITNESS PAULSEN: I have looked into these issues generally in the past. I do not recall whether I've seen the document before.

MS. DES JARDINS: Yeah. I just -- the inflows were originally going to be included in the BDCP analysis, and then they just sort of fell off.

CO-HEARING OFFICER DODUC: And your question to Dr. Paulsen?

MS. DES JARDINS: My question -- my question was just what I asked earlier, which was, "Would this affect your base value of salinity in the no action alternative?" And she hadn't looked at it. So that's fine.

The next thing I'd like to go into is the history. I'd like to go into DDJ-98.

You did talk a little bit about the history of the planning studies that were done for Antioch. And then I'd like to go to Page 46. And there's a reference.

So you said there was salinity -- extensive salinity intrusion in the '20s at Antioch. You're familiar with that?

WITNESS PAULSEN: Yes.

MS. DES JARDINS: So go to Page 46. This is just a discussion of it. So --

WITNESS PAULSEN: And I'm sorry. Could you tell me what this document is?

MS. DES JARDINS: So this is the Decision 990 that granted -- was done in -- granted the Bureau's permits. They had a discussion of these studies. At the top, talks about the State engineer prepared a summary report on the water resources of California in 1927. They recommended a large flow on the Kennett River. And --

CO-HEARING OFFICER DODUC: And your question?

MS. DES JARDINS: Let's go to -- go to 47, please. There's just -- there's a specific recommendation --

CO-HEARING OFFICER DODUC: Dr. Paulsen, are you familiar with this decision?

MS. DES JARDINS: Yeah.

WITNESS PAULSEN: It has been a long, long time since I've looked at it, and I don't know that I've ever read it in this level of detail.

MS. DES JARDINS: I -- I -- there is a question that's --

CO-HEARING OFFICER DODUC: Let's get to the question, please.

MS. DES JARDINS: So it says, "Export to the San Joaquin Valley was considered after providing and

guaranteeing an outflow at Antioch of not less than 5,000 cfs." That was the original study.

If that kind of outflow was guaranteed at Antioch, would it change the salinity intrusion that you'd seen?

CO-HEARING OFFICER DODUC: Mr. Berliner?

MR. BERLINER: I have an objection as to relevance. This is not before the Board at this time.

MS. DES JARDINS: This was the original study of the operations of Shasta Dam under applications for the permit that you're seeking to change.

CO-HEARING OFFICER DODUC: Mr. Aladjem?

MR. ALADJEM: I'm going to join in Mr. Berliner's objection.

The projects and the WaterFix project would be governed by Water Right Decision 1641. I don't know as I sit here whether that 5,000 cfs is incorporated in 1641, but as Mr. Berliner said, it's irrelevant. 1641 governs.

CO-HEARING OFFICER DODUC: All right.

Move on, Ms. Des Jardins.

MS. DES JARDINS: Okay. The next thing I'd like to go to is the -- the drought operations, Land 8, Page 37.

And I think you've discovered this a little

bit. So the last page, this was Tara Smith.

Ms. Paulsen, did you look at issues of the salinity intrusion in 2014? Did you study that for any of your clients or...

WITNESS PAULSEN: I'm aware of the measured data. I'm trying to think -- let me check one thing here.

CO-HEARING OFFICER DODUC: I'm adding five minutes to the clock --

MS. DES JARDINS: Thank you very much.

CO-HEARING OFFICER DODUC: -- because I interrupted to ask questions. But, Ms. Des Jardins, I need you to be more concise and relevant.

MS. DES JARDINS: Yes.

CO-HEARING OFFICER DODUC: I'm sorry. Why are we stopping?

WITNESS PAULSEN: I'm sorry. She was asking me if I had studied salinity during drought conditions in 2014.

MS. DES JARDINS: You know, I've just noticed that the main question here is just -- this was a presentation by Tara Smith. And the observed salinity as you see in the red line was considerably higher than the DSM2 modeled forecast.

And I don't know if you had that, but there

were concerns expressed that the model somehow wasn't capturing the amount of salinity intrusion that they had.

MR. ALADJEM: Madam Chair?

CO-HEARING OFFICER DODUC: And the question is?

MR. ALADJEM: Madam Chair, we've been through the calibration question about DSM2. I'll leave it up to the witness as to whether she can answer. But we're going over the same material.

