SUPREME COURT OF THE UNITED STATES
No. 142, Original

STATE OF FLORIDA,)
)
Plaintiff,)
)
V.) VOLUME XI
)
STATE OF GEORGIA)
)
Defendants.)

TRANSCRIPT OF PROCEEDINGS

The above-entitled matter came on for HEARING before SPECIAL MASTER RALPH I. LANCASTER, held in the U. S. Bankruptcy Court, at 537 Congress Street, Portland, Maine, on November 17, 2016, commencing at 8:50 a.m., before Claudette G. Mason, RMR, CRR, a Notary Public in and for the State of Maine.

APPEARANCES:

For the State of Florida: PHILIP J. PERRY, ESQ.
JAMIE L. WINE, ESQ.
ABID R. QURESHI, ESQ.
STACEY van BELLEGHEM, ESQ.
LAURA J. GLICKMAN, ESQ.

For the State of Georgia: CRAIG S. PRIMIS, ESQ.
ZACHARY A. AVALLONE, ESQ.
CHRISTOPHER J. MANER, ESQ.
CHRISTIAN REIGSTAD, ESQ.

Also Present: JOSHUA D. DUNLAP, ESQ.

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PROCEEDINGS

SPECIAL MASTER LANCASTER: Good morning.

MR. QURESHI: Good morning, your Honor.

SPECIAL MASTER LANCASTER: Good morning.

REDIRECT EXAMINATION

BY MR. QURESHI:

Q. Good morning, Dr. Kondolf.

A. Good morning.

Q. Sir, we spent some time yesterday responding to questions regarding the operation of federal reservoirs and Army Corps of Engineers dredging. Today I would like to ask you some questions about why these projects were undertaken. And I'm going to provide you a document that you cite in your testimony at paragraph 13, and then we'll direct you to particular sections.

MR. QURESHI: Your Honor, with your permission?

SPECIAL MASTER LANCASTER: Sure.

BY MR. QURESHI:

Q. Dr. Kondolf, I have handed you what's marked as Joint Exhibit 1. Can you tell us what this document is?

A. Yes. This is a document that's a letter from the Secretary of War to the U.S. Congress. It's

basically a report of the chief of the Army Corps of Engineers. And it's concerning potential projects on the Apalachicola, Chattahoochee, and Flint Rivers.

Q. And, sir, why did you review this in connection with your work in this matter?

A. I reviewed a number of documents like this. Pretty much every year the Army Corps of Engineers would submit a report like this to Congress to show what they have done to sort of justify their appropriations, and in this case to propose a very large regional-scale project. This was the project that we referred to earlier that involved construction of five federal dams on the Chattahoochee and Apalachicola, and also this very extensive dredging project that we discussed yesterday.

And as is very clear in this document, this was for a regional-scale economic development plan, initiative. And they were going to have a 9-foot deep navigation channel all the way to Columbus, Georgia. And this is a huge scale. It's the same depth as the navigation channel of the Missouri River. So for the Chattahoochee and Apalachicola this was very large-scale. And this

was done to serve the ports of Columbus and Bainbridge.

And in the report here it notes that the Apalachicola itself is only a necessary outlet to the Gulf, that the whole project was done to benefit commerce to the upstream ports.

Q. Okay. Thank you, Dr. Kondolf.

Now, I want to walk through some of the sections that you alluded to. In particular, on page 3, paragraph 3, I would ask you to review the first few sentences. You're welcome to read the entire paragraph if you like.

And my question is going to be what is the significance of the reference to agricultural production and population in principal cities?

A. So here, it's describing the agriculture and the urban centers within the river basin. And these are pretty much -- these are all cities in Georgia -- one is in Alabama; the others are all in Georgia. And the agriculture that's referred to is predominantly in Georgia. So these would be served by the navigation project.

Q. Dr. Kondolf, in the same paragraph at the bottom of the page, there's a sentence that begins, commerce on the river system consists. And then

it goes on to the following page 4. Can you review that to yourself and explain how that discussion informs your understanding of the scale of the project that was undertaken.

A. So this -- this and the subsequent sentence describes commerce at the present time, so in -- when this report was completed in the 1930's, which was mostly movement of sand and gravel, pulpwood to sawmills -- sorry, timber to sawmills and pulpwood to a paper mill. And so that -- the scale of that is much smaller than what's being proposed for this project in order to serve the regional interests.

Q. And this is prior to the onset of any dredging, sir?

A. There was some dredging. It was relatively minor.

We looked yesterday at a plot of dredging over time. And -- and as you saw from that, beginning in 1956, the rate of dredging increased dramatically. So this was really a much larger-scale project that was done for the regional development.

Prior to that, you had more local movement of goods, like as is shown here, pulpwood and timber

and some sand and gravel.

Q. Dr. Kondolf, on page 6 in paragraph 9 there is a discussion about the reservoirs, construction of reservoirs. Let's move from the dredging aspect to the reservoir aspect. And right before paragraph 10 there is a discussion about a dam in the Apalachicola. Can you review that to yourself and explain what that means.

A. So this passage essentially states that the purpose of construction of these dams is to maintain usable navigation depths in the Chattahoochee River to provide those depths up to Columbus, Georgia.

Q. How is it consistent with your opinion that the dredging and the construction of the dams was to benefit the upstream states?

A. Yes. These were really part of the same project, deepening the channel and building the dams. For the lower part of the river it was deepening the channel; above that, the dams were designed to provide the minimum depths. So they were all part of the same project, to make possible navigation up to Columbus and Bainbridge on the Chattahoochee with a 9-foot deep channel.

Q. Sir, earlier you explained that the Apalachicola

was only considered a necessary outlet. And if you turn to page 39, paragraph 140, can you explain how that discussion is consistent with your testimony.

A. This paragraph was one of the paragraphs on which I based my conclusions. And this paragraph very clearly says that the -- that the commerce for which the project is -- was proposed was -- it said that the Apalachicola River, the downstream part after the Chattahoochee and Flint come together, that that river is considered to be only a necessary outlet for these two streams, the upstream Chattahoochee and Flint; and its improvement to a greater depth than now authorized would be dependent on the improvement of one or both of them.

So -- so only a necessary outlet for the upstream streams. So that it was not commerce on Apalachicola per se, but Apalachicola was simply the way for ships to get from the Gulf to these upstream ports.

Q. Dr. Kondolf, the last item I want to review on Joint Exhibit 1 appears on pages 45 and 47. In particular on page 45 in paragraph 158 of Joint Exhibit 1 there is a discussion about the

movement of gasoline and kerosene by barge constituting, quote, by far the largest item of commerce potential for the waterway, end quote.

And then on page 47, there is a chart. Can you explain how that chart relates to the preceding paragraph that I just read from?

A. Yes. So much of this document is sort of projections of what economic benefit could be gained by doing this massive project of dams and dredging. And the document calls out specifically petroleum products as being an important item of commerce.

And so on page 47 in this table there's a detail of the expectation of the -- of the petroleum that would be carried from the Gulf up into these counties as an alternative to the ways that the petroleum was being transported at the time.

And as you go down on this table, it shows a number of counties in Alabama, about eight counties there. And then it describes the savings per ton in petroleum that would accrue from this project and others. By building the navigation project people in these counties would save so much in petroleum costs because of the

transport. So it quantifies that for Alabama.

For Florida it says, no saving.

And then it goes on, and then there are many counties in Georgia listed with the savings expected in terms of petroleum costs for them for those Georgia counties.

So by far, the benefits are clearly for -- primarily for Georgia, a little bit for Alabama. But in this case for the petroleum, there is no benefit shown for Florida at all.

Q. Dr. Kondolf, did you -- do you typically rely on these types of historical documents in your field of study?

A. Yes. As a fluvial geomorphologist, we are often, probably most of the time looking at impacts of human activities on rivers, trying to understand how those occurred, their nature; and then in my specific field, looking at how we can restore some of the function to rivers that's been affected by these human activities. So in order to understand those historical human impacts, it's essential to look at these kinds of historical documents.

And going back to 1986, I think I published my first paper about using these kinds of methods

in -- in restoration kind of planning. I published another paper on that in 1995. In my book, which is about methods in the field of fluvial geomorphology, tools in fluvial geomorphology, we have a chapter specifically on historical analysis and how it's used in the field. We have another chapter on archaeological information as well.

So it's a central part of the field of fluvial geomorphology to do this kind of historical analysis to inform your understanding of how the river has changed.

Q. And based on that type of study, your review of Joint Exhibit 1, as well as other archival records, what is your conclusion about why these federal projects were built and why dredging by the Army Corps occurred?

A. I think it's very clear that the reason for this project, especially this scale of project, was to benefit the upstream ports, especially Columbus.

Q. Dr. Kondolf, I would now like to move to the period when dredging ceased. Can you remind us when dredging by the Army Corps ceased?

A. The intensive dredging was starting in the '50's through 1999. That was the last year of really

large-scale dredging. They didn't do any dredging in 2000. And then in 2001 they started dredging; and they did some, but the barge ran aground and they quit. And there was no -- no dredging after that. So that was 15 years ago the last dredging occurred.

Q. And why might the barge have run aground?

A. I think it was a relatively low water year; but certainly the river -- the riverbed was coming back up.

When they did the dredging, they were digging an artificially deep hole in the riverbed and in a sandy riverbed. And as most five-year-olds could tell you from their experience at the beach, if you dig a deep hole in the sand, the walls are going to collapse. So they were having to go back and try to re-excavate that navigation channel.

Q. And when dredging was occurring prior to 2001, how often did it occur?

A. It occurred most years. And yesterday we looked at some of the diagrams showing the distribution of dredging up and down the river and over time. But -- and the dredging was limited to certain parts of the river. It was upstream of river

mile 23.

And there were certain hot spots which were -- which we looked at in the diagrams yesterday, certain places that tended to shoal more than others, so required more repeated dredging.

Q. Why would they have to dredge every year?

A. Because the riverbed is recovering. You dig the deep hole, and then sand fills it back in. And I think when they proposed the project originally, they had some idea that they could dig this deep channel, and it would stay that way. But, you know, these are sand banks; and they just collapse. And so -- so that's why they were back each -- you know, almost every year in most places. It would depend on where you were, but quite frequently they would have to go back and dredge.

Q. Okay. Sir, what can you tell us about how the river has recovered since dredging ceased in 2001?

A. Since the cessation of dredging in 2001, the first thing is we know that the riverbed has come back up, that it would be impossible for the river to have kept that deep hole in sand. You

know, we know that's going to collapse. And we also know some parts of the river have been shoaling. We lack really good survey data since then, but it's quite clear that that's been occurring.

And then we have the narrowing of the channel. So we looked yesterday at how the channel had widened. Since 2004, which are the last data that were used by the U.S. Geological Survey, we can see in the last 10 years that the river has begun to narrow through establishment of riparian vegetation, willows mostly, that are now narrowing the channel.

We also know that the riverbanks have stabilized. Back during the dredging year of -- when the dredge was operating, it was disturbing sand; and so there was a lot of loose sand on the banks. And since then, with the -- with the stopping of the dredging, the banks have stabilized; and they're now creating a firm substrate. And that's beneficial for mussels because that's important habitat for the mussels to have a stable substrate.

And then the last thing that's really clear in terms of recovery is the sloughs. Many of the

sloughs were blocked during the dredging period. And they -- they are now -- have become more open. So the fishermen can access many of these sloughs that had been blocked during the period of active dredging with all the sand in circulation.

Q. Dr. Kondolf, there was a suggestion yesterday that since dredging has ceased and, as you have described, the river is recovering, what do you need? Why is the river not completely recovered?

A. Well, the river needs adequate flow. And, you know, there have been a number of restoration projects that have been done that are sort of small-scale projects, which are good; but the underlying problem is that the river needs adequate flow.

If you were to use a medical analysis, if the river is the patient, the patient has a systemic disease; and that's the lack of flow. It also has a broken arm. And you can do projects such as a lot of the small-scale projects that have been done to date to reconnect some of the sloughs, which is like fixing the broken arm, which you have to do; and that's important. But that doesn't get at the underlying systemic

disease, which is the lack of water.

So you have to have adequate flow to take advantage of the habitats that have been preserved, the restoration projects that have been done. You need to have adequate water.

Q. Okay. Thank you, Dr. Kondolf. I would like to stick with this topic and show you another document, if I may.

MR. QURESHI: And, your Honor, this is Florida Exhibit 530. It's not marked as 530 because I'm going to pass out a color copy. The copy in the binders is a black and white copy; but this is the same document, Florida Exhibit FX-530.

BY MR. QURESHI:

Q. Dr. Kondolf, this is a February 2013 letter from the United States Fish and Wildlife Service to the ACFS Stakeholders. And you may not have seen this before, but I want to direct your attention to the first page and the bottom paragraph that begins for example, and through the word environmental flow components.

Also, I want you to have an opportunity to review the graph on the last page and paying attention to the red line on the graph on the

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last page.
A. Okay. I haven't seen this letter before, so I'll try to --
Q. Sure.
A. -- take a look at the entire context.
MR. PRIMIS: Your Honor, while the witness is reading the document, I'm going to object to introducing a technical document that the witness has not seen before or opined on before. And I just happen to know from being involved in the case for a long time that there were several detailed technical analyses referenced here in the first paragraph which he has no knowledge of.
MR. QURESHI: Your Honor, I'm simply going to ask him how the references to the environmental flow components are consistent with his direct testimony.
SPECIAL MASTER LANCASTER: Proceed.
MR. QURESHI: Thank you, your Honor.
A. Okay. Again, I'm not conversant in all the -- all the background of this.
Q. Certainly, Dr. Kondolf. My question simply is there is a reference on the first page to minimum and maximum flow duration, magnitude, frequency,

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and the rate of change that were observed at USGS gages during the pre-dam period. And there is a reference to these being essential environmental flow components.
Now, in your direct testimony on -- and that's in tab 2 of the binder they gave you yesterday, in paragraph 49 you write, maintaining an adequate flow regime is needed to keep the river healthy while it continues the natural process of self-healing.
So I would like to understand how this is consistent with the reference in the U.S. Fish and Wildlife Service's letter.
A. Well, it appears that here they're referring to using pre-dam flow data as a reference for -- against which to judge flows that you would have today or might be simulated for today.
Q. Okay. Dr. Kondolf, how does that relate to your opinion that the river needs more flows to become healthy?
A. Well, so if I'm reading this correctly -- and, again, I might need to read through it more carefully; but it looks like roughly half the time that the recommended flows were -- were achieved. And so that would indicate that the

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river is not getting sufficient flow now. That's what this appears to be.
Q. Okay. Why does it need that to regain its health?
A. Well, for example, the -- the river has complex habitats on the banks and in the sloughs. And so if the -- if the flows are artificially reduced, a lot of those habitats will not be inundated. So -- I was looking at this figure in the last page. Sorry.
But the principle is that you can have excellent complex habitats along the banks of the river or in sloughs; but if the flows have been artificially reduced, the river won't be inundating those, and they won't be part of the river ecosystem.
Q. And can you describe what steps the State of Florida has done to promote recovery of the river to help it regain its health?
A. I think the most -- most important thing is that the State of Florida has set aside thousands and thousands of acres in the floodplain. And it's one of the least disturbed floodplains in North America by far. And the State has -- by buying or getting easements, it's ensured that most of

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the floodplain will remain undeveloped. And so that's by far the most important thing because then, as long as you have a good flow regime, the river has the capacity to recover.
And that's really the thing. Rivers have a tremendous self-healing potential. And that potential is very high on the Apalachicola because of the wide floodplain that exists. And so as long as there is a healthy flow regime, then we can expect continued recovery of the river.
In addition to setting aside the floodplain, the State of Florida stopped the dredging that was going on and initiated a number of restoration projects. First they required the Army Corps of Engineers to do the restoration projects, but the Corps would tend to be very heavy-handed and blunt, using very large river equipment to do it. And then the State of Florida was -- began doing these projects themselves.
And they have hired my team, my colleagues at the University of Florida and me, to undertake an analysis of -- of restoration projects for river mile 40 to 63 and to look at the relationship

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between channel change and mussel habitat there and how that can inform future restoration.

Q. Dr. Kondolf, there was a suggestion yesterday that it's only river mile zero through 23 that has not suffered from the impacts of dredging. Are there other areas of the river that you have observed that are showing signs of improvement; and, if so, why?

A. Yes. There's a lot of improvement throughout the river. I mentioned that the -- you know, that channels were largely recovering from dredging because -- which is what we would expect. The bank stabilization, the fact that many of the sloughs are now accessible. Fishermen can get in there. The water can get in there, which wasn't the case during the dredging.

And we also see that the overwidening of the channel is reversing, that the channel was starting to narrow.

That's the preliminary results of our analysis of aerial photographs since 2004.

Q. And, Dr. Kondolf, how are you able to differentiate the impacts of dredging on the river versus the impacts of low flows?

A. Well, first, the lower 23 miles of the river do

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not show any effects of the dredging. So we know that reduced flows there are entirely attributable to the reduced flows from upstream. The lower water levels in that part of the river are because of upstream reductions.

And that's a very important part of the river because that has the vast majority of the swamp forest, which is the Ogeechee tupelo which provides the tupelo honey. And it's ecologically very important for fish and whatnot. That's described in Dr. Allan's report.

As we go upstream on the river, with Dr. Hornberger's modeling and Dr. Allan's biological information, Dr. Allan's report is able to distinguish and identify the effect of that reduction in flow from the -- excuse me, the reduction in the stage of the river, the height of the river, from the reduced flows from upstream. So he's able to quantify that.

And that's potentially quite important because, for example, if you talk about a difference between 5,000 and 7,000 cubic feet per second, that's about 37 sloughs that are connected in that interval. So that's a lot of habitat that -- that would be restored by just

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having that much -- that difference in flow.

Q. Dr. Kondolf, I'm going to move to a slightly different topic; and this relates to the 2009 American Rivers document that was highlighted during your cross-examination. That's behind tab 4 of your binder.

Before we dive into the substance of it, can you explain why you prepared the document?

A. I was asked by American Rivers, which is a national nonprofit environmental organization. Their -- their goal is to preserve and restore rivers in America. They asked me to assess the prospects for restoration of the Apalachicola River.

American Rivers has identified the Apalachicola as a river of concern. And, in fact, this year, American Rivers identified the Apalachicola as the most endangered river in the United States. Each year American Rivers puts out a list of the most endangered rivers, and this year they identified the Apalachicola as the most endangered. And they cited the lack of flow as the primary threat to the river.

So it's in that context that they asked me to prepare this report.

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Q. Okay. And since preparing this report in 2009, what additional work have you done in connection with Apalachicola River?

A. I'm currently working with colleagues at the University of Florida on a project for the Florida Fish and Wildlife Commission to evaluate channel change and mussel habitat from river mile 40 to 63.

And after I completed the -- this report for American Rivers in 2009, I returned to the river a few times in subsequent years as well -- I don't remember exactly how many -- because my -- my mother grew up in Tallahassee and around there. And so we would bring her back to the beach. She -- she found the beaches in California too cold. So we were bringing her back each summer. And so I was in the area anyway; I was very close, so I would go and visit the river with the riverkeeper. And so through that I had a chance to see more sites and sort of get a better understanding even since I did this report.

Q. And can you explain how this worked for the State of Florida as well as these personal visits to the area, how have they informed some of the

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observations you made in 2009?

A. In 2009 in this report, I was -- in a way I was pitching, you know, some restoration projects. And -- and so I think since then I appreciate perhaps more the value of some of the projects that had been done. And in this report I point out that they were not -- they were not restoring the process. So in a way they were not fixing the patient's systemic problems, but just, you know, fixing the broken arms. And I had, I guess, maybe more of a critical attitude in this report.

But since that time, for example, I have been to some of these small projects that were done, which include removing sediment from the mouth of some of these tributaries. And the purpose was to get the cold water from the tributary into the river for the striped bass and other fish.

And it is really remarkable. If you approach those in a boat, the water is just alive with fish. They're all hanging out in that cold water that's coming in from the tributary.

So anyway, I appreciate much more some of the projects that had been done. Even though they're not fixing the river's, you know, systemic

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problems, the systemic disease, at least they are providing a lot of benefit.

And I also -- in the report I emphasize one of the first principles is do no harm; and so I emphasized that. But I also make a strong case, well, we should be looking at, for example, reconnecting Battle Bend, which I acknowledge in the report is a big project. But the emphasis in the report is, well, let's really look into this. And as I have observed further recovery in the river and appreciate the potential impacts of the Battle Bend reconnection that I'm proposing, which would be a really big project and require Congressional deauthorization and all this stuff, I realize that I wouldn't promote that project so strongly today. That would be a difference.

Q. Okay. Thank you, Dr. Kondolf.

I want to focus in on one of the items you mentioned, that "do no harm" principle. And that's actually highlighted on page 11 of GX-248.

Why don't you take a moment to review that to yourself and explain to us what exactly that means.

A. So in this paragraph I draw an analogy to -- to the physician's craft in medicine. And I -- I

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try to point out that -- you know, I have already noted that the river can do a lot of self-healing. And so by analogy with a human patient, we should emphasize natural recovery, that the -- by exercise or diet or simply the ability of the body to heal, that we let the river heal itself. And when we consider large, intrusive projects, that we should be confident that the benefits are going to outweigh the impacts.