MS. DES JARDINS: Yeah, I'm just wondering if it's possible -- this is would be relevant because it's if -- if she is familiar and it did do this, then if it also -- the modeling might underestimate the salinity intrusion at your client's.

CO-HEARING OFFICER DODUC: Are you familiar with this study or this chart, Dr. Paulsen?

WITNESS PAULSEN: I am not. These data at Clifton Court Forebay are in the southwest corner of the Delta, the interior of the Delta. And we wouldn't expect, in 2014, I don't think, Bay water to intrude that far into the Delta, I don't think.

CO-HEARING OFFICER DODUC: All right. Thank you.

MS. DES JARDINS: Okay. It did. But we don't

need to --

CO-HEARING OFFICER DODUC: Move on, Ms. Des Jardins.

MS. DES JARDINS: It's all right.

So I think, finally, there's -- I had a question about climate change and the potential shift in year types. So let's go to that, PCFFA-78, Page 15. So this was a climate change study. And it showed that potentially in the future, we could see an increase in dry and critically dry years. And --

CO-HEARING OFFICER DODUC: First of all, let's pull up the study. And then let's ask Dr. Paulsen if she is familiar with the study.

MS. DES JARDINS: Yeah.

CO-HEARING OFFICER DODUC: Actually, this is not even the study.

MS. DES JARDINS: PCFFA-78, Page 15.

Yeah, so Page 15. And this just shows -- zoom down. So -- go ahead, pull out.

So this just shows potentially black is up at the top, is observed. And it shows -- and the different colors are under a range of different models -- how the left bar is frequency, how the percentage of critically dry and dry years could increase in climate change.

And it's not so much are you familiar with the study but if we saw this sort of increase that this modeling shows, would that potentially affect the impacts at Antioch?

MR. ALADJEM: Again, Madam Chair, if the witness is familiar with this, she may answer. But otherwise, it calls for speculation.

CO-HEARING OFFICER DODUC: Are you familiar with this study Dr. Paulsen?

WITNESS PAULSEN: I am not familiar with this study. I have reviewed studies and information on climate change and drought in California and in the Delta. So I can't answer from the basis of --

CO-HEARING OFFICER DODUC: And to the extent --

MS. DES JARDINS: But I --

CO-HEARING OFFICER DODUC: To the extent --

MS. DES JARDINS: I'm curious about --

CO-HEARING OFFICER DODUC: And to the extent those studies impact the analysis that you conducted for your client, then they are included in your testimony?

WITNESS PAULSEN: I believe that's the case.

CO-HEARING OFFICER DODUC: Thank you.

MS. DES JARDINS: Okay. Would it -- would it

increase the impacts if you saw an increase in dry and critically dry years?

WITNESS PAULSEN: The best way I know to answer that is to look -- to consider that, if we were to consider that question, we would look at the mix of year types going forward.

And the recent years were critically dry. And we know that a lot of people, DWR included, I believe -- I'm looking for the reference, and I'm not putting my finger on it -- but expect more droughts in the future than we've had in the past.

MS. DES JARDINS: Okay. Thank you. That's it.

WITNESS PAULSEN: There is a reference to that in the work that we've done here. And I apologize that I'm not putting my finger on it immediately.

MS. DES JARDINS: Well, I --

CO-HEARING OFFICER DODUC: I'm sure Ms. Des Jardins can find it if she's that interested.

MS. DES JARDINS: Well, I'm also allowed to ask questions on subjects that are relevant to the hearing, and I think this is relevant.

CO-HEARING OFFICER DODUC: Again, very kind of you Mr. Aladjem and Mr. Emrick, to make Dr. Paulsen available.

MS. DES JARDINS: That concludes it. Thank you.

CO-HEARING OFFICER DODUC: All right. Any redirect for Dr. Paulsen only at this point?

MR. ALADJEM: Madam Chair, I don't believe we have any redirect.

CO-HEARING OFFICER DODUC: Does that go for you as well, Mr. Emrick?

MR. EMRICK: That is true. No redirect from the City of Antioch.

MR. ALADJEM: And Madam Chair, if it would please the Chair, we would ask that Dr. Paulsen be excused.

CO-HEARING OFFICER DODUC: I think it would -- actually, I do have one question for Dr. Paulsen.

Your analysis of the baseline, whatever that terminology is, I think earlier in your testimony you made a comment and I think it's also in your written testimony, that salinity in some part of the Delta improved with the onset of the State Water Project and the CVP but also was greatly impacted negatively in other parts of the Delta.