And those large, intrusive projects, those could be likened to open heart surgery. And, certainly, if it's really needed, it's great. But you don't want to go into that lightly because there -- it's a -- there's a lot of trauma on the system from open heart surgery. So you don't -- you don't necessarily do that lightly.

And I think in relation to your earlier comment, something like the Battle Bend reconnection might be considered open heart surgery. So you would -- you wouldn't do that unless you felt that the river was not recovering sufficiently on its own.

Q. And, Dr. Kondolf, you mentioned the self-healing

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aspects of the river. Are you suggesting that we just leave it alone, and it will be fine in some time?

A. No. The self-healing -- you know, again, with the physician's analogy, self-healing requires good diet, exercise, fresh air. So the river -- and the main thing the river needs is flow. It has the space. It has the floodplain. These have been preserved. What's missing now is the adequate flow regime. And with that, the river can heal itself. I mean, it's doing it already.

Q. If we could please turn to page 41 of GX-248, sir. There's a discussion of a proposal to remove sediment plugs from particular sloughs. Please take a moment to review that and then let us know if that project was undertaken.

A. Okay. So this is generally about removing sediment plugs from the inlets of sloughs or the mouths of tributary streams. And some of these projects have been undertaken. The State of Florida required the Army Corps to do some of these projects back during the days of dredging.

And then the State of Florida undertook some of these projects themselves since, which Battle Bend was the largest one. They opened up the

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downstream part of Battle Bend. There were three others, Blue Springs Run, Sweetwater Creek, and Kelly Branch -- there was a dam removed on that, which was a little different. But there have been a number of projects to -- to remove the sediment.

And here, I proposed Swift Slough as one example. And at the time I wrote this report in 2009, I was not aware of an analysis done by the U.S. Fish and Wildlife Service which is reported in their 2006 biological opinion in which they actually went in the field and assessed the potential to clear the sand from Swift Slough. And they determined that it would actually have more of an impact -- negative impact than a benefit. So -- so I wasn't aware of that.

But for each of these -- and I think I make it clear in the report, for each of these potential slough projects, you would need to -- you would need to do an assessment and to determine whether there's more benefit to be -- to be gained versus impact from the project.

Q. Okay. Dr. Kondolf, you mentioned the 2006 BiOp; so I would like to provide you a copy. And maybe you can highlight for us the particular provision

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you're referring to.

I refer you to page 120. And perhaps you can explain how this discussion refers to your assessment.

A. It's a large document.

Okay. Page 20 --

Q. I'm sorry, doctor. I said page 120.

A. 120.

Q. It's the paragraph beginning the adverse.

A. Okay. That's why I recognize that.

Okay. So this paragraph begins in which the Fish and Wildlife Service is saying that the adverse effects of low flow to the -- these mussels could be minimized by increasing the minimum flows or conducting habitat management.

And by habitat management they go on to say that they have looked at Swift Slough in 2006 to see whether they should excavate sand to -- to connect Swift Slough at a lower flow. And they said, after careful examination of the channel morphology, they determined that it would -- it would do more damage than benefit because essentially it would drain these pools that the mussels were living in.

Q. Okay.

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A. So that would be a case. But in the context of my recommendations in my report, you know -- you know, I think we should be evaluating all these possible projects; but in each case we want to -- we don't want to do more harm than good. And in this case the Fish and Wildlife Service did a field inspection and determined that removing the sand in that location would probably do more harm to the resource than benefit.

Q. Okay. Dr. Kondolf, in your opinion, since 2009 has the State of Florida undertaken steps to restore the Apalachicola River?

A. Yes. Certainly, the -- again, there have been these projects, Blue Springs Run, Sweetwater Creek, Kelly Branch, those are examples of projects that have been undertaken. And I think more land has been acquired and set aside. And, you know, they hired my group based in the University of Florida to provide them with scientifically-based recommendations for restoration for river mile 40 to 63; and we're hoping that that will be expanded in the future.

Q. Okay. Dr. Kondolf, if I may now refer you to tab 3 of the binder that you were provided yesterday. It was a PowerPoint presentation.

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And counsel represented to you that was prepared by Mr. Ted Hoehn.

You asked counsel for Georgia the date on which this presentation was prepared. He never told you. Why did you ask for the date?

A. Well, a lot of these things, the photographs that apparently show dredging going on and the text that describes many of the impacts, those would appear to be things that were current in the 1990's perhaps or 1980's; but you wouldn't see that today. There's been a lot of recovery in the river since then. So -- so that's why I was asking about the date because it seems like a dated document.

Q. And Mr. Hoehn actually testified that the date of the document was 2005, but some of the photographs may have appeared from earlier eras. He also explained that many of the issues highlighted in the presentation have since been remedied and are no longer in existence. How is that consistent with your observations?

A. I haven't looked at the entire document, but that would make sense. 2005 was when the permit was denied. And so I'm sure a lot of these slides -- they had to have been taken before 2000.

And so -- so, yes, given the recovery in the river, I would imagine that some of the issues highlighted here had resolved themselves or had been addressed.

Q. Okay. You didn't review all of the slides with counsel for Georgia; but if you flip to the latter half of the presentation -- and the pages, unfortunately, are not numbered; but they're entitled Additional Effects of Low Flows. I would like for you to explain how what's depicted on those slides is consistent with your personal observations.

A. Okay. So these -- this describes -- because of the lower flows you are inundating less of the -- of the roots of trees. That's evident in this photograph; it looks like cypress trees and their roots. It also shows a slough that is apparently drying up. And there is a disconnected pool, which would have concentrations of fish.

And as these -- as the sloughs disconnect from the river and you can no longer have flowing water through them, the pools become isolated, stagnant, and usually the dissolved oxygen levels drop. And so that's a big stress on the organisms, and it can be lethal.

So -- and then there's also a slide entitled Submerged Aquatic Vegetation Decline. So that would refer to the -- I presume to some of the -- the vegetation that's naturally submerged in the water and has a lot of ecological importance for different species. But as that is exposed as the river levels decline, then, of course, you lose that habitat.

Q. And is it your assessment that the river is continuing to suffer from these types of issues?

A. Yes. Yes. Especially in the dry years. It's -- it's a -- the lack of flow is still a significant problem, yes.

Q. Dr. Kondolf, if we may now go to tab 6 of the cross-examination binder, a copy of a study prepared by Ms. Helen Light at GX-88. Have you reviewed this report before?

A. Yes, I have.

Q. And, sir, what's your assessment of the work in this report?

A. I think it's an excellent report of -- the authors are all very good scientists; and they did a very good job. It's -- you know, of course, it's a report with a certain limited scope. It's 10 years ago now. And it relies

largely on data from 20 years ago or more. So obviously, you know, there are a lot of things that have changed since this report was done; and some of the conclusions I wouldn't necessarily agree with in any event. But I think it's a very good piece of work.

Q. Okay. And can you highlight any particular conclusion that you would disagree with?

A. I could go through and look at these, but --

Q. For example, at the bottom of page 1, there's a discussion about water level decline. What's your assessment of that particular opinion?

A. Okay. And this one was highlighted in the deposition and so on.

Yes. So this -- this statement says, water level decline caused by channel change is probably the most serious impact. The next sentence on the top of page 2 says, this decline has been exacerbated by long-term reductions in spring and summer flows.

I think I would not agree with the conclusion that water level decline caused by channel changes is the most significant anthropogenic impact.

One thing I think is useful to keep in mind

is this report only addressed the nontidal part of the river, so river mile 20 upsteam, when in fact from river mile 23 downstream you have no effect from the channel change.

And also, the purpose of this report was simply to look at the physical changes from the dredging. It was not -- the purpose of the report was not to assess the effects of lowered flows from upstream. There is -- later in the document there is some discussion of those lower flows; and so that it's -- the importance is recognized. But that was not the focus of this report.

Q. And even if we go beyond river mile 23 and go further north, the water level decline associated with dredging, what's your assessment of that today?

A. Well, again, there's been a lot of recovery of the bed, which has to happen. There is no way you could dredge a deep channel and not have it fill in with sediment in a context like this.

And we know from the analysis of Dr. Hornberger and Dr. Allan in which they essentially remove the effect of the consumption by upstream states, then you can see that there

is a significant impact from the lowered flows.

In terms of the impact of the -- of the remaining effect of the dredging, you know, there's certainly -- that is certainly still out there; but we're -- again, we're seeing the channels recovering from that.

Q. Dr. Kondolf, I now would like to move to a discussion on sloughs. You had some questions yesterday about the connectivity level of sloughs, and there was a focus on the Swift Slough. How many sloughs are in the Apalachicola River?

A. There are over 300 sloughs connected to the Apalachicola River.

Q. And knowing what you know about river dynamics, what is your expectation regarding the change -- in regard to changes to the connecting flow level to these various sloughs?

A. Well, first, these 300 sloughs are connected at all different flows. There's a USGS report from 1998 that inventoried all the sloughs and their -- the flows at which they were connected at that time. And that report showed from about 4,000 cfs up to 19,000 cfs that, you know, different sloughs will connect or disconnect at

those different flows. So there's a wide range.

So essentially at almost any flow level if you were to drop a thousand cfs, you would be cutting off 10 or 20 sloughs. So throughout the range of flows there are different sloughs that connect or disconnect.

And over time, the level at which a slough connects can change. And one of the factors has already been talked about, deposition of sand as a result of the dredging. But even without that, there are always fluctuations. It's an alluvial river. It's a dynamic system. So there would always be fluctuations in the level of when some of these sloughs would connect.

And we know that since the dredging stopped, that many of these sloughs are flushing out of sediment and that the -- they're accessible and connected at a lower level than they were before.

Q. And what is required to flush out additional sediment and connect additional flows in the sloughs?

A. River flow is needed. That's what's needed.

Q. Okay. Dr. Kondolf, can you describe for the Court some of the other river systems that you have studied?

A. I have worked a lot on rivers in California, of course. The San Joaquin River is one that I was involved in. And there's a court case on that -- a pretty well-known court case. In the San Joaquin, the construction of Friant Dam actually dried the river out in two places downstream. So there used to be between two and 300,000 salmon that swam upstream the San Joaquin each year, and that run was exterminated by the dam.

But, fortunately, the policy is now to restore the salmon run. And the question is what flow regime exactly do you need for that? And that was what I worked on before -- in the settlement for that case.

And this year for the first time we have continuous flow in the San Joaquin from the dam down to the delta.

So I have worked on the San Joaquin. I have worked on the Sacramento, the Trinity River, the Klamath River, worked on the Mississippi. Internally I'm doing a lot of work on the Mekong right now. I have worked on the Rhone River and its tributaries in Europe, some -- a couple of rivers in Portugal, Thailand -- Taiwan, sorry. Well, Thailand also, and -- well, Korea.

Q. Okay. Thank you, Dr. Kondolf.

Just based on your extensive study of rivers -- rivers around the world, can you give us your assessment of the Apalachicola River?

A. In my view the Apalachicola is a real gem. It's a beautiful system, highly productive, one of the most biodiverse and ecologically productive systems in the planet, certainly in North America. And the fact that the floodplain has been preserved, it has tremendous potential to continue to be such an amazing place.

What it really needs is flow. It needs to have adequate flow to preserve this for future generations.

Q. Thank you, Dr. Kondolf.

SPECIAL MASTER LANCASTER: Recross?

MR. PRIMIS: Yes, your Honor.

RECROSS-EXAMINATION

BY MR. PRIMIS:

Q. Dr. Kondolf, we highlighted yesterday in your American Rivers report where you acknowledged that low flow could have an impact on the river as well as channel change. Right?

A. I believe so.

Q. And I showed you the portion of your report that

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said that. Right?
A. It's a bit of a blur; but I think so, yes.
Q. Okay. And I'm only asking you because you have done no quantitative analysis to assess the relative impact on the river of channel change caused by the Army Corps as opposed to low flow. True?
A. Certainly from river mile 23 downstream we can attribute all the reduction in river stage to reduced flows from upstream because there is no channel change down there. As you go upstream from that point, it was not part of my responsibility to quantify the different effects. But those that have been -- at least the effect of the reduced flows from upstream have been quantified by the Hornberger and Allan reports.
Q. Dr. Kondolf, I'm just going to ask you to narrow your answers and try to answer the question I'm asking. So I'll just focus on river mile 23 and up.
You personally, sir, have done no quantitative analysis to assess the relative impact between Army Corps dredging and channel change on the one hand and low flows on the other. Correct?

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A. So, again, the purpose of my report was not to do a quantitative disaggregation of those two, no.
Q. Are you capable of answering questions yes and no?
A. It depends on the question.
Q. How about the last one? Can you answer that question yes or no?
A. Again --
Q. I'll withdraw the question, Dr. Kondolf.
A. I'm happy to expand on it, if you would like.
Q. No. I'm going to ask you for the opposite, please.
Dr. Kondolf, with regard to low flows that you have talked about, you have done no quantitative analysis to assess whether they are caused by drought versus Corps operations versus Georgia's use versus evaporation. Correct?
A. It's correct that I have not -- it was not part of my report scope to analyze what factors could be causing the reduction in flow from upstream to the Apalachicola River.
Q. Is another way of saying that no?
A. Yes. In answering your question, I did not analyze those factors.
Q. Okay. Sir, you were shown JX-1, which is the

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letter from the Secretary of War. Can you pull that out.
It was a loose document from Mr. Qureshi.
A. Yes, I have it here.
Q. Okay. And you said that this suggests that all the dredging was done to benefit Georgia. Right?
That's your opinion?
A. The dredging project and the construction of the dams was done principally to benefit upstream ports in Georgia and to some extent Alabama, but Georgia primarily.
Q. Okay. I just want to point out that the document we're looking at, JX-1, it bears the header 76th Congress First Session. Correct?
A. Yes. That appears to be right.
Q. And you understand that the dam was built as a result of an Act of Congress. Right?
A. Yes.
Q. And Georgia doesn't control the Congress; I don't think you're saying that. Right?
A. No, I'm not saying that Georgia controls the Congress.
Q. And this letter is from the Secretary of War. Correct?
A. That's correct.

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Q. And that person is appointed by the President of the United States. Right?
A. Yes. That's correct.
Q. The Governor of Georgia doesn't appoint the Secretary of War. Right?
A. That's correct.
Q. And in the last part of the cover page, he notes that he's giving this report as requested by resolution of the Committee on Rivers and Harbors of the House of Representatives. Correct?
A. That's correct.
Q. And that's the United States House of Representatives. True?
A. That's correct.
Q. Now, you mentioned on your redirect that you have done work in 2015 on the Apalachicola River. Correct?
A. That's right.
Q. And in paragraph 8 of your written direct, that's where you have a very short description and note that that's what -- that you have been doing some work there. Right?
A. That's correct. In paragraph 8 I briefly describe that work.
Q. And when we talked about Ted Hoehn's presentation

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from 2005, you said that's dated. Right?
It's out of date. That's your view?
A. Well, some of the photographs are certainly from the dredging era, which would be, you know, 20 years ago. So --
Q. So the photographs are dated?
A. Well, and the -- the presentation is from 2000 -- what was it, 2005 or something?
Q. Yes, sir. And Helen Light's report from 2006 that talked about channel change being the single biggest effect on the river, that's from 2006. And you said that's outdated. Right?
A. Well, I --
Q. It's a little old?
A. Well, I mean, it is 10 years old; and it relies on the -- the data it relies on is 20 years old.
Q. And your 2009 American Rivers report that talks about the severe degradation caused by the Army Corps of the Apalachicola River, you said that's somewhat outdated, too, because we're doing this work now in 2015. Right?
A. Well, I -- again, I think for the time these reports were done, that they were -- it was fine. But things -- we do get new information. As we continue to work, we get further information.

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Q. And you want the Court to rely on the fact that you have done more work and have new information. Right? That's why you're here?
Things have changed since 2009. We should look at new information. Right?
A. Well, if it's relevant, certainly, yes.
Q. Okay. Now, in paragraph 8 -- take a close look. You don't mention any further documentation of any work you have done for the Florida Fish and Wildlife Commission in that paragraph; do you, sir?
A. I'm not sure what JX-128 is, but it looks like historical gage data.
Q. Well, it's your -- it's your testimony; and you attached Exhibit 128 as attachment A.
A. Yes.
Q. So you can look at it. It's gage data. Right?
A. Yes. Yes.
Q. So you have never disclosed to this Court that you actually have done and documented additional work after your 2009 American Rivers report in the Apalachicola River. Right?
A. No. I think that -- I think that says it right here.
Q. Did you cite to that report?

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You did a report, right, in 2015?
A. Yes. My team did a report -- progress report in 2015.
Q. It's not cited anywhere in your written direct testimony; is it, sir?
A. Maybe not. No.
Q. It's not. And you didn't mention it with Mr. Qureshi. Correct?
A. I don't think so, no.
Q. And when Mr. Hoehn was here, you're aware he didn't mention that there was a 2015 report on the Apalachicola River and mussels that you were a part of; did he?
A. I don't know. I wasn't here.
Q. Now, you -- you -- so you acknowledge you did do a report that you delivered to the Florida Fish and Wildlife Commission in 2015. Correct?
A. Yes. I think it was November of 2015.
Q. And Ted Hoehn works for the Florida Fish and Wildlife Commission. Right?
A. Yes.
Q. In fact, Mr. Hoehn, is the person responsible for mussels along the river. Correct?
A. I don't know what his responsibilities are.
Q. Well, you know Mr. Hoehn got your report. Right?

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A. I assume so. I -- I don't know.
Q. He's the person at Fish and Wildlife who would get it and review it. Correct?
A. I'm not sure who would get it and review it at Fish and Wildlife.
Q. And you didn't review his testimony at all to prepare for this?
A. No. I think -- I think I was shown a couple places where he mentioned me; but, no, I didn't review his testimony.
Q. And none of those mentioned your November 2015 report. Correct?
A. I don't recall.
Q. You don't. Well, the transcript will reflect that he didn't mention it.
MR. PRIMIS: Your Honor, may I approach?
BY MR. PRIMIS:
Q. This is GX-1335.
And Dr. Kondolf, this is the report that you provided to Florida Fish and Wildlife in November of 2015 concerning your work on river mile 40 through 63. Correct?
A. That's right.
Q. And now that you have seen it, can you confirm, again, you never cited this in your written

direct testimony. Right?
A. I don't remember -- well, apparently I didn't. I --
Q. Now, let's walk through this report, the one that you gave to Florida Fish and Wildlife and which was not mentioned by their representative. On page 2 you say at the bottom there is a history of human impacts. Correct?
A. So this report had multiple authors. I -- most of it was not written by me; but -- but it was written by other members of the team.
Q. Okay. Dr. Kondolf, I should have asked this. Let's just look at the first page. Your name is the third one down. Correct?
A. That's right.
Q. That's you, Mat Kondolf?
A. Yes.
Q. So you were a part of this project?
A. That's correct.
Q. And you know the context of this document?
A. Yes. So this was a progress report for the -- for this larger study which still had a year to go.
Q. Okay, sir.
A. So --

Q. On page 2 you outline --
MR. QURESHI: Your Honor, may I request that you allow the witness to finish his answer before you begin your next question?
BY MR. PRIMIS:
Q. Are you done, Dr. Kondolf?
A. So as I said, this was a progress report. There was another year to go in the project. And so this was done so that we could get paid for our deliverables 1 through 4.
Q. And that's actually a good point. So thank you to Mr. Qureshi for letting you finish.
You're currently getting paid by the State of Florida to do this work. Right?
A. That's correct.
Q. And that's -- separate and apart from your expert testimony, you are a paid consultant for the State of Florida. True?
A. Yes. This is a research project through the University of Florida. And I'm one of the investigators for this project.
Q. For which you were compensated. Correct?
A. That's correct.
Q. Now, you have a whole section on history of human impacts, correct -- your team in this report?

A. Yes.
Q. And I'm not going to go through it again because it's very similar to what was in your American Riverkeepers report, but take a moment and just confirm that the history you describe here is accurate?
A. I didn't actually write this. And it does -- it's not complete. I think my American Rivers report, that was my work; and that's probably a better reflection of my summary of the history. But this was done by members of the team.
Q. The team that you were a part of?
A. Yes.
Q. Okay. Can you go to page 8.
A. Okay.
Q. Do you see the section called Channel Dredging and Sediment Disposal?
A. Yes.
Q. In the middle there is a sentence that starts dredge deposits. Can you take a look on that -- take a look at that.
Right in the middle of the Channel Dredging and Sediment Disposal paragraph on page 8.
A. Right. Beginning dredge deposits?
Q. Right.

MR. PRIMIS: I'm also helping the Court out here, too.
SPECIAL MASTER LANCASTER: What page is that?
MR. PRIMIS: Page 8.
SPECIAL MASTER LANCASTER: Thank you.
MR. PRIMIS: In the section called Channel Dredging, about halfway down.
SPECIAL MASTER LANCASTER: All right.
BY MR. PRIMIS:
Q. Dr. Kondolf, have you had a chance to read that?
A. The sentence or the entire rest of the paragraph?
Q. Well, I'm focused on that sentence to the end of the paragraph.
A. Okay. Okay.
Q. Now, this report that you and your team submitted to Florida Fish and Wildlife is telling the State that there are dredge deposits. And when there are high flows, the sand on those dredge deposits can be deposited back into the river. Correct?
A. Yes.
Q. And one effect of that, I think you said, is that that can raise the bed of the river, right, when that sand goes back in?
A. That's true. Yes.

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Q. But another effect documented right here by your team and reported a year ago to Florida Fish and Wildlife is that they can plug slough channels. Right?

A. That's correct. There is -- sand is moving -- during floods there will be sand moving in and out of the channel, in and out of sloughs. The overall effect, since the cessation of dredging, is there is less sand in circulation; and so the sloughs are tending to flush out. But, yes, you can certainly get sand going back into sloughs as well.

Q. Dr. Kondolf, I would just like a clean question and answer. Your team reported to Florida Fish and Wildlife a year ago in 2015 that sand and dredge spoils are still going back into the river and can clog sloughs. Correct?

A. Yes. That's correct.

Q. Now, the last sentence of that paragraph, your -- you and your team reported to the State of Florida that these remaining dredge spoils are a persistent source of sand to the river channel. Isn't that what you and your team told the State?

A. That's correct.

Q. And can you go to the next change -- next

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page, 9. There is a section called Observed Channel Changes Caused By Human Activities. Correct?

A. That's correct.

Q. And, again, a lot of the content here is similar to material we covered yesterday; so I won't do it again. But I do just want to establish for the record that you and your team outlined for the State of Florida a year ago in an updated report that there are many coinciding anthropogenic activities. Correct?

A. Yes.

Q. And then you go ahead and list them, like channel widening and deepening and other factors. Correct? Is that part of your report?

A. So you're saying that we refer to many coinciding anthropogenic activities within a relatively short history --

Q. Correct.

A. -- making it difficult to attribute any given channel change to a single human activity. Yes.

Q. Now, can you go to the next page, Dr. Kondolf, page 10 at the bottom. There is a section called Lower Water Levels and Less Frequent Floodplain Inundation. Do you see that?

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A. Yes.

Q. And we have a standing rule in the case that lawyers are not to read lengthy passages; but I think, with some relief from the Court, this one is pretty important, and I want to make sure this one is in the record. So I hope I have developed some goodwill by not reading.

But your team tells the State of Florida that degradation of the riverbed and channel widening of the river has decreased connectivity to the floodplain and slough channels. Correct?

A. Yes. That's what it says.

Q. And you reported that one year ago -- almost one year ago today. True?

A. Right.

Q. And you say that that causes floodplain desiccation and loss of riparian tree species characteristic of swamps. Correct?

A. That's correct.

Q. And that affects the tupelo trees that you mentioned on your redirect. Correct?

A. That's correct. That's -- the tupelos are mentioned, yes.

Q. And it has caused many previous perennial sloughs to go dry. True.

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A. Yes. There is a reference there to the report by Helen Light, et al., of 2006 and Darst and Light. So it's in effect summarizing information from those USGS reports.

Q. And reporting it to the State of Florida Fish and Wildlife in 2015. Correct?

A. I write that -- I think it's clear it's referencing this -- these reports -- the information in those reports.

Q. And let's just focus on the next sentence because you were talking all about mussel habitats on redirect. You told the State of Florida a year ago that these impacts of the Army Corps operations has impacted mussel habitat in the slough channels through loss of perennially flowing water, deposition of sediment carried in from areas of the mainstream -- mainstem disturbed by dredging or outright desiccation.

Is that what you told the State of Florida last year?

A. Yes. And, again, the citations in that paragraph are to the USGS reports. And all this is summarized in those USGS reports.

Q. And you're not saying, sir, that there isn't still dredge spoils, and they're not still going

into the river. Right?
A. No. There are still some out there, yes; and some of them are still being eroded, yes.
Q. And they can still impact the sloughs. Right?
A. Yes. I would just emphasize, too, that the scale of the sediment coming in from those is very small compared to the scale of the impacts during the act of dredging. I think you made that point very well yesterday talking about the scale of the dredging. The scale of the sediment that comes in from these deposits that remain, these spoil deposits that remain, is quite a bit smaller.
Q. Dr. Kondolf, on the next page, page 11, there is a section called Preliminary Findings of Recent Changes.
A. Yes.
Q. And can I direct your attention to the middle of that paragraph starting these changes.
A. Yes.
Q. Can you read to the end, and then I'll ask you some questions.
A. Yes.
Q. Now, you testified here that the river is in a period of recovery; but a year ago your team told

the State of Florida that the river may be in a period of recovery. Correct?
A. That's correct.
Q. And, Dr. Kondolf, one thing that this paragraph points out is that very high flows, like 140,000 cfs, almost flood conditions, have a good effect because they wash sand into the river. Correct?
A. I'm not sure I follow you.
Q. That's okay, Dr. Kondolf. Let's move to page -- two pages later. Do you have a chart called figure 2? Do you see that?
A. Yes, I see that.
Q. And each of those stars is a dredge spoil site as documented by the Army Corps in 2001. Correct?
A. Yes.
Q. Can you go two pages later, and there we have another aerial shot of the river. And this shows, again, where the dredge spoils occur along the stretch that you're looking at from river mile 39 to 64. Correct?
A. Well, two pages later it seems to be figure 4, which is something else. Can you specify which figure you're talking about?
Q. Yes. Figure 4 -- oh, I'm sorry. That's tree-line width. This is showing the changes at

tree-line width on figure 4. Correct?
A. That's correct.
Q. Now, let's go to figure 7. It's a couple pages later. It has three horizontal maps of aerial photos of the river.
Mr. Smith put them up vertically, but in your report they're horizontal. Do you see that?
A. Yes.
Q. And the top one is dated 2012. Right?
A. The one on the right, yes.
Q. And those -- the sand that's shown, those are dredge spoils in 2012. Correct?
A. Well, they're -- they're point bars. And in some cases the point bars were augmented by sand deposited from dredge spoils. But I would have to look at the individual ones here.
So, for example, the second one down is -- is probably a natural -- well, let's see. It could be a natural point bar that developed as part of the -- these hook and bays. Certainly, the fourth one down and the fifth one down, those definitely look like they are fresh deposits of sand. So they would not have been dredge spoils but, rather, recently-deposited -- well, the term is -- that's used is part of the hook, this

feature that grows out into the channel and is effectively narrowing the width of the channel.
Q. Dr. Kondolf, can you turn to page 22 of your report, please. And I direct your attention to the bottom of the last paragraph, perhaps four or five lines from the bottom.
A. So page 22, this is the paragraph beginning the daily water surface elevation data?
Q. Yes. The part beginning we chose not to use a further downstream station at Sumatra. Do you see that?
A. Yes.
Q. And what your team is saying here is that there are tidal effects on the river levels south of Sumatra at mile 20, and so they did not attempt to capture river level information for those. Correct?
A. And I -- I didn't write this; but that appears to be what it says, yes.
And, again, I tried to make this distinction yesterday -- I think it's worthwhile -- is down near the Sumatra Gage, that lower part of the river, you have the river floodplain at this level. You have the channel down here. So the tides can go up and down in the channel, but they

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don't affect the surface of the floodplain. So the floodplain surface is affected by higher flows in the river.

So we have to -- it's important to distinguish the river channel itself may be tidal, whereas, the floodplain surface is only affected by riverine flows.

Q. Dr. Kondolf, can you turn to page 31 of your 2015 report to Florida Fish and Wildlife. You have a section called Dredge Spoil in the Floodplain. Correct?

A. That's correct.

Q. At the bottom of that page there's a picture of Sand Mountain taken in 2015?

A. That's correct.

Q. It's still there?

A. Yes. As I said yesterday, Sand Mountain is still there.

Q. And in this section you report to Florida Fish and Wildlife in that first sentence that spoil mounds from past dredging is likely a continual source of sediment. Correct?

A. That's right.

Q. Can you go two pages back now to page 33, and there's a section called Slough and Cutoff

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Inspections and Associated Photography. Do you see that?

A. Yes.

Q. Now, here is another slough that we haven't talked about called Mary Slough. Right?

A. Let's see.

Q. The last line above the caption identifies it as Mary Slough near river mile 58.5. Correct?

A. Yes. Figure B-5 on figures 22 to 24. Let's see.

Okay. I'm not sure that the photograph below -- I don't think that is Mary Slough.

But -- that's a cutoff that's in -- natural cutoff that's in progress.

Q. Okay. Well, let's go to the next page.

A. Okay.

Q. You're disputing, by the way, that this is Mary Slough?

A. I don't think this is Mary Slough.

Q. Okay.

A. No. This is -- so near -- near the Florida River -- I mean, if you like, we could pull out a photo; and I could show you where this is. Near the Florida River there's a very pronounced meander bend in the river. And at flood flow water flows across this meander bend. And so as

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it does that, it erodes out -- it's eroding out a channel.

This is a natural part of river dynamics is that you can get what are called meander cutoffs. So you have a meander bend; and it can cut off in two ways, either a neck cutoff or it's just bank erosion that eventually cuts through. Or you can have what's called a chute cutoff -- C H U T E, not spelled as you would expect. And this -- and this is where during the flood flows the river begins carving out a shortcut channel.

And that's what's happening here. I would expect, you know, in 5 or 10 years' time that the river might be flowing through this channel instead of the existing river. And that's just a natural part of river dynamics.

Q. Dr. Kondolf, can you now turn to page 44 of your November 2015 report. And just to put it in context, if you look at page 43 first, you will see that we're in a section called Mussels.

A. Yes.

Q. And then go to page 44. And I want to direct your attention to the bottom of page 44, and in particular the sentence about five lines from the bottom that starts this survey.

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A. Okay.

Q. Before we go into this, the Latin name A neislerii, do you see that?

A. Yes.

Q. That is the fat threeridge mussel. Correct?

A. I believe so. I'm not an expert on mussels, but I think I recall seeing that that is the Latin name.

Q. You just testified on redirect about the work Dr. Allan was doing on mussels. Correct?

A. Yes.

Q. So you're familiar enough --

A. Yes.

Q. -- to give testimony to the Supreme Court about it?

A. Yes.

Q. Okay. In this report of November 2015, you report to the Florida Fish and Wildlife Commission that the fat threeridge is likely one of the most abundant mussels in the middle reaches of the Apalachicola River. Right?

A. Again, perhaps we should --

Q. My question, sir, was did you report what I just said before the Florida Fish and Wildlife Commission?

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MR. QURESHI: Again, the witness needs to answer your question before you begin the next question, please.

MR. PRIMIS: Your Honor, I won't debate with counsel. Can I just ask you to have the witness give an answer to my narrow question?

SPECIAL MASTER LANCASTER: Just so you should understand, if you can answer the question yes or no, do so. Your counsel can come up and ask for clarification.

A. Okay. I think it would be the least misleading if I pointed out this is a report that was done by multiple authors, and I did not write this section on mussels. Our mussel expert on the team, Michael Gangloff, wrote the section on mussels. So this was not my work here.

Q. Dr. Kondolf, you and your team submitted a report a year ago to Florida Fish and Wildlife saying that the fat threeridge was likely one of the most abundant mussels in the middle reaches. Correct?

A. That is in our report, yes. Again, it's not a section that I wrote or even reviewed; but that -- that's the opinion of -- of my colleague obviously.

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Q. And you said your colleague is Michael Gangloff, who is a mussel expert who included this in your joint report to Florida Fish and Wildlife. Correct?

A. That's correct.

MR. PRIMIS: No further questions, your Honor.

SPECIAL MASTER LANCASTER: Redirect?

REDIRECT EXAMINATION

BY MR. QURESHI:

Q. Very briefly, Dr. Kondolf. What was the purpose of this work that's memorialized in GX-1335?

A. This was a progress report, so we had actually just started our study in the summer. And we had a deadline to produce these, you know, deliverables, they're called, reports or datasets that we -- we were to provide in order to get paid for our initial section of work. And so that's what this reflected.

So this was not a final report in any way. It was simply the deliverables report, essentially a progress report.

Q. And what's your understanding as to why the State of Florida was undertaking this work?

A. Again, the purpose of our study was to develop a

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strong scientific basis for evaluating restoration projects that would benefit mussels in this reach from river mile 40 to 63. And this reach has a lot of what are called hooks and bays. And it's a way that the river channel has been changing apparently to renarrow the riverbed. That seems to be the result of these channel changes.

Q. We went through the report, and counsel for Georgia took particular sentences out of particular sections. Can you tell us as a whole what's the relationship between this report and the conclusions you reached in your direct testimony?

A. The conclusions in my direct testimony stand. I don't -- there's -- this report is -- well, there's some aspects here that -- for example, the -- we talked -- in here we report on the -- our analysis of 2013 aerial imagery showing that there has been narrowing of the river and colonization by vegetation. And that -- that informed my expert opinion that -- some of the experience that I gained from doing this work for Florida Fish and Wildlife Commission.

Q. And the narrowing of the river and the

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colonization represents what?

A. That's a part of the recovery of the river from the past impacts.

Q. And was required for the river to fully recover?

A. To fully recover the river needs flow. It needs adequate flow.

Q. Okay. Thank you, doctor.

MR. PRIMIS: No further questions, your Honor.

SPECIAL MASTER LANCASTER: Doctor, you're going to have to help me here. I'm not sure that I'm familiar with the topics. But GX-1335 bears your name in part as --

THE WITNESS: Yes.

SPECIAL MASTER LANCASTER: -- as an author.

THE WITNESS: Yes.

SPECIAL MASTER LANCASTER: And your testimony is that you did not write certain parts of this; is that correct?

THE WITNESS: That's right.

SPECIAL MASTER LANCASTER: Did you read it all?

THE WITNESS: I don't -- I don't think I read the mussel part. But I read other -- I

think I read all the other parts.
SPECIAL MASTER LANCASTER: Did you approve of this report in total?
THE WITNESS: Yes. I would say there was -- it was kind of a last-minute thing to pull it together, I think, amongst all of us on the team. But, yes.
SPECIAL MASTER LANCASTER: Are you familiar with the tri-state Compact?
THE WITNESS: Unfortunately, I'm not.
SPECIAL MASTER LANCASTER: Are you familiar with the ACF Stakeholders Sustainable Water Management Plan?
THE WITNESS: I have heard of it, but I'm not familiar with it.
SPECIAL MASTER LANCASTER: You told me and the rest of the crew about your extensive experience with rivers worldwide. Do you know anything about the Penobscot?
THE WITNESS: Not much, I -- I confess.
SPECIAL MASTER LANCASTER: You know it's in Maine?
THE WITNESS: I know it's in Maine.
SPECIAL MASTER LANCASTER: I have been improving my vocabulary since this thing

started. I now understand what riverine is. What is fluvial?
THE WITNESS: Fluvial is the same. It's just the Latin-based word. Fluvius from Latin for river. So fluvial just refers to something pertaining to rivers.
SPECIAL MASTER LANCASTER: Further direct?
Further cross?
MR. PRIMIS: No, your Honor.
MR. QURESHI: Nothing further, your Honor.
SPECIAL MASTER LANCASTER: Thank you very much.
THE WITNESS: Okay. Thank you.
SPECIAL MASTER LANCASTER: Why don't we recess.
(Time Noted: 10:26 a.m.)
(Recess Called)
(Time Noted: 10:40 a.m.)
MR. PERRY: Good mourning, your Honor.
SPECIAL MASTER LANCASTER: Good morning.
MR. PERRY: Florida would like to call David Sunding, who is Florida's agricultural and natural resources economist. He is also

an expert on specific practical measures that have been applied to limit agricultural and municipal water use across the country for the benefit of the environment.
THE CLERK: Please raise your right hand.
Do you solemnly swear that the testimony you shall give in the cause now in hearing shall be the truth, the whole truth, and nothing but the truth, so help you God?
THE WITNESS: I do.
THE CLERK: Please be seated.
Pull yourself right up to the microphone and please state your name and spell your last name.
THE WITNESS: Let me get some water.
My name is David Sunding. My last name is spelled S U N D I N G.
MR. PERRY: Your Honor, may we approach to provide the witness with the --
SPECIAL MASTER LANCASTER: Thank you.

DIRECT EXAMINATION

BY MR. PERRY:
Q. Dr. Sunding, do you adopt that prefiled direct testimony as your testimony in this case?

A. I do.
Q. Thank you.
MR. PRIMIS: Your Honor, we have -- again, I'm going to hand out some documents for the cross-examination.
SPECIAL MASTER LANCASTER: Sure.

CROSS-EXAMINATION

BY MR. PRIMIS:
Q. Good morning, Dr. Sunding.
A. Good morning.
MR. PRIMIS: Your Honor, just to explain what we have done here, there are a number of lengthy expert reports that bear on Dr. Sunding's testimony; but there's really two or three pages that we're going to come back to again and again. So I have just excerpted them, stapled them, and put them in the sleeve.
BY MR. PRIMIS:
Q. And, Dr. Sunding, are you able to recognize these as tables from your reports which we have just copied and pasted into a single demonstrative?
A. Yes. That appears to be the case.
Q. Okay. Dr. Sunding, you were first retained by Florida for this case around 2006 or 2007.

Correct?
A. Yes.
Q. And you have been working on becoming familiar with the issues in this case for almost a decade. True?
A. Sure. With varying levels of intensity during different time periods.
Q. Doctor --
A. My early involvement was not too much.
Q. Dr. Sunding, can you just bring the microphone closer?
A. Sure. I'll scoot the chair up.
There you go.
Q. Are you good?
A. Is that better?
Q. Yes.
One deficit that you have is you haven't been here every day, so the lawyers know all the tricks of the trade at this point. And the microphone is a big one.
A. All right.
Q. As is speaking slowly.
A. All right.
Q. So, Dr. Sunding, you're an economist by trade. Correct?

A. I am.
Q. And your opinions in this case focus on what you believe Georgia could do in terms of cost effective conservation measures for water. Correct?
A. That's a large part of what I'm testifying about.
Q. Okay. I'm just trying to set the stage. We'll get to your opinions.
Before I do go to your opinions, I just want to make clear some of the things that you're not offering opinions about in this case, okay, to define your role.
Now, after being involved in this case for almost a decade, you didn't -- you haven't disclosed any opinions in your expert reports about the economic impact of harm to Florida due to Georgia's water use. Correct?
A. I don't think that's right.
Q. Let me get your deposition transcript.
MR. PRIMIS: May I approach, your Honor?
BY MR. PRIMIS:
Q. Dr. Sunding, you were deposed in this case. Correct?
A. I was.
Q. And you were under oath and told the truth.

Correct?
A. Absolutely.
Q. Okay. Could you turn to page 24, line 20.
MR. PRIMIS: And I would ask Mr. Smith to play clips 322 and 323.
(Whereupon the video was played.)
BY MR. PRIMIS:
Q. Dr. Sunding, were you asked those questions; and did you give those answers?
A. Yes. And I still believe they're accurate.
Q. Now, you did not analyze any biologic or hydrologic impacts of Georgia's consumptive use in Florida. Correct?
A. No. That was in the domain of other experts.
Q. You would agree that you could have analyzed the value of Florida's commercial oyster or fishing industries under certain Georgia consumptive use assumptions; is that correct?
A. Are you talking about an increment or a total value of, say, commercial landings?
Q. Dr. Sunding, you haven't analyzed Florida's oyster or commercial fishing industries in this case. Correct?
A. No. I think that was included in Dr. Phaneuf's expert report. I don't remember reporting on a

value of the commercial fishery.
Q. For oysters or fish. Correct?
A. No.
Q. And you mentioned Dr. Phaneuf. Correct?
A. Yes.
MR. PRIMIS: That's P H A N E U F.
BY MR. PRIMIS:
Q. Dr. Sunding, you understand he's not coming to trial and providing testimony?
A. That's my understanding.
Q. Now, you haven't disclosed any opinions about harm to the commercial oyster industry in Florida. Right?
A. No. I did not analyze, say, what would be a change in revenue or economic activity in the commercial fishery as a result of changes in Georgia's consumption.
Q. You didn't analyze the monetary or economic impact of alleged harm to mussels in Florida; correct?
A. That's right. I don't believe that's possible to do reliably.
Q. You didn't analyze the economic or monetary impact relating to alleged harm to trees or plants in the ACF Basin. Correct?

A. Yes. Again, just so we're tracking the way -- when you say impact, what I'm hearing is change. So I analyzed the fact that there was injury, but I didn't analyze a change.

Q. Can you turn to page 15, line 1, of your deposition, Dr. Sunding.

MR. PRIMIS: And, Mr. Smith, could you play clips 6, 7, and 8 which go from 15, line 1 to line 11.

(Whereupon the video was played.)

BY MR. PRIMIS:

Q. Were you asked those questions --

MR. PERRY: Your Honor?

BY MR. PRIMIS:

Q. -- and did you give that answer?

MR. PERRY: I'm sorry. Your Honor, might I note that the transcript actually reads just a bit differently than the clip that was played because the clip omits the objections.

BY MR. PRIMIS:

Q. Were you asked those questions, and did you give that answer?

A. Yes. And I think it's consistent with what I just said.

Q. Now, Dr. Sunding, you conducted a survey in this case which asked residents of Florida, Georgia, and Alabama questions about the resources in the ACF Basin. Correct?