I'm curious, in analyzing the water quality impact for your two clients, did you encounter or did you conduct any study of water quality without the two

projects?

WITNESS PAULSEN: Oh, the -- you mean the Central Valley Project and the State Water Project?

CO-HEARING OFFICER DODUC: Mm-hmm.

WITNESS PAULSEN: We did not do that here. I have done that kind of work in the past. There is one report that I was also trying to put my finger on. And I know it's in this binder. I can't remember which exhibit it is -- where we did look at that question.

CO-HEARING OFFICER DODUC: And was that part of the basis for your conclusion that water quality -- negative water quality impacts in certain parts of the Delta were attributable to the projects?

WITNESS PAULSEN: I believe that my testimony was that water quality, specifically at Antioch, degraded as a result of the Central Valley Project's operation starting in the 1940s or so and then again as part of the State Water Project's operation starting in the 1960s.

And in fact, that -- the degradation that occurred in the 1960s, my understanding is that that was the driver for the agreement between the City and the State that was entered into in 1968, that it states that the State Water Project would have negative effects on the City's water supply and therefore this

agreement was entered into in response to those anticipated effects.

CO-HEARING OFFICER DODUC: Okay. And there was an analysis of water quality without project operation?

WITNESS PAULSEN: Yeah. There's a -- Mr. Bernal may speak to this in more detail, but there's a provision in that contract that we talked about, I think, that sets a baseline number of days, 208 days, where water quality was historically expected to be flesh.

I reviewed some of the information from the negotiations that happened back in the 1960s, handwritten and typewritten documents. And there was some debate over whether 208 was the right number. I think the City believed it should be more. But 208 was the negotiated number that was arrived at.

So, yes, at that point in time, there was some analysis. There's other analysis in here, too. There's a DWR report that's got some bar graphs that shows degradation roughly every 20 years through the 1900s, the green. I remember exactly what it looks like.

There are also the historic salinity reports that noted the marked increase in salt water intrusion

in the Delta in the late teens.

In fact, it was noted in one of them -- I like the phrase "the urge of war." There were plantings to feed the troops in World War I that resulted in the diversion of additional water from the Sacramento River for sure, maybe from the others as well. I remember it from the Sacramento -- and that that caused some of the salinity intrusion that started at that point in time.

So, yes, there's a wealth of historical data and information that indicates how salinity has changed over time.

CO-HEARING OFFICER DODUC: Thank you. As a former modeler myself, I can appreciate Ms. Des Jardins' enthusiasm as well as your expertise.

And I believe we are done with you.

WITNESS PAULSEN: Thank you.

CO-HEARING OFFICER DODUC: Let's ask if you have redirect for -- I've forgotten his name now.

MR. ALADJEM: Mr. Ehlers.

CO-HEARING OFFICER DODUC: -- your other witness?

MR. ALADJEM: Yes, we have two very simple questions for Mr. Ehlers on redirect.

CO-HEARING OFFICER DODUC: Okay. Let's ask him to come up. That way, we can be through with

Brentwood's case in chief before we get to Mr. Emrick's final witness.

And, Mr. Ehlers, you are still under oath, so I will go ahead and ask your counsel to conduct his redirect.

And I believe only the Department of Water Resources and Ms. Meserve, who is no longer here, conducted cross of this witness. Did I remember that correctly? Ms. Des Jardins as well? Okay.

REDIRECT EXAMINATION BY MR. ALADJEM

MR. ALADJEM: Mr. Ehlers, good afternoon, sir.

In its water treatment and waste discharge operations, does the City rely on the water quality objectives in Decision -- Water Right Decision 1641?

WITNESS EHLERS: Yes, it does.

MR. ALADJEM: Second question, Mr. Ehlers. Has the City considered any plans to implement a project that would address anticipated water degradation other than water quality degradation resulting from the WaterFix project?

WITNESS EHLERS: Yes. The City is currently going to work with Contra Costa Water District on the expansion of Los Vaqueros. And the environmental document is getting ready to start, and the City has committed its portion for the expansion for

impoundment.

MR. ALDAJEM: Very good. No further questions.

CO-HEARING OFFICER DODUC: Any recross?

(No response)

CO-HEARING OFFICER DODUC: All right. Not seeing any, Mr. Aladjem, you have until noon Wednesday to submit your list of exhibits, including the corrections, I believe, for Dr. Paulsen's testimony.

MR. ALADJEM: And we will do that. Thank you, Madam Chair.