A. I did. That's right.

Q. Okay. We're going to come back to this later, but I just want to ask you; apart from the survey, you would agree that you have not attempted to quantify in any economic or monetary sense the impact on Florida of Georgia's consumptive water use. True?

A. That's largely true. I would add one exception to that. In my direct testimony I also noted the amount of resources that the State of Florida has spent conserving land in the Apalachicola region.

Q. Dr. Sunding, can you turn to page 16, line 21, of your transcript, and going through page 17, line 1. And does it say there, apart from the survey, have you attempted to quantify in any economic or monetary sense the impact on Florida of Georgia's consumptive water use?

And after an objection to form, you said, nothing comes to mind, no.

Were you asked that question, and did you give that answer?

A. Yes. And I stand by that. You were asking me about what I quantified. I added one -- I added one -- you know, one qualification to the answer, which is that I also reported on what others testified about the amount of resources that Florida has dedicated to preserving land in the Apalachicola.

Q. I would just like a clean answer to this question. Were you asked the question posed at 16, 21; and did you give the answer at line 17, 1 of your deposition under oath?

A. Yes. Absolutely.

Q. I want to ask you some questions now about causation, sir. Okay?

A. All right.

Q. You would agree that as a general matter, it is important to eliminate other variables that could have contributed to the harm alleged. Correct?

A. Could you help me out with the context? Is that just a general statement or with respect to some specific situation?

Q. Dr. Sunding, can you answer that question?

A. I can't without more detail.

Q. Okay.

A. I want to make sure I know what you're talking about.

Q. Can you turn to your deposition transcript where it appeared you knew what I was talking about. Page 19, line 3.

MR. PRIMIS: And, Mr. Smith, could you play clip 228.

(Whereupon the video was played.)

BY MR. PRIMIS:

Q. Were you asked that question, and did you give that answer?

A. Yes. In the context of a much longer discussion about biological issues.

Q. Dr. Sunding, you have not personally undertaken to do an analysis of what other -- of eliminating what other variables could have contributed to the harm alleged in this case. True?

A. I think that's right.

Q. Now, I understand that you have had discussion with other Florida experts about causation; but to be clear, you personally are not offering any expert opinion on whether Georgia's water use has caused the harm to Florida that's alleged. Correct?

A. I think that's right. I'm an economist, not a biologist or ecologist.

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Q. Now, can you turn to paragraph 35 of your written direct testimony. And we have included it in your binder. There is a tab called Sunding Direct; but I think you each have a loose copy of it, too. And specifically I want to ask you about paragraph 35. Have you had a chance to look at that?

A. Yes. I read the paragraph.

Q. Okay. And, Dr. Sunding, your view is that the Apalachicola is a large ecosystem. Correct?

A. Sure. Yes.

Q. And it's your sworn testimony that changes in streamflows will impact this ecosystem in ways that are complex and multifaceted. Right?

A. Yes. That's reflecting my understanding as an economist of what the biologists have testified to.

Q. And your testimony is that the changes in streamflows will impact this ecosystem in complex and multifaceted ways. Right?

A. That's my understanding, yes.

Q. And, in fact, it's your view that it's difficult for people to comprehend the ways in which those streamflows could impact the ecosystem. Correct?

A. Yes.

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Q. Now, Dr. Sunding, as an economist, you routinely look at costs and benefits of proposed actions. Correct?

A. That is true, yes.

Q. And you would agree that comparing the costs and benefits of an environmental policy is a standard means of evaluating whether it is socially desirable. Correct?

A. I do agree with that as a general matter, although I gave a lot more context and some other opinions in my testimony.

Q. Now, can you turn to paragraph 39 of your direct.

A. I -- just give me a second to read it.

Q. Sure.

A. All right. I see it.

Q. In paragraph 39 you say that the actions that you proposed would enable Georgia to cap its annual consumptive use of water at current levels at minimal incremental cost and would provide substantial environmental benefits to Florida in both drought and nondrought years.

And that's your sworn testimony. Right?

A. Yes.

Q. Now, after you had been working on this case on and off for 10 years, none of the other experts

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in this case have provided expert opinions that quantify the benefits to Florida from your proposed conservation measures. Are you aware of that?

A. I guess I'm confused by your question because my understanding was that -- at least Dr. Allan had looked at a thousand cfs.

Q. Well, let me reframe my question. After working on this case for 10 years, none of your expert reports provide expert opinions that quantify the benefits to Florida from your proposed conservation measures. Correct?

A. That's right. They quantify an incremental change in economic welfare.

Q. Okay. Now, you mentioned Dr. Allan. And I do now want to talk about a couple of Florida's biology and ecology experts. Okay?

You understand that a series of Florida's environmental experts and biological experts modeled the impacts of a remedy scenario. Correct?

A. I do understand that.

Q. And you understand that the remedy scenario that they modeled involved a proposed 50 percent reduction in agricultural water usage, a 50

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percent reduction in evaporation from small impoundments, and the elimination of all interbasin transfers in the ACF Basin. Are you aware of that?

A. That all sounds familiar.

Q. And that's not a specific thing that you recommended. That came from Dr. Flewelling. Right?

A. I'm not sure who it came from.

Q. Hornberger or Flewelling, someone else; right?

A. Yes.

Q. We have a tab in your binder called Florida Experts -- FLA Experts. It's all the way at the back.

Just let me know when you're there, Dr. Sunding.

The first page says Greenblatt. Correct?

A. Oh, it is way at the back.

Q. Way in the back.

A. Got it.

Q. I'm just going to give the Court a moment to get there.

MR. PRIMIS: Are you there?

BY MR. PRIMIS:

Q. So we have here a demonstrative from Marcia

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Greenblatt's direct testimony. And do you know who Dr. Greenblatt is?
A. No, I don't.
Q. Your not aware that she's Florida's expert on salinity patterns in Apalachicola Bay?
A. No.
Q. Dr. Sunding, I just want to ask you as a follow-up to your testimony that Georgia's reduction in use will provide substantial environmental benefits, did you take into account Dr. Greenblatt's testimony that the remedy scenario she ran would result in somewhere less than 1 part per thousand reduction in salinity in Apalachicola Bay?
A. No. I never have seen this before. I don't know who she is.
Q. So you're not aware that the white parts depicted in Dr. Greenblatt's exhibit indicate less than 1 part per thousand with the cuts that --
MR. PERRY: Objection, mischaracterization.
A. No, I'm not familiar with this document at all.
Q. Okay. Let's go to the second tab -- I'm sorry, the second slide behind Florida Experts. And we have excerpted a chart here from Dr. Allan's expert report regarding the tupelo trees. Have

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you seen this one before?
A. I may have seen this one before. I also spoke with Dr. Allan about how he was quantifying impacts. But this particular table does not look familiar.
Q. All right. Now, with regard to the substantial environmental benefits to Florida, you're aware that when Dr. Allan ran the remedy scenario with the 50 percent reduction in agricultural irrigation, that he showed that for the tupelo trees on his 10 percent metric, you got 29 fewer days of harm over 16 years. Were you aware of that?
A. Again, you're picking a table out of his report. I'm not familiar enough with this to give an opinion about it.
Q. Are the 29 days benefit to the tupelo trees over 16 years a substantial environmental benefit?
A. Well, when I made that statement, I wasn't referring just to the tupelo trees. There are, as you know, a number of species that Dr. Allan examined.
Q. Okay.
A. So it would have -- the tupelos would have been part of it, but not the entirety by any means.

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Q. When -- how about Dr. Wilson White; are you familiar with him?
A. No.
Q. Let's turn to the next demonstrative.
Now, you don't recognize Dr. White as an oyster on -- I'm sorry, an expert on oysters?
A. No.
Q. And you're not aware that he ran the remedy scenario through his model to see what kind of change there would be in oyster biomass?
A. No. He was not one of the experts that I interacted with.
Q. So I take it then you're not familiar with the chart we have included here from page 50 of his direct testimony which shows a maximum change in oyster biomass, running the 50 percent reduction scenario, of a little over 1 percent?
A. No. I have never seen this table before or this figure before.
Q. And so you have no opinion whether Dr. White's 1 percent change, would that type of reduction in Georgia be a substantial environmental benefit. Correct?
MR. PERRY: Objection, mischaracterization.
A. No.

2762

Q. Now, can you turn to FX-784. It's your first expert report, and Florida gave it an exhibit number for identification. So it's the first tab.
A. All right. I see it.
Q. Now, after having been involved in this case on and off for a decade, this was the initial report that you submitted in this matter. Correct?
A. Yes, it was.
Q. Page 1 of the report has your statement of opinions -- it's actually page 3.
A. Yes, it does.
Q. And then if you go to page 9, there's a table. Correct?
A. Yes, there is. I think it's the same one you excerpted in the handout you gave me earlier.
Q. Correct, sir.
And you include in your statement of opinions this table which shows four different scenarios for conservation in Georgia of a thousand cfs at peak summer streamflow. Correct?
A. That's right.
Q. Now, your report back on page 86 also has a much smaller table that you said could get you up to 1500. Correct?

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A. Yes. I looked at both a thousand and 1500 cfs reductions.
Q. And when you summarized four different scenarios in the statement of opinions up front, you included these four scenarios for a thousand. Right?
A. That's right.
Q. Now, did you review the testimony of Dr. Hornberger in this trial?
A. I did.
Q. So you saw the transcript of his testimony here in Maine?
A. Over the live testimony here in court, no --
Q. Yes.
A. -- I don't think I saw that.
Q. Okay. You should get it. There are draft transcripts which are actually outstanding quality, and you can review them.

So Dr. Sunding, when Dr. Hornberger was here, he testified that in all of his modeling, the only thing he modeled from you was a 1,000 cfs scenario. Are you aware of that?
A. That -- that is consistent with my memory. So it wouldn't surprise me that he would say that.
Q. Now, you did a second report in this case.

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Right?
A. You mean the defensive report?
Q. Yes.
A. Yes.
Q. So about three months after this initial report with the four 1,000 cfs scenarios, you submitted a second report, which we have at FX-801. And this one is dated May 20, 2016. Correct?
A. That's right.
Q. Now, having laid out the four 1,000 cfs scenarios in February, if you look at page 2 of FX-801, we now see a scenario that gets us up to 2,000 cfs. Correct?
A. It's actually page 3, isn't it, paragraph 8?
Q. I have paragraph 6 on page 2.
A. No. I don't think that's right.
Q. Can I approach and just make sure we're looking at the same thing?
A. My gosh. I have the wrong thing. Let me --
Q. I knew there would come a point where I would have to say I was wrong to Dr. Sunding, but it's not this time.
A. Not this time, no.
Q. I'm banking it.
A. All right. Paragraph 2, yes; you're right.

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Q. So here in paragraph 2 in May of 2016 you outlined a scenario to get to 2,000 cfs in peak summer streamflow. Correct?
A. That's right.
Q. Now, the 2,000 cfs scenario -- and now, it might just be easier to flip -- use these -- the charts in the sleeve.
A. All right.
Q. I'm now focusing on the May report, which is the second page of this little handout.

When you did the 2,000 cfs scenario, your report assumed hydrology conditions in 2011. Right?
A. That's right.
Q. And just so the Court understands, that essentially means the rainfall and the runoff and the usage of 2011. Correct?
A. That is right.
Q. And you evaluated 2011 hydrology, and then you said we can get 2,000 if we use those assumptions. Right?
A. Yes. So there's a given level of demand of 2011 hydrology, meaning that amount of precipitation; and then I considered reductions from the amount of consumptive use that occurred in 2011.

2766

Q. Okay. Now, Dr. Sunding, I want to focus on the municipal and industrial portion of this 2000 scenario. Okay?
A. All right.
Q. And you understand that sometimes you say M & I. Right?
A. I do.

MR. PRIMIS: And that's an M, ampersand, I.

BY MR. PRIMIS:

Q. So focusing on the M & I aspects here, we have municipal outdoor water use for 385. Right?
A. That's right.
Q. And we have municipal leak abatement for 95?
A. That's right.
Q. And 66 cfs from eliminating net basin exports. Right?
A. You're right.
Q. And if you tally those up, would you agree that you get about 546?
A. Yes.
Q. Okay. I don't have a calculator. We had calculator issues yesterday, but the math here is a lot easier.

Now, you know Dr. Flewelling. Right?
A. I do.

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Q. And you know that Dr. Flewelling estimated Georgia's total M & I consumption over a period of about 20 years. Correct?
A. Yes. I know that he did that.
Q. Okay.
MR. PRIMIS: Mr. Smith, can you put up --
BY MR. PRIMIS:
Q. Actually, we have a demonstrative of this. If you go to the tab called Georgia Demonstratives -- I'm sorry, Sunding Demonstratives. We gave you your own tab.
The first one is a depiction of figure ES.2 from Dr. Flewelling's expert report at page 3.
And if you look at 2011, Dr. Flewelling estimated Georgia's M & I consumption at just a shade over 500 cfs. Right?
A. I think that -- this is, yes, information that was in Dr. Flewelling's report from the consumptive use database.
Q. Right. I just want to get at the figure. He's at about 500 cfs. Right?
A. It is.
Q. Now, we drew a line across here that represented your 545 cfs number for M & I in 2011. And you

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will see, sir, that it is higher than the total amount of consumption estimated by Dr. Flewelling. Isn't that right?
A. No. That's not right.
Q. For --
A. You're comparing things that should not be compared.
Q. Okay. Well, then you can clarify that when Mr. Perry is up. But right now, I want to ask you does the red line showing your 545 cfs number exceed the number calculated by Dr. Flewelling using the methodology here in his table, which was about 500 cfs?
A. Well, it's difficult for me to answer because I'm not proposing a 545 cfs reduction in every year, which is what a line implies.
There are a number of other errors in this comparison, but I do agree with you that the -- the M & I reduction that we just added up is 545; and that is greater than the amount of consumptive use that's shown on this table from this figure. But I do hope we come back to this because I don't think that's an accurate way to compare things.
Q. Okay. And I just want to be very specific. Your

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545 cfs reduction assumed 2011 conditions. Right?
A. Yes.
Q. And I'm just asking about 2011 from Dr. Flewelling. Your reduction under 2011 conditions exceeds what Dr. Flewelling calculated as Georgia's consumptive use in 2011. Right?
A. It exceeds his calculation of this part of Georgia's consumptive use.
Q. Right. The M & I part?
A. No. Even beyond that. There is M & I consumptive use that's not shown in this figure.
Q. Now, I take it, Dr. Sunding, you're not suggesting that metro Atlanta should cut its water use by 100 percent. Right?
A. No. I have never suggested that.
And let's be careful when we go back and forth between water use and consumptive use, because they are different, as you know.
Q. Dr. Sunding, did you ever go back to Dr. Flewelling and say, hey, I'm looking at streamflow contributions in peak summer months of 546 out of M & I reductions. Does Georgia even use that much on M & I?
Did you have that conversation with him?

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A. Sure. We have had conversations all throughout the process of developing my analysis.
Q. Can you turn to page 126, line 16, of your deposition, sir.
MR. PRIMIS: And, Mr. Smith, I would ask you to play the clip from 126, line 16 to line 21.
(Whereupon the video was played.)
BY MR. PRIMIS:
Q. Dr. Sunding, were you asked that question; and did you give that answer?
A. I did.
Q. Okay. Now, I would like to look at the estimated M & I savings that you included in your direct testimony in this case. Okay?
A. So you're talking the direct testimony is the last report that I did?
Q. The --
A. The most recent one?
Q. The most recent one we think of as your written direct testimony.
A. All right. Got it.
Q. It's not an expert report.
And that one appears in paragraph 90 of your written direct. And, again, I'm still going to

be focusing on M & I. Do you see that?
A. Yes.
Q. Now, if we add up those same three items from your written direct testimony, that being leak abatement, reduced municipal outdoor use, and eliminate net basin exports, the combined effect of those has shrunk. Right?
A. Yes, because of examining different policies.
Q. Right. You changed the policies you examined; and you went from 546 cfs reduction for M & I, and you reduced it to 315. Correct?
A. That's right.
Q. And just let's be fair, Dr. Sunding. You didn't just change the policies; right? You corrected some errors that reduced the number?
A. That's right. That's true as well. There were -- there were at least two issues that I can think of now that I corrected; and then I also changed the policy. I considered different implementation of the outdoor water use restrictions.
Q. And you changed that policy that you looked at after the time of your deposition. Correct?
A. Sure. But my testimony was always about evaluating economic impacts across a whole range

of policies.
Q. Dr. Sunding, when you went from 546 cfs for M & I and reduced it to 315 through error corrections and policy changes, you reduced the amount by 42 percent of what you were recommending Georgia do to conserve for M & I. Correct?
A. Well, there are a couple of issues. I'm not recommending anything. I'm examining the cost of different conservation scenarios.
But, yes, it did go down by -- I'll accept your number -- 42 percent.
Q. And I do want to pause on something you just said. It is true, sir, that you're not recommending any particular policy to the Supreme Court; you're just evaluating different potential options and their costs. Correct?
A. Yes. And I can offer testimony and have about which policies might be the most economical for Georgia to implement. But it's the State of Florida that's bringing the complaint.
Q. Now, we don't need to put the chart back up; but you will recall for 2011 conditions Dr. Flewelling had about 500 cfs of consumptive use by metro Atlanta. Right?
A. Understanding that that's not total consumptive

use, yes; that's the number that was on his figure.
Q. And so 315 is still about 60 percent of what Dr. Flewelling had in this figure. Correct?
A. Of consumptive use, yes.
Q. Okay. So now, I want to switch from M & I over to agricultural usage. And we can stick with your 2,000 cfs scenario. And this, again, is page 3 of the handout or paragraph 90 in your written direct.
I find it easier to use the handout.
A. Okay.
Q. But I'll defer to everyone's preference.
A. Okay. So I would like to turn to the right page in my direct. So it's page 3 of the handout or -- what's the right page in my direct?
Q. It's paragraph 90.
MR. PERRY: Page 44.
MR. PRIMIS: Or page 44.
MR. PERRY: The handout, I believe, is from your report -- the first report.
MR. PRIMIS: This -- your Honor, this was a source of some confusion at Dr. Sunding's deposition because there are different sets of numbers. Just -- I want to

be clear what I have handed out.
BY MR. PRIMIS:
Q. This three-page demonstrative tucked in the sleeve, Dr. Sunding, the first table is from your February expert report. And it's the four 1,000 cfs scenarios. The second page is the 2,000 cfs reduction chart from your second expert report. And the third page is the 2,000 cfs chart from your written direct.
A. Yes.
MR. PRIMIS: And, your Honor, they are all a little different; so it matters which page we're on.
BY MR. PRIMIS:
Q. And I will just say that for the third page of this demonstrative, the 2,000 cfs from your written direct, it indeed appears on page 44 of your written direct testimony. Correct?
A. Yes. Okay.
Now, I'm with you.
Q. Okay. Now, in the 2,000 column you have six different scenarios that sum up to a certain amount of savings in agricultural water usage. Right?
A. I would just describe it a little differently. I

have six different conservation measures that produce different amounts of consumptive use savings --

Q. Right.

A. -- in agriculture.

Q. That's fair. The first three on the chart are M & I, and then everything under eliminate net basin exports is agricultural?

A. That's correct.

Q. And there are six agricultural conservation scenarios. Right?

A. Yes.

Q. Now, when you add up in the 2,000 column all the agricultural ones, you get 1,685 cfs savings in peak summer streamflow under your direct testimony. Correct?

A. Yes. And just so I'm clear, are you referring to the column that's labeled .6 Connectivity?

Q. Yes.

A. All right, yes. I will take your word for the math.

Q. That's the only column you have got that adds up to 2,000. Correct?

A. That's right.

Q. So that's -- it sums up to 1,685 cfs in peak

summer streamflow savings. And, Dr. Sunding, you know that Georgia's agricultural water use is actually lower than 1,685 cfs; is that right?

A. I don't know that, no. I think that's wrong.

Q. Okay. And let's say even under your scenario, if you wanted to reduce agricultural water use by 50 percent in Georgia, that would imply that Georgia would have to use at least 3,370 cfs in peak summer streamflow. Correct?

A. If -- so if I wanted to reduce streamflow depletions by -- give me the question again.

Q. Sure.

A. Let me make sure I'm getting you.

Q. If you have a recommendation -- if you have a set of -- not recommendations, sorry. If you have a set of scenarios that total up to 1,685 cfs benefit at peak summer streamflow, you would -- Georgia would have to use at least twice that if you were targeting a 50 percent reduction. Right?

It's just simple math.

A. Well, yes. But the thing I'm thinking about, not all agricultural water use has the same impact on streamflow, as you know. Pumping right next to the stream has more connectivity than pumping

further away. So I would have to think through that aspect of it.

Q. With the qualification you just gave, you would actually need to have more Georgia water use than double 1,685, correct, because you don't get one to one out of the groundwater. Right?

A. I think that's right, yes.

Q. All right. So if the charge here were, Georgia, you got to cut by 50 percent -- or you would have to actually cut more -- Georgia would have to use more than 3500 cfs for agriculture. Right?

A. Under the assumptions you just laid out, yes.

Q. Now, can you turn in your binder to the tab called Complaint -- Florida Complaint, and turn to page 21. Do you see the Prayer For Relief on page 21 of the Complaint?

A. I do.

Q. In the second paragraph Florida told the Supreme Court that it would like it to enter an Order capping Georgia's overall depleted water uses at the level then existing on January 3, 1992. Do you see that?

A. Yes.

Q. And you were working with Florida at the time this complaint got filed. Right?

A. Yes. I didn't have a role in writing this, of course; but I had been doing work for Florida for a while before this was written.

Q. You were aware that Florida was seeking a return to January 1992 depleted water use levels in Georgia?

A. I'm not sure if I did or not.

Q. You have become aware of it during this case though. Right?

A. I have heard 1992 come up. My feeling is that's a -- that's largely a legal issue. I haven't -- I haven't given that an excessive amount of thought.

Q. You haven't calculated anything to figure out what 1992 conditions were?

A. No. I have some testimony on that point in my first report, about the cost of reducing consumptive use relative to different baselines. And I did calculate the cost of achieving a given level of streamflow starting at 1992 levels.

Q. You anticipated where I was going. So, Dr. Sunding, you would agree with me that when you proposed the 1,000 cfs reduction, you understand that that would have actually taken Georgia to a level of water use lower than 1992

levels. Correct?
A. I'm not sure of that.
Q. Well, you recall in your expert report you estimated how much it would be to get to 1992. Correct?
A. I -- that's not quite what I remember.
Q. Okay.
A. I'm trying to turn to the page where I did that.
Q. Sure. Turn to page 7 of your first report, which is the first tab, FX-784.
A. All right. I'm at page 7.
Q. And on page 7 you analyze the cost of your 1,000 cfs scenario, assuming that Georgia's irrigated acreage have remained at 1992 levels. Correct?
A. Well, I think it's actually -- just so we're tracking, I think it's actually sort of the inverse of what you said. I was starting from a 1992 level of consumption and then going down to the same level of streamflow you would get to by reducing by a thousand from 2011.
Q. Right. And this is getting a little confusing, so I'm going to try and clarify it. You looked at how much it would cost to get from 2011 down to 1992. Correct?
A. I didn't cost that.

Q. But you then concluded that it would actually cost more to get to your 1,000 cfs level. Right?
There is an incremental cost to go from 1992 levels to your 1,000 cfs level. Correct?
A. Which is less than the cost, yes. But I want to make sure we're understanding each other. What I wrote about in my first report was the cost of reading -- or reaching a given streamflow target starting at 1992 levels or 2011 levels.
Q. Okay. Fine. So if we have the thousand cfs level, it would cost this much to get to 1992; and then it costs more to get up to 2011. Right?
A. Yes, but working the other way around. You start with the status quo level of consumption and then work down to a given streamflow level.
Q. Yes.
MR. PRIMIS: I'm sorry, your Honor. We're getting a little bogged down.
BY MR. PRIMIS:
Q. But the basic point I'm trying to establish, Dr. Sunding, is that when you went from -- you compared 1,000 cfs versus 2011 and 1,000 cfs versus 1992. Right?
A. Yes.
Q. And you make the point if Georgia had just stayed

at 1992 levels, it would cost them less to get to 1,000 cfs streamflow benefit now. Right?
A. Yes.
Q. And implicit in that, isn't it, sir, that you would have to have a greater reduction at the 1,000 cfs level than to be at the 1992 level?
A. Yes. And I'm going to answer it this way. I think I get your question, but I really want to make sure we're on the same page with this.
What I wrote about in my first report was we have three levels of streamflow. There's the 2011, 1992, and then where you get to if you subtract a thousand cfs off of the 2011 actual. And so I examined the cost of going from 2011 actual to 1,000 minus that, and then from 1992 actual down to the same level of streamflow. But if Georgia had capped its consumption at 1992 levels, my testimony is that it would cost less to reach that same streamflow target than if it allowed consumption to grow to what it actually did.
Q. And because there is a cost to go from 1992 levels down to a 1,000 cfs level, you would agree that you need to cut more than 1992 levels to get to a thousand. Correct?

A. Yes. That -- that cost is positive. So it implies that you would have to go down below 1992 levels.
Q. Correct. And if you take the cfs savings from the thousand and then add another thousand on top to 2,000, we're a lot lower than what Georgia was using in 1992. Correct?
A. Sure. That's how the math would work.
MR. PRIMIS: Your Honor, I just need one moment. I am going to do a little math in a minute.
I want to be mindful of the clock. And we can break whenever; but I -- I can probably do this in 15 to 20 minutes. Not finish, but get through this part.
SPECIAL MASTER LANCASTER: Proceed.
MR. PRIMIS: Thank you.
And my colleague Mr. Sturek -- Ken Sturek -- is going to help me set up that easel.
BY MR. PRIMIS:
Q. So, Dr. Sunding, on your estimated costs tied to the streamflow benefits, I want to look now at your first report, which is the first page of that three-page handout.

A. All right.
Q. So you -- you have some costs in this chart. And I just want to be clear. When you say cost per year, that's -- that's averaged out over a three-year period. Correct?
A. Well, it's a -- it's an average cost that's borne every year to achieve certain conservation savings in dry years. So I have tried to adjust for the fact that many of these conservation measures aren't needed every year.
Q. And you assume in your analysis that dry years occur --
MR. PRIMIS: Ken, bring it over here, please.
BY MR. PRIMIS:
Q. You assume that --
MR. PRIMIS: Turn it around.
BY MR. PRIMIS:
Q. You assume that dry years occur once every three years. Right?
A. Yes. That was an assumption that I was given by the hydrology team for Florida.
Q. And so if you wanted to determine the cost of any of these measures here in your first expert report, in the dry year itself you actually need

to multiply the estimate by 3. Correct?
A. Yes. For at least some of it.
Q. So it's the same principle in your direct testimony. True -- too, correct?
If you want to estimate the cost of achieving some of these streamflow benefits in the dry year, you have to multiply the cost estimate by 3. Correct?
A. Yes. Again, understanding that some of these measures in table 4 are permanent measures that would be undertaken every year; and some are measures that are just undertaken in dry years.
Q. And you would agree that sometimes droughts happen in back-to-back years. Right?
A. Absolutely.
Q. And if there are two consecutive years of drought, you have to take that one-year cost and then incur it two years in a row. Correct?
A. Yes.
Q. So I want to compare the dry year math from your first report to your direct testimony. Okay?
A. All right.
Q. Now, on page -- it's page 9 of your first report; but it's right here in this handy flier we gave out.

For the first scenario, you estimate a cost per year for deficit irrigation of $64 million. Right?
A. All right.
Q. Do you see that?
A. Yes.
Q. And that would get you a summer streamflow benefit of a thousand cfs. Right?
A. Yes.
Q. And if you multiply that by 3 to get the single dry year cost, it's actually $190 million. Right?
A. Yes.
Q. So then if we go to the third page of your -- of the handout, we have the table from your direct testimony. Right?
A. Yes.
Q. And you have a total cost for the 2,000 scenario of $35.2 million. Right?
A. Yes.
Q. And if you multiply that by 3 you get 105 million. True?
A. 35 times 3 is 100 million roughly, a little more. But I'm feeling uncomfortable with where I think you're heading.

Q. That's part of the plan, Dr. Sunding.
So in February of 2016, for scenario 1, deficit irrigation, you said you could get a thousand cfs. Right?
A. Yes.
Q. And the cost that we just figured out with the multiplication was --
A. $64 million.
Q. Times 3. And the dry year is 190 million. Correct?
A. Yes.
Q. And then in October of 2016, you said we could get 2,000 cfs for a total of 105 million. Correct?
MR. PERRY: Your Honor, I think Mr. Primis is referring to the prefiled direct. Is that correct?
MR. PRIMIS: I'm sorry if I misspoke.
BY MR. PRIMIS:
Q. In your prefiled written direct in October of 2016, the single dry year cost to get 2,000 cfs is about $105 million. Correct?
A. But, again, the reason -- part of the reason I'm uncomfortable with this is I think you probably know that some of the measures I'm talking about

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here are not dry year only measures. So it's not proper to compound the cost the way you're trying to do.

Q. Dr. Sunding, would it cost less than $105 million to achieve 2,000 cfs in a single year?

A. If you looked at just a drought year, yes. Because some of these other measures are done every year. And it's not proper to attribute all the costs to just the dry years.

Q. But you do agree that as you initially analyzed it, it would have cost $190 million in a single year to get 1,000 cfs. Right?

A. Yes.

Q. Now, let's talk about why some of your costs went down, Dr. Sunding.

A. Sure.

Q. If we focus on the first report, in the chart you have some estimates for reductions in municipal outdoor use.

A. Yes. That's right.

Q. And you were -- we're focusing now -- this is the first page of that handout, page 9 of your first expert report. You costed out 20 percent and 30 percent reductions in outdoor water use. Right?

A. I think that's right. Yes.

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Q. And you said that would cost Georgia 22 million for a 20 percent reduction and 40 million for a 30 percent reduction. Right?

A. It would cost Georgia water consumers that much in consumer surplus loss.

Q. And these are the types of scenarios where you would have to multiply it by three to get the single year cost, right, because these are drought year measures?

A. Yes.

Q. And so if we do the same type of math we did in a drought year, you would estimate that the cost would be $66 million for a 20 percent reduction in municipal outdoor water use, and 120 million to get it up to 30 percent reduction. Correct?

A. Yes.

Q. Now --

A. I think it's actually 150 million, isn't it -- or no?

No. 40 times 3. I got it.

Q. Now, if we go back to your direct testimony, which is page 3, you now estimate that -- a 50 percent reduction in outdoor water use. Correct?

A. Yes.

Q. And you say that can generate 207 cfs. Correct?

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A. Yes.

Q. And the cost you assign to that in your written direct testimony is now zero.

A. Because the column is labeled fiscal cost. So it's a different kind of cost than what I was looking at in the first report.

Q. Apples and oranges?

A. To some extent, yes.

Q. Okay. But for the type of cost you were looking at in February, that cost was $120 million for 150 cfs in a dry year. Right?

A. Yes.

Q. And, now, with your different costs, your fiscal costs, it's zero for 207 cfs. Right?

A. Yes.

Q. Now, you do actually have a cost metric in your direct testimony for this outdoor water use. You know that; right?

A. Yes.

You're referring to the consumer surplus metric?

Q. No. Not there yet.

A. All right.

Q. You estimate that for a 50 percent cut-back in outdoor water use there would actually be a $78

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per connection service cost -- per service connection cost. Correct?

In paragraph 76.

A. Let me take a look.

Q. About four lines up from the bottom.

And I stand corrected. You are referencing a welfare loss there, so that is what you are talking about. But you estimate $78 per service connection. Correct?

A. And, I'm sorry. What page?

Q. I'm sorry. It's paragraph 76, page 37 of your trial testimony.

A. All right. We keep switching back and forth between reports.

Q. If there's a way I could have had you write fewer reports, Dr. Sunding, I would have taken that deal.

Okay. Are you there yet?

A. Yes.

Q. Is --

A. You're right; this is the welfare cost we have been talking about.

Q. So you estimate a welfare loss of about $78 per service connection. Right?

A. Yes.

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Q. And you know that given the number of service connections, that that would cost hundreds of millions of dollars a year in welfare loss in metro Atlanta. Correct?
A. I haven't done the math; but it would be -- it would come to over a hundred million, definitely.
Q. Somewhere between 100 and 200 million?
A. I think so, yes.
Q. Now, in paragraph 79 of your expert report you explain -- I'm sorry, of your direct testimony -- now, it's my fault.
In paragraph 79 of your direct testimony you explain why you don't include any costs for a 50 percent reduction in municipal and outdoor water use. Correct?
A. Yes.
Q. And the first reason is that it's not associated with any fiscal cost. Right?
A. That's right. It's not something the legislature would have to appropriate money for to compensate people.
Q. Now, on that point, Dr. Sunding, that's the same cost you assigned a number to in February. Right?
A. Yes. And I reported it again in my direct

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report -- in my direct testimony.
Q. We haven't changed the types of costs. Right?
You had welfare costs of 120 million in a dry year in February. And you changed the name to fiscal costs and reported zero. But the welfare cost of 120 million still exists. Right?
A. Sure. Yes. And that's why -- that's why I reported it.
Q. And as an economist, you know that a welfare cost is a real cost. Right?
A. It is a real cost. And as I point out in my testimony, it's a -- it's qualitatively different than a fiscal cost. I think any economist realizes that.
Q. You thought it was real enough to make significant estimates for it in February. True?
A. And I reported those estimates again in my direct testimony. Yes.
Q. But in the handy chart that we look at to see what the cost to Georgia is, you changed the label; and you report zero. True?
A. Because I was focusing on it -- yes. Because I was focusing on a different aspect of cost.
Q. Now, Dr. Sunding, you also say that these hundreds to $200 million in welfare costs, they

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will be offset because the people of Atlanta will feel good about it. Right?
A. I'm not sure I would put it exactly like that; but, yes, I think there are welfare gains that would be experienced by Atlanta residents from having more water in the stream.
Q. The way you would say it as an economist is that the preferences of urban consumers to minimize downstream impacts to Florida would offset these hundred to $200 million of welfare costs. Correct?
A. Sure. Those would -- would both be examples of welfare costs.
Q. And that concept comes from this survey you conducted, right, where you asked people what they would be willing to pay for and what they might do. Correct?
A. Yes. Sure.
Q. Now, the survey never actually asked respondents what they would do if confronted with a 50 percent reduction in outdoor water usage to help Florida out. Right?
You never asked that specific scenario?
A. I disagree. It asked them what they would do if they were confronted with particular outdoor

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watering restrictions that we know would generate that amount of water.
Q. Is it your testimony that you said to these people, we're going to cut your water consumption for outdoor use by 50 percent?
A. Oh, no. Definitely not. It's -- we have the survey instrument that was included in my report. And the questions talk about certain kinds of outdoor water use restrictions. And then we asked people what was their willingness to support those if the water would make its way down to Florida.
We have other information about how much water that would save, and that's where I built the crosswalk.
Q. Okay. Now, Dr. Sunding, you didn't quantify the value, if any, to Georgia residents of minimizing the downstream impacts to Florida. Correct?
A. You mean monetary value?
Q. Correct.
A. Right.
Q. You say that the -- Georgia would -- it would be offset -- the cost would be offset by this positive feeling, but you never actually -- you didn't do any quantitative analysis to determine

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that. Correct?
A. No. It's in my experience easier for survey respondents to answer questions about specific behaviors or things that are easy to comprehend.
MR. PRIMIS: Your Honor, this might be a good time for a break, if it's not too early.
SPECIAL MASTER LANCASTER: Fine.
MR. PRIMIS: Thank you.
(Time Noted: 11:46 a.m.)
(Recess Called)
(Time Noted: 12:46 p.m.)
MR. PRIMIS: I'm sorry, your Honor. I didn't see that you had slipped in.
SPECIAL MASTER LANCASTER: I sneaked in.
MR. PRIMIS: Well, you're always welcome.
We have two housekeeping matters to put on the record. The first is that I simply marked for identification this chart as Sunding demonstrative 1 in case we need to track it down later.
And, second, Mr. Dunlap advised us about the Court's approach to written direct testimony and what will actually be admitted. And our understanding, both parties, is that unless there is an opportunity to

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cross-examine or an agreement, that direct written testimony will not be admitted into the record.
We do have an agreement on one pair of witnesses. They kind of testify against one another. It's Dr. Scyphers, S C Y P H E R S. He's a survey expert. And Dr. Cantor is Georgia's response to Dr. Scyphers. And the parties have agreed that that testimony can come in without the need for cross-examination.
SPECIAL MASTER LANCASTER: Mr. Perry?
MR. PERRY: That's right, your Honor.
SPECIAL MASTER LANCASTER: Thank you.
MR. PRIMIS: Okay. May I proceed?
SPECIAL MASTER LANCASTER: Please.
MR. PRIMIS: Thank you.
BY MR. PRIMIS:
Q. Dr. Sunding, before the break we were talking about various scenarios that gross up to either 1,000 or 2,000 cfs of streamflow. Do you remember that?
A. Sure. I remember it.
Q. You're not suggesting that the Court pick any particular number, whether it's 1,000 or 2,000 or something in between. Correct?

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A. Well, again, I'm -- it's the State of Florida that's suggesting. What I analyzed is the cost of conservation -- conservation scenarios. But I -- as I understand it, what Florida is asking for is a cap on consumption that would translate into a certain amount of reduction in depletions, whether it's 1,000, 2,000, or something in between.
Q. And just to make the record clear on my question, it's not your role to say to the Court the streamflow impact number should be X or Y; you're just evaluating a series of options and calculating it out. Correct?
A. That's right. That's fair.
Q. Dr. Sunding, I want to focus your attention on what we call indirect costs.
A. All right. Sure.
Q. Can you turn to paragraph 91 of your direct testimony.
This is your trial testimony I'm talking about.
A. Oh. Paragraph 91?
Q. Yes, sir.
A. Sure.
Q. And in particular, the third line down starting

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with echoing claims.
A. Yes?
Q. And do you see here that you're stating that it would be improper in this case to consider employment impacts from reductions in agricultural output that result from water conservation efforts. Correct?
A. No. I'm not saying that. I quantified indirect impacts myself in this case.
Q. You have; right. But you're not offering that as part of your testimony here. Correct?
A. No. Those numbers weren't included in my direct testimony. They were in my expert report.
Q. Okay. Just -- again, since there's a lot of paper around, I just want to be clear. In your expert report you calculated the indirect costs in terms of things like job losses and the like; but you don't include that as part of your written direct testimony for the trial. Correct?
A. That's correct. And to be clear, I did that for the agricultural sector.
Q. Correct. Thank you for that clarification.
So let's go to your first report where you calculated those impacts. It's paragraph 81. And it's FX-784, which I think is the first tab

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in the binder.
A. All right. I'm there.
MR. PRIMIS: It's page 54, just so everyone can follow along, of FX-784, that first tab.
BY MR. PRIMIS:
Q. Okay. Now, this section, Dr. Sunding, is called Indirect and Induced Impacts. Correct?
A. It is.
Q. And in paragraph 81, you observed that in addition to the direct economic cost of not growing various crops, that the irrigation cut-backs will also impact industries that support agricultural activity. Correct?
A. Yes.
Q. Then if we go to page 55 of your report, you actually provide some calculations that estimate those impacts. Right?
A. Yes. In table 9, for example, those are displayed.
Q. Right. That's what I was talking about.
And for purposes of this exercise, you estimated the indirect economic and employment impacts of a 50 percent reduction in agricultural water use. Correct?

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A. Let me just refresh my memory about how I did this.
Q. Paragraph 83 might refresh your recollection.
A. Right. That's what I'm reading.
All right. Yes, I think you characterized that correctly.
Q. So what you're doing here is you're looking at the indirect effects in terms of other industries that could be impacted or other jobs that might be lost that aren't directly related to pulling corn or cotton out of the ground. Right?
A. That's right.
Q. And table 9 reflects the numbers that you generated by doing that analysis. Right?
A. Yes.
Q. You say also in paragraph 83 right after that, you estimate an additional $8 million in indirect economic impact and $15 million in induced impact. Correct?
A. I see that, yes, in paragraph 83.
Q. And like we did earlier with the single-year costs, these are annualized over a three-year period. Correct?
A. That's right.
Q. So you actually tripled them to find out what the

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one-time impact would be in that drought year. Right?
A. Yes.
Q. If we do that here, we end up with 24 million in indirect economic impact and 45 in induced economic impact in that dry year. Correct?
A. Yes.
Q. If you sum those up, you get $69 million in a dry year of indirect economic impact under your analysis. Correct?
A. Yes.
Q. You also tallied up some job losses that would go along with the agricultural reduction. Correct?
A. Yes.
Q. You estimate that with a 50 percent reduction in agricultural irrigation, there would be a loss of 488 full-time jobs in the farming sector. Correct?
A. So -- right. Those are job losses on farm.
Q. Right. Okay. And those would be 488 full-time jobs. And that's depicted in table 9. Right?
A. Yes.
Q. You also identify 64 jobs in indirectly-affected sectors and 93 jobs in induced economic impacts. Right?

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A. Yes.
Q. If we tally those up, we get approximately 650 jobs?
A. That sounds right.
Q. Now, again, these are annualized numbers?
A. I knew you were going to ask me that. That I can't remember if these are annualized or when the impacts actually occur.
Q. Well, if they are annualized, you would, again, multiply by 3. And we calculated about fifteen to 1600 jobs -- actually, no; I'm wrong. We calculate 1935 jobs lost in the dry year with the three-time multiplier?
A. That's right. If that's how I calculated these impacts, that would be correct.
Q. So if we lose 1935 jobs in that dry year from the 50 percent cut in Georgia, I just want to compare that to a number in Florida. Are you aware that Florida's official records show that there are only about 1700 licensed oyster harvesters in Apalachicola Bay?
A. No. But that -- that sounds about right based on what I know about the industry.
Q. And so the job loss you projected from a 50 percent reduction in Georgia would actually

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exceed the number of all oyster fishermen licensed in Apalachicola Bay. Correct?

A. Well, not -- not exactly. The table that we're referring to, you will note, is labeled impacts. So these are people who might lose a job in agriculture or some other sector. But they could find another job. So it's not to say that they would be unemployed for the duration of the water cut-back. They would just have some dislocation.