CO-HEARING OFFICER DODUC: Thank you Mr. Aladjem.

And now I will ask Mr. Bernal to please stand and raise your right hand.

(Witness sworn)

ROWLAND BERNAL, JR.,

called as a witness by the City of Antioch, having been first duly sworn, was examined and testified as hereinafter set forth:

DIRECT EXAMINATION BY MR. EMRICK

MR. EMRICK: You've been sworn; you understand that, right?

WITNESS BERNAL: Yes.

MR. EMRICK: And can you please state your name and spell it for the record, please?

WITNESS BERNAL: Rowland Bernal, Jr., R-O-W-L-A-N-D, B-E-R-N-A-L, J-R, Junior.

MR. EMRICK: But you go by "Ron"; is that correct?

WITNESS BERNAL: Correct.

MR. EMRICK: All right. And you're here today to present testimony on behalf of Antioch relating to the proposed WaterFix project; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: And we've presented some exhibits to have you verify. Exhibit 100 is a copy of your written testimony; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: A true and correct copy?

WITNESS BERNAL: Yes.

MR. EMRICK: And Exhibit 100A is a copy of your qualifications?

WITNESS BERNAL: Yes.

MR. EMRICK: Those qualifications, I think, are included in your written testimony as well.

Exhibit 101 is a true -- this is Antioch Exhibit 101 is a true and correct copy of the 1968 agreement between Antioch and Department of Water

Resources?

WITNESS BERNAL: Yes.

MR. EMRICK: And Exhibit 102 is a true and correct copy of the 2013 extension of the 1968 agreement between Antioch and DWR; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: Were you involved with those negotiations involving the extension of the 1968 agreement?

WITNESS BERNAL: Yes.

MR. EMRICK: And Exhibit 104 is a true and correct copy of Antioch's 2015 urban water management plan; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: And then Exhibit 103, we've presented a 2016 agreement between Contra Costa Water District and DWR; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: And Antioch is located within the service boundary of CCWD; is that correct?

WITNESS BERNAL: Yes.

MR. EMRICK: And are you testifying today as an expert?

WITNESS BERNAL: No, I'm not.

MR. EMRICK: Are you testifying today based

upon your knowledge and background with your work with the City?

WITNESS BERNAL: Yes, I am.

MR. EMRICK: What's your present position with the City of Antioch?

WITNESS BERNAL: I'm the Assistant City Manager, the Public Works Director, and the City Engineer.

MR. EMRICK: Okay. And maybe you can tell us, give us an overview of your duties with the City of Antioch, present duties.

WITNESS BERNAL: I oversee 14 divisions in the Public Works and Engineering Department, about a hundred employees. And it's a full-scale public works department, full service specific to water. There's water distribution, water treatment, and the water rights that I'm directly involved with.

MR. EMRICK: Okay. And what's your educational background?

MR. BERLINER: I have a bachelor's from UC Davis 1986 in civil engineering.

MR. EMRICK: What's the present population of Antioch?

WITNESS BERNAL: It's currently 113,000, a little bit more.

MR. EMRICK: And next series of questions I think have already been answered by Dr. Paulsen -- the location of the City, the location of the City with respect to San Joaquin River. So I will skip over those questions.

I think Dr. Paulsen talked about the fact that Antioch diverts water from the San Joaquin River channel; is that correct?

WITNESS BERNAL: Yes, that's correct.

MR. EMRICK: And where's the present location of the City's diversion, if you know?

WITNESS BERNAL: It's at the west terminus of Fulton Shipyard Road.

MR. EMRICK: What's the relationship to A Street?

WITNESS BERNAL: A Street extends further to the west, so it's close to the -- close to A Street but is not actually on A Street.

MR. EMRICK: Do you have any knowledge as to how long the City's diversion has been in its present location?

WITNESS BERNAL: It's my understanding since at least 1904.

MR. EMRICK: And is the City's intake diversion, is that the City's -- well, let me ask you

this.

Other than the San Joaquin River, does the City have other sources of water?

WITNESS BERNAL: Yes.

MR. EMRICK: Can you explain that other source of water for me?

WITNESS BERNAL: When the water quality in the river is not acceptable for us to divert, we purchase water, raw water from Contra Costa Water District.

MR. EMRICK: And you say when the water in the river's not acceptable to divert. What's the criteria that the City uses to determine it's not acceptable?