Q. So we would have almost 2,000 dislocated people in Georgia?

A. Yes. The -- the agricultural labor force is one of the mostly highly elastic parts of the labor sector. So these people -- you know, I know this from California, Texas, other places. They can move around from sector to sector quite easily.

Q. I might have missed it. Do you have an elasticity analysis here in your expert report about Georgia farmers?

A. No. These are farm workers, not farmers.

Q. Dr. Sunding, do you have an elasticity analysis in your expert report or written direct testimony about these dislocated Georgia farm workers who would lose their job in a dry year with irrigation reductions?

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A. If you look at paragraph 84 --

Q. Yes?

A. -- the first sentence reads, it should be noted, however, that IMPLAN's employment impact estimates are likely overstated.

And one of the reasons is that just because someone loses a job in one sector doesn't mean that they sit on their hands until the water comes back. They adapt.

Q. My question was did you calculate that and put it in your report?

A. Not a numerical value, no.

Q. Now, Dr. Sunding, in your first expert report, which we're in right now, if you go to -- actually, let's stick -- I want to look at the table; so we can use the handout. It's the first page of the handout, or in your book it's your first report.

And you have the four scenarios for 1,000 cfs. Correct?

A. Yes.

Q. That's on page 9 of your first report, or it's the first page of this three-page handout.

A. I like the handout.

Q. The handout is easier, because I'm going to move

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now -- I hope it's the last time; but I am going to move across reports.

A. Okay.

Q. So what I want to draw your attention to -- actually, of course, our handout doesn't have this; but the -- we can just cut to the chase. In your initial expert report you calculated what you called dry year peak streamflow depletions. Correct?

A. Yes.

Q. And you focused on what you modeled to be a dry year, which was a combination of 2011 and 2012 hydrology conditions. Correct?

A. That's right.

Q. Now, in your second expert report you changed that. Right?

A. Yes. I evaluated the conservation measures under a different assumption about hydrology.

Q. Right. You took 2012 out of the picture, and you focused just on the year 2011. Right?

A. Yes.

Q. And you used 2011 hydrology in this second report. Right?

A. Yes.

Q. Now, you called it in your second report a

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drought year scenario, not a dry year scenario. Right?

A. I believe you're right.

Q. And the reason you did that is because the drought was more severe in 2011 than in 2012. Right?

A. I mean, certainly it's the case that 2011 was drier than 2012. Yes, I think that's why I changed the terminology.

Q. And when you actually changed, going from a hybrid of 2011 and 2012 and just to 2011, that had the effect of generating more streamflow savings from the same actions. Right?

A. Yes. Because demands are higher in a very dry year like 2011. That's correct.

Q. Now, when I asked you why you changed that benchmark to go from 2011 and 2012 hybrid to just 2011, you couldn't answer that question without revealing conversations with counsel. Correct?

A. That's right.

Q. And you declined to answer the question. Right?

A. That's right.

Q. Now, with regard to the 2011 conditions -- well, actually, no. Let me move on. Let's go down to your direct testimony, sir. The written

testimony for this Court.
A. All right.
Q. And in particular, I want to go to paragraph 71.
A. Almost there.
Q. Actually, let me start you on paragraph 75, which is page 36.
A. Okay. Just give me a second to read it.
All right.
Q. All I really want to determine here, Dr. Sunding, is that for your drought year calculations in your final written testimony for this Court you assumed those 2011 drought conditions. Correct?
A. Yes, that's right.
Q. You didn't use the 2011-2012 hybrid. Right?
A. That's correct. It's a different assumption.
Q. So, now, let's go to paragraph 71. And here you say that you're evaluating scenarios where Georgia could reduce consumptive use in both drought and nondrought years. Correct?
A. Yes.
Q. And the scenarios you have in tables 4 through 6 of your direct testimony, and that we have got excerpted here in the handout, they include estimates of nondrought year water savings associated with the conservation measures.

Right?
A. Yes. Because some of the conservation measures are in place in both dry and nondry years or drought and nondrought years.
Q. And you also say in your testimony that these conservation measures would, quote, provide substantial environmental benefits to Florida in both drought and nondrought years. That's your view. Right, sir?
A. Yes.
Q. Now, the first time you presented estimates of nondrought year water savings in the way you have done here in your direct testimony was in the direct testimony. Right?
A. That's right.
Q. You didn't have a column called nondrought year in report 1. True?
A. That's correct.
Q. And you didn't have a column called nondrought year in report 2. Correct?
A. That's also correct.
Q. And so the first time I saw this was when we got your direct testimony. Correct?
A. Yes. I'm sure that's right.
Q. Now, I want to test this proposition about

substantial environmental benefits in nondrought years, that being having cuts to Georgia in nondrought years. And can you turn in your book to GX-1276.
A. All right.
Q. The first page of GX-1276 just says Exhibit 3, but that's because it was an exhibit to a court filing in an earlier case.
If you turn to the next page, you will see that this is a declaration of Douglas Barr. Do you see that?
A. I do.
Q. And do you know who Doug Barr is?
A. No, I don't.
Q. Are you aware that he was the executive director of the Northwest Florida Management District?
A. I am now. I see in his qualification statement in paragraph 2 that it says that.
Q. Okay. And do you see on the top of this that it was filed in federal court twice, in January of 2009 and in December of 2009.
A. Yes. That's the way it appears.
Q. Can you turn to paragraph 31 of Mr. Barr's affidavit. It's on page 13. And I would ask you to read to yourself the sentence following the

internet link, about halfway down.
A. That begins thus?
Q. It begins thus.
A. All right.
Q. And I take it, Dr. Sunding, that you're in no position to dispute Mr. Barr's assertion that flows in average annual years are more than sufficient to connect floodplain channels and inundate aquatic habitat to sustain the significant biological processes in the river and bay?
A. No. I see that is his opinion, and that's outside my area of expertise.
Q. You can't -- you can't disagree or agree with that. Right?
A. No.
Q. Do you also see that Mr. Barr says that upstream consumption in average annual years of flows is not significant enough to interfere with those processes?
A. I do see he says that.
Q. And, again, the same answer; you can't really agree or disagree with that. Right?
A. There are other experts who would be better positioned to comment on that.

Q. Well, let's talk about that. In this case, your discussions with other experts, in virtually all of those discussions that you have had with other Florida experts they focused on dry years. Correct?

A. Yeah. The discussions that I had, especially with the biologists and the hydrologists, were largely almost exclusively focused on dry years.

Q. In fact, you have not heard any issues from those other experts raised about average or wet-year problems. True?

A. I can't -- I can't think of any. But that was not all I had in mind when I wrote this sentence in my direct report that we're discussing now.

Q. Dr. Sunding, can you turn to page 280, line 23, of your deposition, please. And I'm going to play a clip from 280, 23 to 281, line 9.

A. What page are we on in the deposition?

Q. Page 280.

A. 280.

Q. And let's hold -- let's wait. 280, line 23 --

A. All right.

Q. -- to 281, line 9.

MR. PRIMIS: And, Mr. Smith, can you play that, clips 233 and 234.

(Whereupon the video was played.)

BY MR. PRIMIS:

Q. Dr. Sunding, were you asked those questions; and did you give those answers?

A. Yes. Understanding that this discussion is about biological impacts.

Q. Dr. Sunding, I now want to shift gears and talk about what you have described as a least-cost means of conservation-based scenarios. Okay?

A. Okay.

Q. And I don't know if anyone else knows what I'm talking about, but you do. Right?

A. I think so. But I would like you to be specific as you go along.

Q. Sure. Absolutely.

So now, we're looking at your table from your direct testimony. So it's the third page of the handout.

A. All right. Yes.

Q. And you have got a -- well, let's wait for the Court to get there.

MR. PRIMIS: This is page 44 of the direct testimony, table 4.

BY MR. PRIMIS:

Q. Dr. Sunding, I want to focus in particular on the

row called Deficit Irrigation to Reach 2,000 cfs. Do you see that?

A. I do.

Q. Now, when you talk about deficit irrigation, that's your least-cost means of conservation. Correct?

A. Again, we're going to have to be careful about terminology. Deficit irrigation is not the least-cost alternative across all the conservation possibilities. But I do use a least-cost concept in defining the cost of deficit irrigation. I just want to make sure we're talking about the same thing.

Q. Dr. Sunding, I was just reading from the -- trying to save some time. I was reading from page 51 of your first expert report, paragraph 73, next to last sentence.

A. Right, yes. This is what I was just talking about.

Q. Right. I thought that's what I read verbatim, but you agree with that statement?

A. I do.

Q. Okay. So this deficit irrigation concept provides the least-cost combination of deficit irrigation that will achieve any given reduction

in consumptive use. Right?

A. Yes. Understanding that this approach means how I am modeling the way water would be moved around across crops and soil types under a deficit irrigation regime.

Q. I was going to get to that.

So you rank in terms of order opportunities for irrigation cut-backs that go from the least to the most expensive. And then you try and target the ones you have determined to be least expensive. Right?

A. Yes.

Q. That's how it works?

A. Yes.

Q. There's a lot of factors that go into that. Right?

A. Sure. I considered the type of water year that determines productivity. In part I considered the crop; and I considered the soil quality, the type of soil that different farmers are operating on.

Q. You also looked at the level to which their groundwater connected to the river. Correct?

A. That's correct.

Q. So you're looking at crop type, soil type, user

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type, connectivity of the aquifer, and you're taking that all into account and saying under a certain year, this type of crop is the least expensive to eliminate. So let's start there. Right?

A. Yes. It's not exactly how I would say it, but the idea is correct.

Q. Now, when we talked about how you could implement such a thing where you have all these different moving parts, I was confused. I said, how are farmers going to know if it's my turn to reduce?

And one way you said that the State could do this is to adopt a cap and trade system. Right?

A. Yes.

Q. This would mean that either the Court or Georgia or someone else picks a cap, and then you assume that the efficient market will sort out who is going to water what crop. Right?

A. Yes. That there would be a cap established on the total amount of water used. And then farmers would move water around to maximize profits subject to that resource constraint.

Q. And once you have that resource constraint, farmers would efficiently act to reduce water use depending on the crop and soil type and

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connectivity and all those other factors. Right?

A. Absolutely.

Q. Now, you're familiar with the difference between riparian states and prior appropriation states at a general level. Correct, sir?

A. I am, yes.

Q. You're aware that in prior appropriation states, water rights are segregated from ownership of the land?

A. In prior appropriation states, yes.

Q. And whereas in riparian states, water rights are tied to the property adjacent to the water. Correct?

A. Yes.

Q. You know Georgia is a regulated riparian state. Right?

A. Yes.

Q. And you also know that in a riparian state, the owner of the land doesn't have a stand-alone right to transfer the ownership of that water. Correct?

A. Yes.

Q. And you're not aware of a single riparian state that has a marketplace for trading water among irrigators. Correct?

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A. Not -- not a riparian state, but my mechanism doesn't necessarily involve trading across users.

Q. It would be a departure from a riparian regime to have farmers owning their water rights and trading them amongst themselves. Correct?

A. Yes. It would be easier for farmers to transfer within their own operations, which is part of what I have in mind. I mean, remember, farmers own multiple pivots in many cases; and they can move water around within their own operations to achieve the same kind of outcome I'm talking about.

Q. My question related to a cap and trade system where farmers trade amongst themselves. That would be a departure from a regulated riparian situation. Correct?

A. Yes. If Georgia wants to minimize costs, it will likely have to make some institutional improvements.

Q. The legal regime for property in Georgia would have to be changed. Correct?

A. I can't comment on the legal regime. But there would -- there would likely have to be some change in institutions.

Q. Let's stick with deficit irrigation, Dr. Sunding.

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And can I refer you to paragraph 49 of your direct testimony.

A. Sure.

Q. Can you read the second sentence of paragraph 49.

A. The second sentence of paragraph 49?

Q. Yes.

A. My gosh. I'm on the wrong report.

Q. We're -- just to be clear, we're talking about the Sunding direct written testimony, paragraph 49, second sentence.

A. All right. So it begins I found?

Q. Yes.

A. I found through my analysis --

Q. Don't read it out loud.

A. Oh, I'm sorry. I thought you wanted me to. Yes.

Q. So you're saying here that you have done an analysis, and you have determined that Georgia farmers apply much more water than they need to irrigate their crops. Right?

A. Some do is what the sentence says.

Q. And those some that do are effectively wasting water in your view. Correct?

A. Yes. They're applying water above a biological maximum.

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Q. Now, you haven't gone out personally around Georgia and seen any wasteful watering practices. Have you?
A. **No. Although I have seen pictures.**
Q. You have seen pictures?
A. **From this case, yes.**
Q. Maybe I'll show you a picture. Before I do that, you haven't spoken to anybody who has seen or reported wasteful watering practices in Georgia. Correct?
A. **That's -- that's not quite true. I have spoken to experts on the Florida side who report having seen wasteful irrigation practices.**
Q. Okay. Can you turn to page 322 of your deposition, Dr. Sunding. And you were asked at your deposition, sir, have you spoken to anybody who has seen or reported such a thing, referring to wasteful watering practices. And your answer was not a specific instance I can recall.
Did you -- were you asked that question; and did you give that answer?
A. **Wait. Where are you? You're on page --**
Q. 322.
A. **What line?**
Q. Line 25. And my question is were you asked that

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question, and did you give that answer?
A. **Well, right. But just above that is what I had in my mind when I answered the question about talking to Drs. Hoogenboom and Bottcher.**
Q. Dr. Sunding, you mentioned some pictures. Correct?
A. **Yes.**
Q. I want to show you a picture. We have marked this as GX-898.
MR. PRIMIS: Can I approach?
SPECIAL MASTER LANCASTER: Yes.
MR. PRIMIS: I handwrote the exhibit number on your copy so you would have it.
BY MR. PRIMIS:
Q. Dr. Sunding, does this look like the picture that you recall seeing of a wasteful watering practice?
A. **Sure. I have seen a number of pictures that look like this.**
Q. And the reason you would say this is wasteful is because you have a center-pivot irrigation unit spraying water onto a road, and you can quite clearly see the road being irrigated. Correct?
A. **I see the road being irrigated. It's a little difficult to draw a connection between this**

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picture and the figures that were in my report that started this whole discussion.
Q. Well, should this irrigation unit be watering the road?
A. **No.**
Q. Okay. Now, Dr. Sunding, you know that GX-898 is a picture that was taken in Florida of a Florida irrigation system; or did you not know that?
A. **Well, when I saw the GX on the bottom, I assumed.**
Q. Okay. And you understand that a Georgia investigator drove around Florida to see if there were any instances like this, and he found this one. Are you aware of that?
A. **Yes.**
Q. You weren't just shown pictures of Georgia doing this kind of thing; you saw pictures of farmers in Florida irrigating roads. Correct?
A. **I have.**
Q. Now, to figure out whether there's overwatering in Georgia, you ran a crop simulation model. Correct?
Or you had Dr. Hoogenboom, who is another expert in this case, run a crop simulation model?
A. **That was one part of the analysis. There was more to it than that.**

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Q. Well --
A. **But that was something that Dr. Hoogenboom did.**
Q. And then you overlaid your calculation of irrigation depths from the Georgia agricultural metering database to determine whether farmers were watering above what you determined to be an optimal amount. Right?
A. **What Dr. Hoogenboom determined to be an optimal amount, yes.**
Q. And if a farmer irrigates over what you thought or Dr. Hoogenboom thought was an optimal amount, you say they're wasting water. Correct?
A. **Yes.**
Q. You would agree with me, sir, that, on average, irrigation depths applied by Georgia farmers are actually below the optimal amount as calculated by you and Dr. Hoogenboom?
A. **Yes. I -- I think that. I think I believe Dr. Hoogenboom thinks that, and I believe that even Dr. Irmak thinks that, that on average Georgia farmers are below this maximum irrigation depth.**
Q. It's below the optimal irrigation depth. Right?
A. **It's not optimal. It's -- what I'm looking at is really a biological maximum. So it's the amount**

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of water beyond which there's no additional beneficial plant growth.

Q. Dr. Sunding, just to make this crystal clear, your analysis and Dr. Hoogenboom's analysis show that Georgia farmers in the aggregate are underwatering compared to that maximum amount that you identified. Correct?

A. Yes. That question I like better.

Q. In addition to your preference to the question, do you agree with the assertion?

A. I do. It's just that you used the word optimal before, and you modified the question in a way that I will agree with.

Q. Dr. Sunding, can you turn to page 25 of your written direct testimony.

We have a figure 4 there. You actually have a figure 3 and a figure 4. Correct?

A. I'm sorry. We're on which page now?

Q. Page 25.

A. Yes.

Q. If we look at the bottom one, figure 4, the way your analysis worked was that red vertical line shows what you considered to be the maximum productive depth for the type of crop and soil and growth year depicted. Right?

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A. Yes. Again, that's the number that I got from Dr. Hoogenboom.

Q. So here, if you're growing peanuts on fine soil in 2011, this would show that the vast majority of farmers are to the left of the maximum productive depth and, therefore, underwatering. Right?

A. Yes, it does.

Q. And there's a few instances to the right of people you say would be overwatering?

A. That's correct.

Q. And then on the other one, you have more people in that particular instance who you considered to be overwatering; is that right?

A. Yes. It's just another example.

Q. Now, have you calculated the percentage of farmers using your analysis that are underwatering in Georgia?

A. I don't -- we might have calculated that sometime along the way; but I don't have it in my head now if I did.

Q. Are you familiar enough with your own analysis to agree that it's more than 80 percent of Georgia farmers who would be underwatering under your analysis?

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A. That -- it could be true.

Q. And right now, we're talking about percentage of acreage, just to be clear. The percentage of acreage that is underwatered is higher than 80 percent. Correct?

A. That I don't know.

Q. Do you have any basis to disagree that it's 80 percent or even higher in other years?

A. You know, I would have thought it somewhere in the 60 to 80 percent range; but I -- again, I may have done that calculation at some point; but I don't have it in my mind now.

Q. Okay. We have had our experts do it, so we'll bring it up later in the trial.

Dr. Sunding, I want to talk now about your assertion that agricultural irrigation is, quote, clearly discretionary. Do you recall giving that testimony?

A. I do.

Q. You don't believe that farmers in ACF Georgia should exercise their discretion to stop irrigating altogether. Right?

A. I'm not sure I understand the question.

Q. Well, you're not of the view that all the farmers should exercise their discretion and should go

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entirely to dry-land farming in southwest Georgia; are you?

A. No. I don't think I have said that.

Q. You would agree that without irrigation, farming is totally dependent on precipitation. Correct?

A. It is dependent on precipitation, but there are a lot of other inputs that go into agriculture besides just water.

Q. Well, we're here talking about water. So as it relates to water, you would agree that natural precipitation exclusively if you're not going to do irrigation. Right?

A. Yes. I just think your question before was overstated.

Q. Precipitation varies from year to year. Right?

A. Of course, it does.

Q. Varies from season to season?

A. Yes, it does.

Q. And it can also vary regionally even within the ACF Basin within the same season. Correct?

A. It can, yes.

Q. You would agree that irrigation helps farms improve their yields. Correct?

A. In certain years. Not in every year.

Q. You would also agree that irrigation helps

stabilize production. Right?
A. Yes. I would agree with that.
Q. And without irrigation, you can have a bouncing around of yield according to how precipitation varies from one year to another. Correct?
A. Yes. Yield can go up and down to a greater degree with no irrigation.
Q. And irrigation also raises average yields across all years it's used. Correct?
A. Yes.
Q. It eliminates downside risk in years where yields would otherwise be low. Correct?
A. Well, now you're talking about a financial risk. And to answer that, you would have to know something about whether or not growers have access to crop insurance.
Q. Dr. Sunding, can you turn to page 254 of your deposition, please, lines 16 through 24. Are you there, sir?
A. You're on page 254, line 16 through 24?
Q. Correct.
A. All right.
Q. The question was, of what benefit is stabilized production for farmers?
The answer was, well, it's two benefits. If

irrigation is used predominantly in the drier years, it has two effects. It raises average yields across all years, and it eliminates or reduces some downside risk. So in years that the yields would otherwise be low, it reduces risk.
Were you asked that question, and did you give that answer?
A. Yes. And there we're talking about production risk as opposed to financial risk. They're different.
Q. Dr. Sunding, farmers who practice dry-land farming face an increased risk of a lower yield during a dry year. Correct?
A. I think that's right. Yes.
Q. Farmers who practice dry-land farming face an increased risk of crop failure in dry years compared to farmers who irrigate. Correct?
A. That may also be true, yes.
Q. And you would agree that agricultural lenders pay attention to the yields that come off of a farm when making a decision whether to loan money out, among other factors. Right?
A. Among other factors, sure. That fits with my experience.
Q. That's because agricultural lenders are

interested in the stability of yield from a farmer's crops. Right?
A. Yes. Again, among other things, sure. They want to get repaid if they're loaning money.
Q. And you would agree that it is possible that the presence of irrigation influences a farmer's ability to secure a loan to finance his farm. True?
A. I think it's possible.
Q. I want to make a big transition now, and we're going to talk about pecans.
A. All right.
Q. All right. You have an opinion about pecans. Right?
A. Yes.
Q. Let's go to paragraph 54 of your direct testimony. Can you read that and just let us know if that's where you offer your pecan opinion?
A. Paragraph 54 or page 54?
Q. Paragraph, on page 27.
By the time you figure this routine out, we're going to be done, Dr. Sunding.
A. Right.
Okay. I see it.

Q. Okay. And here you say that if farmers reduce pecan irrigation by 38 percent at certain times of year, you can generate streamflow benefits exceeding 100 cfs in a dry year. Correct?
A. Yes.
Q. You base this conclusion entirely on a paper written by Lenny Wells from the University of Georgia. Correct?
A. It's not entirely on the paper. As we discussed in my deposition, it's more than that.
Q. Dr. Wells gave a PowerPoint presentation to farmers, too, that you looked at. Right?
A. Yeah. More than one presentation, but I have a copy of the PowerPoint that he uses.
Q. And the PowerPoint is based on his single study. Correct?
A. I don't know about that. I presume he has other experiences beyond those that were reflected in the paper.
Q. That's what you presume?
A. Yes.
Q. Now, the paper came out in April of 2015. Correct?
A. I believe that's right.
Q. The Wells paper, it's five pages long?

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A. The paper in Horticultural Science, yes.
Q. Yes. And it describes a single study conducted from 2012 to 2014. Right?
A. Yes. The paper does.
Q. And this pecan paper for Dr. Wells was conducted on a single pecan farm in Berrien County. Right?
A. I believe that's right.
Q. Berrien County is not in the ACF Basin. Right?
A. It is not.
Q. You have never met Dr. Wells. Correct?
A. No.
Q. You had never heard of Dr. Wells before you read his 2015 article. Right?
A. No.
Q. And you never discussed this paper with Dr. Wells after you read the article. Right?
A. No.
Q. You did not do anything to confirm the analysis in Dr. Wells's article. Right?
A. No. He's outside my field.
Q. In fact, you couldn't check it because you didn't have the underlying data that he used in the study. Right?
A. That's right.
Q. And I think it's your view if it's good enough

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for Dr. Wells, it's good enough for you. Right, Dr. Sunding?
A. He's the lead pecan researcher at the University of Georgia, as far as I know. If he feels confident enough to be out on the road telling Georgia farmers to curtail early season irrigation, that's something I put some stock in.
Q. And if he writes one paper about Berrien County pecan farms on a single experiment, that's good enough for you to tell the Supreme Court Georgia can generate 100 cfs with that measure. Correct?
A. It's more than just the paper. He has a whole career, as far as I can tell from looking at his vitae, working on essentially nothing but pecans and other nut crops. So he has a lot of experience in this area.
Q. Okay. Dr. Sunding, I want to skip back over to M & I.
A. All right.
Q. Municipal and industrial. All right?
I'm sorry. Your reports cover a lot of ground. We need to cover a lot of issues.
A. They do. That's all right.
Q. Now, in paragraph 13 of your written direct -- that's the loose one that was just filed in

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October.
A. Right.
Q. It's in your right hand.
A. Yes. I'm turning to paragraph 13.
Q. Yes.
A. Got it.
Q. Paragraph 13 addresses the issue of return flows. Correct?
A. Yes.
Q. And you say that water withdrawn by an M & I user but then returned to the ACF has little impact on streamflows. Right?
A. That's right. This is the distinction we were talking about earlier between water use and consumptive use.
Q. Right. And it's very important to distinguish between the withdrawal of water and the actual consumptive use of water. Right?
A. I think so, yes. Certainly in this case.
Q. And the consumptive use is the net result of the withdrawal minus the return. Correct?
A. Yes.
Q. Now, you assume that municipal use in Georgia is largely nonconsumptive. Right?
A. Sure. Yes.

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Q. That's consistent with the data that you have seen and that you use in your analysis. Right?
A. Yes, that's right.
Q. Let's go to your first expert report. It's the first tab, page 23.
A. All right.
Q. And I want to focus in particular on table 3.
A. Right.
Q. So in your first report you included this table that shows per capita water use in the Atlanta service area in gallons per day. Right?
A. I see that, yes.
Q. And per capita water use is the amount of water used per person in the Atlanta metro area. Right?
A. Yes.
Q. You would --
A. There are different measures of per capita use. But this is just withdrawals divided by people.
Q. Now, if we focus on the top line, this is the total withdrawals. Right?
A. Yes.
Q. And so this is that distinction you drew. This is the amount that actually gets taken out, but it's the gross number. It doesn't talk about

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returns. Right?
A. Right.
Q. And you would agree that from 2000 to 2009 total withdrawals have declined from 123 million gallons per day to 92 million gallons per day for this service area. Correct?
A. Comparing just those two numbers, yes.
Q. You would also agree that the per capital -- per capita water use in metro Atlanta has steadily declined over the last 16 years; wouldn't you, sir?
A. It is declining. The word steadily may be a little bit of an overstatement. But it has declined over this period.
Q. Dr. Sunding, can you pull out your deposition, page 358, line 23. Are you there?
A. Yes.
Q. The question was, Dr. Sunding, you will agree that the per capita water use in the metro Atlanta area has steadily declined over the last 16 years. Correct?
Answer. Yes.
Were you asked that question, and did you give that answer?
A. Yes. And then if you go down a little bit

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further, there is some more detail on this point.
Q. Dr. Sunding, table 3 in your first expert report only goes through 2009. Correct?
A. Yes.
Q. And you were unaware at your deposition that per capita usage in Atlanta continued to decline after 2009. Correct?
A. In my deposition I think that's the case.
Q. You're aware that Georgia's expert, Dr. Mayer, analyzed per capita water use in the metro district of Atlanta?
A. I saw that, yes.
Q. And you know that he found that per capita water use continued to decline through 2013. Correct?
A. Yes.
Q. And you're aware that Mr. Mayer has calculated that per capita water use has gone beneath 100 gallons per capita per day. Correct?
A. Yes.
Q. Now, sticking with M & I, I want to talk about your estimates of the amount of outdoor water that is used in Georgia for M & I purposes. Okay?
A. All right.
Q. Just give me one moment.

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Let's go to -- sticking in your first report, to page 72, please, sir.
A. All right.
Q. And you have a table there, table 11. Correct?
A. I see it, yes.
Q. This is where you estimated Georgia's total outdoor water use in the ACF Basin for the year 2011. Correct?
A. I just want to read the text that's describing table 11.
Okay. Yes.
Q. Okay. And, sir, would you agree -- and this is municipal and industrial outdoor water use. Right?
A. Well, it's -- we need to be a little careful about this. There are municipal withdrawal permits, and then there are industrial withdrawal permits. Some large manufacturers, like the pulp and paper facilities and whatnot, they will have their own withdrawal permits. Those were not part of the analysis. But there were also some businesses that buy water from urban water utilities.
So I just want to be clear about what we're talking about when we use the term municipal and

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industrial, especially in this context where there are both kinds of permits.
Q. Okay. Well, just how would you define -- there is a number there, 114,550 acre-feet.
A. Yes.
Q. How would you define what is included in that?
A. That's -- I would call it municipal and industrial, but just understand there's a whole other category of industrial users that are outside this analysis.
Q. Okay. That's fine.
Now, you made a similar estimate for the same type of thing in your second report. Correct?
A. Yes.
Q. And it was a different number. Correct?
Let's go to your second report, FX-801 at page 4.
A. Yes.
Q. So you have a table there called table 2, outdoor use in the ACF Basin.
A. Yes.
Q. Now, the number you estimate is 162,792 acre-feet. Correct?
A. For 2011, yes.
Q. So the number in the first report was 114,000,

and the second report it's now 162,000 and change. Right?

A. Yes. And this -- this has to be just a reporting issue because nothing changed in the analysis between those two dates.

Q. The number changed?

A. Right. But the analysis didn't change. This has to be reflecting either a different set of permits or something like that, but the analysis didn't change between these two reports.

Q. Let's go to your direct testimony and see if there's another estimate for the same thing. And can you refer to paragraph 74.

A. Yes.

Q. Okay. At the bottom of paragraph 74 in your direct testimony, there is a sentence that begins, aggregate outdoor water use in the ACF in Georgia. Do you see that?

A. I do.

Q. And there you say that it resulted in over 130,000 acre-feet of consumption in 2011. Correct?

A. Yes.

Q. So we have had 114,000 in February, 163,000 for some reason in May, and now for trial we have

130,000 acre-feet in outdoor water use as you calculated it. Correct, sir?

A. Well, again, there are really only two numbers. The -- whatever discrepancy is between the first and second reports has to do with just the way the numbers are put together for the tables. I only had two versions of -- two versions of an estimate of outdoor water use. The one in my direct testimony corrects for an error that you presented to me during my deposition.

Q. Sir, is it fair to say you had one figure for outdoor water use in February; and you have a different one here in November. And there's one in the middle that you can't explain?

A. No. The one in the middle, the 162, that -- that number I know was what the original modeling was. I would have to take time and look at the table in the first report to see exactly what I was reporting that for.

Q. And you do agree that you corrected an error and now have a different number from your first report to your trial testimony. Correct?

A. Yes.

No, I agree with the issue that was pointed out during my deposition; and I stand by the

130,000.

Q. Dr. Sunding, can you go to the table that you used for the trial testimony where you have various options for 2,000 cfs.

A. Sure.

Q. And tell me when you're there.

A. All right. I'm there.

Q. Okay. You touched on this earlier; but if we look at the table under drought year, you actually have two columns with a high and a low range. Correct?

A. Are you referring to the connectivity?

Q. You have -- right. You have two estimates for the drought year, one called .43 connectivity and the other called .6 connectivity. Correct?

A. That's correct.

Q. You explained this, I believe, in paragraph 48 of your direct testimony?

A. Yes.

Q. Can you look at that.

A. All right, yes.

Q. And you said in paragraph 48 that decreases in consumptive use in the agricultural sector don't translate directly to reductions in peak monthly streamflows. Right?

A. What I meant by that, it's not a one-for-one relationship.

Q. Right. I want to pause on this. This came up briefly during Dr. Hornberger's testimony, who had adopted this from Dr. Langseth, who I believe you mentioned in your testimony. But the principle is that if you take a gallon of water out of the ground, it does not reduce the streamflow one-to-one per gallon. Right?

A. Yes. That's what I just said.

Q. Whereas, if you're irrigating directly out of a stream, each gallon you take out is gone from the stream; and it does have a one-to-one reduction?

A. That's correct.

Q. And when you have this .43 and this .6 connectivity, what you're modeling are two scenarios. One where pumping reduces streamflow by 43 percent; right?

So if you pull out a gallon, it reduces streamflow by .43 gallons, versus another scenario where it's a more significant reduction in streamflow of .6 for every gallon pumped. Right?

A. On average, understanding that connectivity actually varies over space, you know, by

location. But the .43 and .6 are average estimates across the landscape.

Q. Right. And you actually just made a very important point that I want to pause on. A pump in one location in the ACF Basin may have a very different impact on streamflow from a groundwater pump in a different part of the basin. Right?

A. I believe that's correct. Yes.

Q. And so what you have done is you say on average, it's either .43 on the low end or .6 impact on the high end. Right?

A. Those are the two -- the two sets of assumptions I was given by the hydrogeologist, yes.

Q. The .6, the 60 percent impact figure that you used for connectivity, you didn't use that in either of your expert reports. Correct?

A. That's right. Although I did have language around the .43 connectivity suggesting that that might be on the low side.

Q. Right. You -- when you did your initial work and came up with your thousand cfs estimates, you used a .43 connectivity factor. Right?

A. For the numerical analysis, yes.

Q. And you got that from Dr. Langseth?

A. I did.

Q. And when you did your second report and had 2,000 cfs, you used a .43 connectivity factor. Right?

A. I did.

Q. The first time you offered any numbers for streamflow based on a .6 connectivity factor was in your direct testimony that we're looking at now which we received on October 14, 2016. Correct?

A. That's the first time I modeled that numerically, yes.

Q. Back to your table where you have those two columns, you agree that you get more streamflow benefit in your analysis when you use a .6 connectivity factor. Right?

A. Sure, which I think reflects -- to me that makes sense. That result seems intuitive.

Q. And in the aggregate, it increases your total number from 1800 to 2,000 under the drought year scenarios. Correct?

A. Yes. It makes a modest difference in streamflows.

Q. You say in that paragraph -- you say in paragraph 42 -- I'm sorry. You say in paragraph 90 of your direct that the new connectivity value, the .6 -- I'll just let you get there. It's paragraph 90.

A. Yes. I'm there.

Q. Just give me a moment, Dr. Sunding.

A. Right.

Q. I misdirected you.

Now, I'm wrong. I get confused between the pages and the paragraphs sometimes.

But let's go to paragraph 48 on page 23.

A. Yes?

Q. Okay. You say at the bottom -- in particular I'm focused on the bottom of page 23 where you say that you have a .43 average connectivity, about four lines up from the bottom?

A. I see that. Sure.

Q. And you say that that's highly conservative. Right?

A. Yes. That's the information I was given.

Q. That's what the hydrologists told you, highly conservative at .43?

A. They have told me that for as long as they worked on the project, yes.

Q. Okay. And so you then say you adjusted the connectivity values averaging .6 across the Georgia ACF. Right?

A. Yes.

Q. And you got that from Drs. Langseth and

Hornbergerer to be a more middle-of-the-road estimate. Right?

A. That was the way they described it, yes.

Q. You weren't here when Dr. Hornberger testified; were you?

A. I was not, no.

Q. Are you aware that Dr. Hornberger was asked about Dr. Langseth's selection of connectivity values?

A. No.

Q. Are you aware that in his expert report, Dr. Langseth specifically reviewed and rejected the 1996 Torak and McDowell model that Dr. Hornberger now uses to get the .6 connectivity value?

A. No. I -- I don't know that level of detail.

Q. You don't know that Dr. Langseth rejected that model?

A. No.

Q. Are you aware that Dr. Hornberger admitted that Dr. Langseth had reviewed and rejected the Torak and McDowell model just last week?

MR. PERRY: Objection, mischaracterization.

BY MR. PRIMIS:

Q. We can put the trial transcript up if you prefer, but are you aware of that?

A. For?
Q. Are you aware that Dr. Hornberger said that he had never run the 1996 Torak and McDowell model that he now relies on for the .6 connectivity value that you have used now for the first time?
A. Again, that's all part of their work.
Q. And just to be clear, when we're talking about the .6 model -- .6 factor, that comes from the modeling that was done in 1996 that Dr. Langseth reviewed. You know that; right?
A. But that's outside what I know. No. That's in their -- in their area.
Q. Dr. Sunding, I want to ask you now about the role of the Army Corps. You didn't consult with anyone from the Army Corps of Engineers in doing your analysis in this case. Right?
A. No.
Q. The reservoir and dam operations of the Army Corps are not part of your analysis. Correct?
A. That's correct.
Q. You haven't analyzed how the Corps would handle the additional streamflows that you say can be saved through its dam operations in a drought. Right?
A. No. That's -- that's not an economic question.

That's a hydrological one.
Q. And that's not something that you have considered, whether the water you say would be saved would be passed through by the Army Corps. Correct?
A. It was certainly something I discussed with Florida's experts, and they assured me that the water would make its way to Florida. But beyond that, it's outside my area to do any modeling on this issue.
Q. So just from your own expertise, you don't know. You just rely on other people. Correct?
A. That's right, yes.
Q. And, Dr. Sunding, you haven't evaluated the cost that would be associated with the Army Corps supplementing streamflow through reservoir operations to achieve the values that you have calculated. Correct?
A. That's right.

MR. PRIMIS: No further questions.
MR. PERRY: Good afternoon, your Honor.
SPECIAL MASTER LANCASTER: Good afternoon, Mr. Perry.

REDIRECT EXAMINATION

BY MR. PERRY:

Q. Good afternoon, Dr. Sunding.

A. Good afternoon.
Q. I would like to start at a little bit of a higher level of generality than what Mr. Primis was. I don't want to obviously repeat everything in your prefiled direct, but could you help us understand, just as an initial matter, what an agricultural economist and an expert in natural resources economics does.
A. Sure. I can describe that. What we do in my profession is look at the economic impacts and economic costs of different measures to conserve natural resources. And water would be a prime example. Land would be another example. But we understand how a natural resource is used in the economy. And part of the field is to study what are the economic impacts of public policies to conserve natural resources.
Q. Now, this isn't the only case where you have looked at issues of natural resources and water; is it?
A. No. Definitely not.
Q. Could you describe for the Court a few other examples where agricultural irrigation has been limited because of the impacts on the environment or ecosystems.

A. Sure. I could give examples of situations involving litigation and also other situations where agricultural water uses had to be limited to protect the environment. This is actually a very common issue across the United States where farming areas have overshot a level that's sustainable in terms of environmental conditions.
Some very good examples I could give would be the Klamath Basin in Oregon and just into the northern part of California, the Republican River in Nebraska, the Pecos River in Texas and New Mexico, others as well. But this is actually a very common phenomenon across the country.
Q. Now, with respect to those examples, did you draw on those examples in performing the work you did here?
A. I did. What I tried to do in my testimony is two things. I tried to show what would be the cost to Georgia of different conservation measures, but then also demonstrate that there have been programs adopted in other parts of the country that Georgia could model itself after that would actually make these measures feasible, sort of practical.
Q. Sir, can you give us a couple examples of the

types of measures we're discussing in this case being applied in other circumstances.

A. Sure. I started with the Klamath before, so I'll start with the Klamath now. In the Klamath Basin, there were issues related to in-stream flows -- you know, flows in the river -- and salmon in particular. And farmers had to cut back their water usage in particular dry years. And the way the government did that was they instituted an auction. So they actually paid farmers to reduce their irrigation during certain dry periods to keep the water in the river for salmon.

Q. Would that auction have been somewhat similar to the tools used in the Flint River Drought Protection Act when it was actually being employed?

A. At a high level of generality, yes. There were a number of institutional details in the Klamath program that made it more successful, if I could, than the program in the Flint; but it's conceptually similar.

Q. Now, you have been involved in situations where farmers have been, on a permanent basis, asked to stop irrigating; isn't that right?

A. Yes. That's also quite common.

Q. Can you describe some of those circumstances elsewhere in the country.

A. Sure.

Well, in -- in California right now, we're in the process of a very large-scale unwinding of several hundred thousand acres of irrigated agriculture due to environmental flow considerations.

Another example that I -- sort of more bite-sized that I had quite a bit of personal involvement in is the -- a situation in Nevada in the Newlands Irrigation District, which is actually the first project undertaken by the Bureau of Reclamation in its history. That was another case where, for environmental reasons, there were just too many acres under production. And so the government, working with the Nature Conservancy and the water district itself, started a program where agricultural irrigation rights were retired on a permanent basis both to expand the size of a wildlife refuge, but more importantly to get more water back in-stream.

Q. When you say water back in-stream, was it the purpose of that project to aid aquatic species or

was there a different purpose?

A. That particular project was both aquatic species and then birds. There's a -- in the area outside of Fallon, Nevada, there is a very large national wildlife refuge that they need water to support birds overwintering there in their migratory paths.

SPECIAL MASTER LANCASTER: Excuse me, doctor. Could you speak into the microphone.

THE WITNESS: Sure. Sorry.

SPECIAL MASTER LANCASTER: You don't have to look at me, but she has to get every word you say.

THE WITNESS: All right.

BY MR. PERRY:

Q. Now, sir, Mr. Primis mentioned maybe once or twice the word riparian. Are you familiar with the Imperial Valley and what, if anything, was done there?

A. I am.

Q. Could you describe that for the Court, please.

A. Sure. The Imperial Valley -- let's start with the Imperial Irrigation District is a very large federal reclamation project in the Mojave Desert of California and gets water supply from the

Colorado River. The case of Imperial I think is notable here because the farmers in the Imperial Valley had very senior water rights. They settled that part of California at a very early stage. And historically, farmers in the Imperial Irrigation District had no quantified upper limit on the amount of water they could use, much like Georgia groundwater users in the agricultural sector. And as part of what's known as the Quantification Settlement Agreement on the Colorado River, which I helped negotiate, the farmers in Imperial accepted a cap on their irrigation per acre, much like we're suggesting should happen here. And then they're free to move that water around in whatever way maximizes their productivity.

Q. And when you say move water around, is that between their various fields and among their crop rotations; is that fair?

A. Yes.

Q. Now, you also mentioned, I think a moment ago, the Republican River in Nebraska. Could you just give us just a bit of detail about that, please.

A. Sure. Actually, the only other time I have been to Portland, Maine, was to testify in the

Republican River case. I testified on behalf of the State of Nebraska.

The Republican River has similar environmental flow issues. And something that's notable about that case is that the Nebraska -- the State of Nebraska has overall responsibility for making sure that a consumption cap is enforced. But what the State has done is set up three what are called Natural Resources Districts across the Republican River. And each of those districts represents a particular area. They each come up with a water management plan that makes sense to them, to farmers, and other users in those particular areas. And I describe this in my testimony.

And so what will happen when the State determines what's the allowable amount of consumption under the Compact, they flow that down to the Natural Resource Districts. They actually have to implement the consumption cap, and the State oversees it.

And if there's compliance, great; everybody goes along. If there's noncompliance, then the State has to intervene and request additional measures. But there's both, you know,

back-checking to make sure that the caps are enforced. But, then again, there is an element of local control that makes it more palatable to the growers.