WITNESS BERNAL: When chloride levels exceed 250 parts per million or milligrams per liter.

MR. EMRICK: When it's 250, you do not divert at all?

WITNESS BERNAL: Correct.

MR. EMRICK: Is there any other criteria or chloride level that determines how you might divert from the San Joaquin River? I think Dr. Paulsen had talked about some blending.

WITNESS BERNAL: That's related to the water that we take to our water treatment plant.

So we -- when the water quality drops below 150 parts, we're blending -- blending with Contra Costa

Water water. When the water quality's below 100 parts, we take water directly from the river and use that as our primary source of water.

MR. EMRICK: Let me see if I can summarize my understanding then. At 250 chloride, 250 parts per million, the City ceases its diversion. Under 150 parts per million, the City blends water with water it purchases from Contra Costa Water District; is that correct?

WITNESS BERNAL: Yeah. Down to 100 parts per million, we blend water. So from 250 to 100, we blend. Below 100, we do not.

MR. EMRICK: You just take from the diversion?

WITNESS BERNAL: Take from the diversion.

MR. EMRICK: And the primary use of water within the City of Antioch?

WITNESS BERNAL: It's municipal water, mostly residential but also commercial and industrial irrigation as well.

MR. EMRICK: And can you explain for me -- we've talked a little bit about the 1968 agreement, as did Dr. Paulsen. Can you tell me sort of generally how the City operates under the 1968 agreement?

WITNESS BERNAL: So the place where we divert water has a meter that reads the salinity level and the

chloride levels. It's on a daily basis. Slack tide after higher high tide, there's a determination made of what that level is, whether it's able to be pumped or not or utilized as a useful day.

We take water up to the point where it's 250 parts per million, and we shut down after that. So that's our operation of it.

Related to how it works with Department of Water Resources, at the end of each year, since we're entitled to pump 208 days a year, they will provide us with a record of how many usable days of water we had each year. And then we will take that as the basis for determining the calculation of what our cost was to buy substitute water and then submit that back to DWR for them to check, make sure that they're in agreement.

MR. EMRICK: So if diversions were -- excuse me.

If the City had available under the agreement over 209 days of water available, would it be correct to say that DWR would not be sending you a -- information regarding calculation for payment reimbursement?

WITNESS BERNAL: Well, they would send us information -- they do send us the information on an annual basis because, if we have more than 208 usable

days, then they use that as a carryover day and will credit that towards the subsequent years.

MR. EMRICK: But 208 days is the criteria that you operate under with respect to the 1968 agreement; is that correct?

WITNESS BERNAL: Right, yes.

MR. EMRICK: So the amount of water that you purchase to compensate when water quality is above 250 or that you have to blend, how much of that total purchase are you reimbursed from DWR under the 1968 agreement?

WITNESS BERNAL: One third of the cost.

MR. EMRICK: One third of the cost?

WITNESS BERNAL: Yes. Yes.

MR. EMRICK: And there -- I think we spoke earlier, there was a modification of the 1968 agreement?

WITNESS BERNAL: Correct.

MR. EMRICK: And did that modification extend the term of the 1968 agreement?

WITNESS BERNAL: Yes, the term was extended until 2028.

MR. EMRICK: Are there any other parties to the 1968 agreement other than DWR and Antioch?

WITNESS BERNAL: No.

MR. EMRICK: Are you familiar with the agreement between DWR and Contra Costa Water District that was entered into in March of 2016?

WITNESS BERNAL: Yes.

MR. EMRICK: And how are you familiar with that agreement?

WITNESS BERNAL: I've -- can't say I've read it from cover to cover, but I've read most of the agreement.

MR. EMRICK: Is that an agreement that normally the City of Antioch would want to be familiar with?

WITNESS BERNAL: Absolutely.

MR. EMRICK: And why is that?

WITNESS BERNAL: Because Contra Costa Water District providing substitute water for us, we're interested in the reliability and the quality of the water that we'll be receiving.

MR. EMRICK: Has Antioch entered into any other agreement with DWR since the adoption of the 2016 Contra Costa Water District-DWR agreement?

WITNESS BERNAL: No, we have not.

MR. EMRICK: I could ask you if you just agree with everything Dr. Paulsen said, but you do have concerns about potential impacts to Antioch's water

supply from the WaterFix project; is that correct?

WITNESS BERNAL: That's correct.

MR. EMRICK: And those concerns are based upon the work that Dr. Paulsen has done for you?

WITNESS BERNAL: Correct, the work Dr. Paulsen's done and other information that we've read and heard about the project.

MR. EMRICK: And the primary concern is increased salinity?

WITNESS BERNAL: Correct.

MR. EMRICK: Any other primary?

WITNESS BERNAL: Increased salinity, bromide levels that are increasing is also a concern, and just the fact that it's going to be more expensive to purchase additional water when our intake is not as usable as it currently is.

MR. EMRICK: Has the City looked at any physical solutions for anticipated increased costs associated with the WaterFix project or just from potential sea level rise?

WITNESS BERNAL: We have. We're in the -- in early stages of looking a brackish water desalinization plant or desalination plant for the City of Antioch.

MR. EMRICK: Do you have an estimate of what the cost will be?

WITNESS BERNAL: Depending on the size of the plant, it's over a hundred million dollars, probably in the 125- to the $150 million range.

MR. EMRICK: That's all I have.

CO-HEARING OFFICER DODUC: Thank you, Mr. Emrick.

Cross-examination by the Department? Anyone else wish to conduct cross-examination.

Ms. Des Jardins.

CROSS-EXAMINATION BY MR. MIZELL

MR. MIZELL: My areas are just going to be on the interpretation of the contract, and I would estimate three minutes.

CO-HEARING OFFICER DODUC: Okay.

MR. MIZELL: In your testimony, you talked about the -- how you termed it, the fixed term of the 1968 agreement; is that correct?

WITNESS BERNAL: Yes.

MR. MIZELL: Isn't it true that the 1968 agreement continues in effect until expressly terminated by one of the two parties?

WITNESS BERNAL: It extends year to year, once the term expires until one of the two parties gives notice, correct.

MR. MIZELL: And the 1968 agreement has only

been extended the one time that you're aware of; is that correct?

WITNESS BERNAL: Yes, correct.

MR. MIZELL: Isn't it true that the 1968 agreement could have been terminated by either party beginning in 2008 until a new guarantee was put in place in 2013?

WITNESS BERNAL: Under the terms of the agreement, that would be my understanding, yes.

MR. MIZELL: And yet neither party canceled the agreement, correct?

WITNESS BERNAL: Correct.

MR. MIZELL: Thank you.

No further questions.

CO-HEARING OFFICER DODUC: Thank you.

Ms. Des Jardins. And I would expect that you will not be asking him about model calibration.

MS. DES JARDINS: No. I just have -- I would like a little bit of cross-examination. I just wanted to ask him about salinity in the drought.

Can we bring up DDJ-will again, please.

CO-HEARING OFFICER DODUC: And how much time do you anticipate needing?

MS. DES JARDINS: If -- no more than ten minutes, probably quite a bit less.

MS. DES JARDINS: Mr. Bernal, this is the extreme salinity intrusion that we saw in the Delta on January 28th, 2014, the day before the projects filed for the temporary urgency change petition.

Do you -- you know, do you remember those months? Do you remember the TUCP? You know, did you have a lot of problems with salinity intrusion?

WITNESS BERNAL: We -- I am familiar with the month of January, and we did divert from the river that month, during the course of that month, some of the month.

I do know that, during the drought, we -- we pumped very little from the river because of the high salinity levels. But related to that specific day, I can't say it was any different than --

MS. DES JARDINS: Yeah, this is just an example. This is one of the most extreme salinity intrusion.

But generally you weren't able to pump from the river much at all. It -- was it in 2014 and 2015 or --

WITNESS BERNAL: It varied from year to year, and it depended on when it did rain, if it rained much. But those years, we did not -- we did not take a lot of water from the river, as much as we have historically.

MS. DES JARDINS: So you were really dependant on your supply from Contra Costa?

WITNESS BERNAL: Absolutely, yes.

MS. DES JARDINS: Yeah. And currently is that -- that isn't enough to service your customer base? Or -- I mean, if you had to dis- -- if you had to depend on just the Contra Costa supply at this point, what kind of impacts would that have?

WITNESS BERNAL: Contra Costa has indicated to us and has delivered as much water as we've needed throughout the drought. So it's my understanding that Contra Costa Water District has adequate capacity for the City of Antioch.

MS. DES JARDINS: So if -- so if there was this kind of continuing salinity intrusion, it wouldn't be catastrophic; it would just be costly?

WITNESS BERNAL: Well, losing our intake we believe is catastrophic. So that's a -- you know, our primary source of water, so we do see it as being very important. However, we do have a substitute supply. It is just much more expensive than using our primary source of water.

MS. DES JARDINS: Do you know, like, as far as is it -- is that contract, is that kind of surplus? Is that junior to, like, if Contra Costa expands and they

get more residents, you know, would you still have it? Or --

WITNESS BERNAL: Our understanding is that we -- the Contra Costa Water District has full capacity to serve Antioch, City of Antioch year round if necessary.

MS. DES JARDINS: For the indefinite future? I mean, there's just an issue in the Bay Area of some other cities that are on SFPUC water, but they're junior to San Francisco, and San Francisco is growing.

So I'm just wondering if you know, like, would you be juniored to Contra Costa in 2050 if they had 30,000 more residents?

WITNESS BERNAL: We're a member agency of Contra Costa Water District. And we are, I think, one of their biggest customers, if not, their biggest customer.

The capacity in Los Vaqueros Reservoir is available for Antioch's water supply needs. So unless that reservoir gets to a state where it's not able to supply water, Antioch, according to Contra Costa Water District, is taken care of.

MS. DES JARDINS: Okay. Thank you.

CO-HEARING OFFICER DODUC: Any redirect, Mr. Emrick?

MR. EMRICK: Just quickly.

REDIRECT EXAMINATION BY MR. EMRICK

MR. EMRICK: What's the present cost of water from Contra Costa Water District to the City, if you know?

WITNESS BERNAL: We're paying approximately $750 an acre foot for raw water.

MR. EMRICK: So if you had to go completely to Contra Costa Water District water, that would be a substantial increase in -- financially for the district, is that correct -- I mean for the City; is that correct?

WITNESS BERNAL: Potentially, yes, being that we take a portion, if not, most of our water from the San Joaquin River intake if we can. So, yes, it would be an increase, significant increase to the customers

MR. EMRICK: Okay. That's all I have.

CO-HEARING OFFICER DODUC: Thank you Mr. Emrick.

Any recross?

(No response)

CO-HEARING OFFICER DODUC: All right. Thank you, Mr. Bernal.

That completes the City of Antioch's case in chief as well, and we will expect your request to move

exhibits into the record by noon next Wednesday.

MR. EMRICK: Thank you.

CO-HEARING OFFICER DODUC: In fact, let's set noon next Wednesday as a deadline for submission of all exhibits that anyone wished to introduce into the record that have been used to date.

Ms. Heinrich, let me turn you because this is a legal thing. I think you had a clarification with respect to whether exhibits used for cross-examination must be introduced into the record.

MS. HEINRICH: Yes. The clarification was simply that it's not necessarily required for the parties if they've referred to a document on cross-examination and introduced it for purposes of cross-examination, they don't necessarily need to offer it into evidence. But if they desire to do so, then the deadline, if they haven't already submitted that exhibit, would be noon next Wednesday.

CO-HEARING OFFICER DODUC: All right. And also next week, I expect a ruling will come out from the Hearing Officer addressing the issue of rebuttal, rebuttal testimony deadlines, as well as the requests made by Mr. Herrick yesterday for some kind of discussion regarding scope of rebuttal, the request made by Mr. Berliner at the end of yesterday regarding

filing of objections for exhibits that have come in later, and the request from Ms. Des Jardins for time to respond to any objections filed by the -- by the new deadline.

All that, and I'm sure more, will be addressed in the ruling to be issued next week.

I think that completes it for today. I want to thank everyone for your cooperation during this stage. We will have a slight break, but I expect I will see all of you shortly, sometime in 2017, for the rebuttal phase.

And in case any of you have holiday plans, please keep in mind that those deadlines for submitting objections and responses to objections will likely be around the holidays.

With that, we are in adjournment.

(Whereupon, the proceedings adjourned at 5:05 p.m.)

STATE OF CALIFORNIA)
) ss.
COUNTY OF MARIN)

I, DEBORAH FUQUA, a Certified Shorthand Reporter of the State of California, do hereby certify that the foregoing proceedings were reported by me, a disinterested person, and thereafter transcribed under my direction into typewriting and is a true and correct transcription of said proceedings.

I further certify that I am not of counsel or attorney for either or any of the parties in the foregoing proceeding and caption named, nor in any way interested in the outcome of the cause named in said caption.

Dated the 28th day of December, 2016.

DEBORAH FUQUA

CSR NO. 12948