Q. Now, we have talked a little bit in this case about M & I uses, municipal and industrial. And could you give the Court a sense of your real-world, practical experience on that, too.

A. Sure. Well, I'll give you just some recent experience. I know Atlanta has gone through some revisions to its long-term water demand forecast and water supply planning. I actually did the same thing for the Los Angeles and San Diego area combined for an entity called the Metropolitan Water District, kind of a similarly-generic name to what you have in Atlanta. So I did that for LA and San Diego.

I also did it for San Francisco and the Silicon Valley, developed their long-term demand forecast and evaluated the effects of different conservation programs on their usage.

Q. All right, sir. So let's turn to the specific elements of this case. And I would like you just to start briefly by describing how you took that experience and used it to focus on specific ways

to save water here.

A. Sure. Could I actually start with the Ag sector?

Q. Yes.

A. Sure. So the work that I did on the agricultural sector was extremely data intensive, and I tried to implement it very carefully. The State of Georgia has an agricultural metering database. So they have meters installed on a little more than half the agriculture wells in the Flint Basin. And so we took information by well on how much those farmers were using by year and matched that up with satellite information collected by the USDA.

The USDA flies satellites over agricultural areas in the country every 16 days. Each area is covered every 16 days. And they take that satellite imagery and use it to figure out field by field what farmers are growing. It's an incredible amount of information.

So we took Georgia's information on agricultural water use and matched that up center-pivot by center-pivot with what we knew from the satellites about what was being grown on each field. We controlled for soil quality. It's -- also information was collected by the

USDA, and got a picture. Again, a disaggregated picture. So not just looking at basin-wide averages, but a disaggregated picture of what was happening with respect to agricultural water use. So it really, I think, is a -- as an academic, I would say that is a big accomplishment.

Q. And in -- you used the word a few times depletions. And I believe you are referring to rivers or tributaries when you say that. Could you explain that term.

A. Sure. Depletion is a reduction in the amount of water that's in a stream. So you might have one level of water before some action is taken and then another level afterwards.

Q. So, sir, when Mr. Primis was up here, he was asking you about a three-page or maybe it was a four-page assembly of tables. I would like to actually look at your full prefiled direct in pages 44 and 45. So we can go, first, to the specific agricultural measures that you're talking about.

But importantly, there is not just one table on that page 45 -- or 44 and 45; is there?

A. That's right.

Q. And the first of three tables is for 2000. But

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could you describe the other two tables, please?
A. Sure. So I have three tables looking at the fiscal costs of possible combinations of conservation measures that would achieve. The first table, table 4, looks at 2000. The next table on the bottom half of the page looks at 1500 cfs, so less aggressive measures. And then the third table on the next page looks at the thousand cfs.
Q. Now, these aren't the exclusive measures that Georgia could apply to achieve these aims; are they?
A. No, definitely not. And one theme I tried to advance through my different reports is that Georgia has a lot of options for reducing depletions. You know, ultimately they will have to choose which ones make sense for them. But my testimony is that they have a lot of options that are practical that can achieve these reductions in depletions.
Q. And those other options are discussed throughout your prefiled direct; is that right?
A. Yes.
Q. Okay. So let's turn to this question. Why did you choose the specific options you have here on

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table 4 on page 44 of your prefiled direct?
A. What I was trying to illustrate with the way I chose the measures is I have some that impact urban areas and others that impact agriculture. I have some measures that are permanent, some that are temporary and invoked only in dry years. And then I have some measures that through my analysis I have come to believe are quite low cost, and others that might be palatable for other reasons, but might be a little more expensive.
Q. Well, sir, if we might, I would like to start, as you suggested, with just the agricultural measures. Then we'll get back to the measures for municipal and industrial. But I believe the first agricultural measure on your table 4 is titled Eliminate Unpermitted Acreage. Do you see that, sir?
A. Yes, I do.
Q. Could you describe that for us?
A. Sure. Through the course of our work on this case, in particular once we received the complete wetted acreage database in July of this year, what we were able to do is compare what the wetted acreage database says is happening permit

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by permit with respect to the amount of irrigated area and compare that to the actual permit terms. The permit for groundwater withdrawal will specify an amount of land that can be irrigated with each permit.
This is a very simple analysis. We have just compared one dataset entry to another.
Q. And what did you find?
A. What we found is that there are a large number of groundwater withdrawal permits where users are irrigating more acres than they're allowed under their permit conditions, up to something like 90,000 acres.
Q. And that is principally in the Lower Flint Basin?
A. Yes.
Q. Now, the next item on there reads eliminate excessive irrigation on -- of rotation crops. What rotation crops does that relate to?
A. So my analysis concerns cotton, soybeans, and corn. Those are the three that I looked at for this excessive irrigation analysis.
Q. Okay. Throughout this case so far we have heard a phrase that --
A. Sorry. Did I say soybeans?
Q. You did.

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A. I meant peanuts. Sorry.
Q. So, sir, I'm sorry for interrupting you.
Throughout this case we heard this phrase from Georgia's counsel, and I think it said something like wipe out half of Georgia agriculture.
A. Yes.
Q. Is that what you're doing here on this table?
A. Absolutely not.
Q. Can you explain why not?
A. Sure. This is why we went to all the time and trouble to do such a careful analysis of matching up what farmers were growing with what soil type they're operating on and how much water they're using. So, again, we're doing this analysis pivot by pivot.
Q. I'm sorry. Can you describe what a center-pivot is.
A. Sure. A center-pivot system, you know, is the circular area that's irrigated with a center-pivot.
In designing any conservation program, whether it's for residential electricity or agricultural water, the first place you look is to users who are wasting the resource, who are

using way more than some norm. And so by doing such a disaggregated pivot-by-pivot analysis of water use, we were able to identify the fraction of growers who are using more than they would need possibly to grow their crop.

Q. Now, when you say more than they would need, how is that generally measured?

Is it inches, or how does one do that?

A. Yes. It's measured in terms of inches per acre over the course of a growing season.

Q. And do you know if Florida in its part of the ACF Basin has an absolute limitation on the number of inches that can be applied per acre?

A. It does.

Q. But Georgia does not?

A. That's my understanding.

Q. Okay. Pardon me, sir. And in drought years is it your observation that more or fewer inches per acre are applied?

A. Oh, a lot more. Water -- water demand goes up in a very dry year to replace the precipitation that is not coming.

Q. So why would a farmer apply too many inches per acre?

A. You know, in my original report I have this under

a section on management decisions or farmer behavior.

Why do people leave the light on when they walk out of the room? Why do they leave the faucet on when they're brushing their teeth?

This is not an uncommon finding when it comes to utilities and consumer behavior.

Remember, the water that farmers are using, the groundwater that they're using, is very, very inexpensive. They pay nothing for it beyond the energy cost of lifting it out of the ground. So they're just paying, you know, a few dollars per acre. And given that, they don't have much incentive to be careful.

Q. Some are; isn't that right?

A. Some are. You know, people are not robots. Some people are careful. Some people are less careful.

And what we're identifying in this conservation measure is some fraction of people -- it's not a majority; but it's some fraction who are not as careful as they should be.

Q. Now, from your work on agriculture and other contexts, you know that there are ways to save

water that farmers employ when they're adequately motivated to do that. Isn't that right?

A. Yes. I see it in my work all the time.

Economics is fundamentally about incentives, so this is a question I have studied in the area of agricultural water use.

MR. PERRY: Your Honor, may I approach to hand an exhibit to the witness?

SPECIAL MASTER LANCASTER: Certainly.

A. Thank you.

Q. Now, sir, I have handed you Joint Exhibit 154, which we have discussed at some length in this proceeding already. But what I would really like to do is ask you just to focus on the second page as we discuss page 44 of your report. And in particular, the bullet points that are preceded by the sentence, EPD's initial analysis has suggested several options for further evaluation. Do you see that, sir?

A. Yes.

Q. Now, I want you to keep that in mind while we talk about what's on your table 4 on page 44. Okay?

A. Sure.

Q. So the next item on table 4 is -- on your table 4

on page 44 of your prefiled direct is irrigation permit buy-back. Do you see that?

A. Yes.

Q. Now, if you look at JX-154, which I have -- and then you look across to see where it says temporary removal of land from irrigation, do you see that?

A. I do.

Q. All right. Now, temporary and permanent removal are both possible in concept. Right?

A. Absolutely.

Q. And do you see one bullet up on JX-154 where it says acquiring easements for permanent removal of irrigation?

A. I do.

Q. Is that the same concept that you're evaluating in table 4 just under the subheading Additional Agricultural Measures?

A. Yes. Easements are a very common mechanism in my experience for achieving reductions in irrigation.

Remember that what I'm talking about, either a permanent or a temporary buy-back of irrigation rights, that doesn't foreclose the possibility of farming. It's not like these acres shut down.

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They just convert from one type of agriculture; namely, irrigated agriculture, to dry-land or rain-fed agriculture. And so the way one could do that is by acquiring an easement or a restriction on the land that would prevent farmers from irrigating in exchange for some payment of money.

Q. Are you aware of any federal programs that either temporarily or permanently pay farmers not to irrigate?

A. Absolutely.

Q. Can you describe those, please.

A. Sure. Well, the -- again, back to the Klamath Basin. That was a good example of a successful auction program where the farmers were paid to reduce their irrigation or curtail irrigation on certain acres in exchange for a money payment.

Q. And any other federal programs you can think of that put aside acreage for conservation and the like?

A. Of course. At a larger scale, the federal Conservation Reserve Program, which works through a market mechanism, that results in the retirement of millions of acres across the country every year. And other programs that are

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similar would include EQIP and the Wetlands Reserve Program. So this is in my experience a very common type of a public policy.

Q. Now, the next item on your chart -- and I don't want to ask you to spend too much time on this; but it reads deficit irrigation. Do you see that?

A. I'm sorry. Where are we?

Q. I am back in your prefiled direct.

A. All right.

Q. That's why I was trying to refer you to your chart.

But it says deficit irrigation. It's just under the irrigation buy-back on page 24 of your table 4. Are you with me?

A. Yes.

Q. Very quickly, could you describe how that differs from eliminating excessive irrigation?

A. Sure. Eliminating excessive irrigation would prohibit farmers from irrigating above a biological maximum. The deficit irrigation is about reducing water application below the biological maximum. So what happens is farmers might apply a little bit less water and get a little bit less yield; but they're still applying

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some irrigation water.

Q. And then next you have got farm ponds. Do you see that, sir?

A. Yes.

Q. Describe what that means.

A. Farmers have farm ponds, small impoundments that they use for a number of purposes. The ones I'm looking at here are related to production of the rotation crops primarily.

Q. And so a restriction to reduce evaporation would have some effect?

A. Yes.

Q. And that -- is it your view that that would save water and thus reduce depletions in the river?

A. Yes, certainly. Farm ponds evaporate in the hot summer sun, and water is lost to the system -- large amounts of water.

Q. Now, lastly, you have got switch high-value crops to deeper aquifers. And I would ask you, while keeping that in mind, to look at the exhibit I gave you, JX-154.

A. Yes.

Q. And do you see where in this, the same group of bullets, it says transferring water users to deeper aquifers?

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A. I do, yes.

Q. And it's got surface water in Floridan Aquifer users?

A. Yes. This is what -- what was discussed at this meeting was the concept of transferring surface water users and then users on the Floridan Aquifer down to deeper aquifers below the Floridan.

Q. And when you say this meeting, you're referring to JX-154, which is titled Georgia Environmental Protection Division Stakeholder Meeting Summary. Right?

A. Yes. JX-154.

Q. Okay. Now, can you -- and, I'm sorry, back to your prefiled direct again, page 44, switch higher -- switch high-value crops to deeper aquifers. Just very briefly can you describe what that means.

A. Sure. What I'm envisioning here in this measure is switching a fraction of farmers that are producing high-value crops like pecans or farmers who run greenhouses or grow turf grass, switching 75 percent of them -- so not all, but 75 percent from surface water sources in the Floridan down to deeper aquifers.

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So it's the very same measure that was shown in JX-154.

Q. Now, sir, I would like to move up to the top part of the chart. And here, we'll be talking about municipal and industrial use, including but not limited to metro Atlanta.

So you have got municipal leak abatement as your first item there. Just a very short description of what that is and why it's important, please.

A. Sure. The term municipal leaks, I think -- I'm using it the same way Georgia's experts are using it -- this is water that leaks out of the distribution system in urban areas. So between the water treatment plant and the meter on the customer's home or business water leaks out of breaks in the pipe and gaps and whatnot. And that water is lost to the system.

Q. Okay. The next one is the lawn watering or municipal outdoor use, and it is reduced by 50 percent. Do you see that?

A. Yes.

Q. Before -- before I ask you about that, I would like to come back to a couple questions that Mr. Primis asked you about some of your columns

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here on your chart. So the very last column, the farthest to the right reads Incremental financial -- or fiscal cost, pardon me. What does that mean?

A. Well, we'll break it down adjective by adjective. Incremental refers to costs that would be related to any Order that the Court might issue here. So what I'm trying to reflect there is that Atlanta and other cities in the ACF Basin have already undertaken leak abatement programs. And what I'm considering is programs beyond what they're already doing.

Q. All right. And Mr. Primis also asked you to compare this one of three charts on pages 44 and 45 with some charts that were in your original report, right, where it said 1,000 cfs. Is that right?

A. Yes.

Q. How does this concept of incremental financial cost compare or differ from what you did in your initial 1,000 cfs chart that Mr. Primis was focused on?

A. Sure. The main difference is an issue that Mr. Primis and I talked about just a little bit. There is a distinction between fiscal cost, you

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know, what's the actual dollar outlay that's required to achieve conservation savings, and welfare losses that might result from consumer impacts, aesthetics, quality of life. Those are not measures where dollars change hands, but they are impacts that economists consider routinely.

Q. And you did consider and evaluate that here in this report. Right?

A. I mentioned those numbers here in the report as in my first report.

Q. Now --

A. The welfare loss numbers.

Q. Right. Right. Specifically on municipal outdoor use, which I called lawn watering a bit ago, when you say welfare costs, you evaluated that in part by determining whether, through a survey, residents of metro areas in Georgia would undertake additional costs for lawn watering if it meant a particular outcome in terms of water flow. Do I have that right?

A. Yes. That -- I did a couple of things. I did the survey that you were mentioning and engaged whether or not urban residents of Georgia were willing to undertake conservation measures to benefit the Florida environment. But I also

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looked at what urban consumers are actually paying for water. I mean, they're buying water from their local utility to water their lawns and shrubs and wash their cars, use for other purposes. And so I used that information on the actual transactions that are occurring to figure out what's the loss from preventing those transactions from occurring, from imposing an outdoor watering ban.

Q. Now, just pausing a minute to talk about your first expert report just for another minute.

When you put examples in that report for a thousand cfs, was that part of a series of data points that you made available to the State of Georgia on how each of these measures worked?

A. Absolutely. I turned over all my models for both urban and agricultural conservation costs. And I thought I made plain from the beginning that these models can be used to measure a whole range of outcomes. In the reports, each one I'm examining just particular combinations or points on a curve; but the underlying point is that my models evaluate a range of outcomes. And Georgia has had all that for some time.

Q. So when Mr. Primis infers from his comparison of

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your charts that your number or your methodology has somehow dramatically changed, is that fair?

A. No.

MR. PERRY: Now, your Honor, it's just about 2:30, which is our typical time for a break.

SPECIAL MASTER LANCASTER: It's fine by me.

MR. PERRY: Okay. We'll have a short break.

(Time Noted: 2:30 p.m.)

(Recess Called)

(Time Noted: 2:40 p.m.)

SPECIAL MASTER LANCASTER: Ready?

MR. PERRY: Thank you, your Honor.

BY MR. PERRY:

Q. Dr. Sunding, do all farmers in Georgia irrigate?

A. No, sir. No. Certainly not.

Q. About what percentage do?

A. Well --

SPECIAL MASTER LANCASTER: Mr. Perry, do you want to just raise that microphone a little.

Thank you.

MR. PERRY: Is that better?

SPECIAL MASTER LANCASTER: Much.

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A. Do you want to ask the question again?

Q. I will. What percentage of Georgia farmers in the Flint and Chattahoochee Basin irrigate?

A. It's about half.

Q. And have you looked to see the number of farmers with small farms or large farms that irrigate?

A. I have. The agricultural census that the USDA performs every five years has statistics on the fraction of farmers that irrigate over different size categories.

Q. All right. And do larger farms tend to irrigate more or irrigate less, or is there any statistically significant difference?

A. There -- larger farms, you know, over several hundreds or several thousand acres, tend to irrigate somewhat more; and some smaller farms tend to irrigate more. So there is somewhat of a pattern in the data. But there are farmers across every size category, significant numbers, that chose not to irrigate in the ACF Basin.

Q. Why would it be economic not to irrigate?

A. Well, to -- to understand -- you know, we have heard a lot in the questions from Mr. Primis about the benefits of irrigation. There are costs of irrigation as well. And when farmers

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make a decision about whether or not to irrigate, they're making an economic choice. To irrigate, farmers have to, in the first instance, purchase equipment, very expensive equipment like a center-pivot system, to apply irrigation water. So there's a cost -- an upfront capital cost of irrigating that farmers would have to compare to the benefits of irrigating.

Another category of cost is the cost of the water, lifting it up out of the ground, if farmers are irrigating with groundwater.

Q. Would that be a pump?

A. A pump, exactly. So they have to pay an energy cost, and the cost of the well and the pump to get that out of the ground.

Q. Now, you mentioned, when Mr. Primis was up here, crop insurance. Is that -- is the premium for crop insurance federally subsidized?

A. It is. Crop insurance is not what we call actuarial fair, meaning that the payouts don't have an expected value equal to the premiums.

Q. Do farmers have the option to insure against some loss in yields and perhaps a loss of a crop in an extreme circumstance through crop insurance?

A. They do. There are federal programs that insure

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against crop loss, including drought loss.

Q. And including yield and not to the entire crop?

A. Yes.

Q. So, sir, I would like to focus back now where we were before the break. That's on page 44 of your prefiled direct, table 4. And now, I would like to ask you to do something a little different.

I understand you have some markers up there, and I can see the tablet. I want to make sure the Court can see the tablet.

But if you don't mind, sir, I would like to have you rise and identify graphically what your 2,000 cfs actually means. And we can do it item by item on your chart; but if you could draw that out, I would appreciate it.

A. All right.

SPECIAL MASTER LANCASTER: Doctor, please keep your voice up.

THE WITNESS: I will.

SPECIAL MASTER LANCASTER: Thank you.

THE WITNESS: I'm used to teaching, so I can talk loud.

Can I move this a little bit --

MR. PERRY: With the Court's permission.

THE WITNESS: -- so you can see it?

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A. Is that all right?
Q. It's fine with me.
MR. PERRY: I want to make sure that the Court --
MR. PRIMIS: Do you have a marker?
THE WITNESS: I do.
Can you see what I'm --
MR. PRIMIS: I'll make it over there if I need to.
THE WITNESS: Okay. Sure.
BY MR. PERRY:
Q. Please proceed, sir.
A. All right. So what Mr. Perry asked me to illustrate was how do these conservation measures add up to a 2,000 cfs reduction in depletions. And so I will draw it like this.
So on this axis, what I would like to show is months of the year. So we'll do this over a calendar year and start in -- start in January. And then we go through June and then on to December. So this is, you know, as we go throughout the calendar year.
And then what I would like to show on this axis is a reduction in consumptive use that results from implementing different measures.

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Okay. So just to get oriented what I'm showing here, so with a measure like leak abatement, which is one of the measures I'm talking about --
Q. Is that a municipal measure, leak abatement?
A. It is. This is fixing the leaky pipes in the distribution system.
The leaks in the pipes happen as a result of pressurization. The water in the urban system is under pressure to move it around. And so the leaks happen all-year-round because the system is under pressure all-year-round. So a program of leak abatement would result in a reduction in consumption that was about the same from one month to another, again, because the water is under pressure.
So this would be, say, leak abatement. So I'll just call that leaks.
And then a second measure would be reducing urban outdoor use, say, through an outdoor watering ban, like what Atlanta put in place in 2008.
So if that were to happen, there's not much irrigation in January. Nobody waters their lawn in January, at least they shouldn't be. But that

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irrigation, the outdoor water use, is higher in the summertime, so higher in, like, the June-July time frame.
So if you stopped water use, the reduction in depletions you would get would look something like that (witness drawing).
Q. And, again, that's a municipal type of measure. Right?
A. Yes.
So then let's move to the agricultural side and measures that reduce agricultural consumption, permanent or temporary buy-back, measures like deficit irrigation.
Crop water use also peaks out in the summertime. And so what that would look like is something like this (witness drawing).
And I drew it a little bit larger because there's more agricultural water use than urban.
So when I talk about a measure that improves streamflows by 2,000 cfs, I'm evaluating that at the peak month, which is June.
Q. Now, why would there be more use in June than, say, January?
A. Because both -- what has a temporal pattern is the outdoor water use and then the crop

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irrigation because crops grow in the summertime, and they need more water. The plants use more water in the summer.
Q. Now, one related question, if I might, sir. Does this differ from year to year how your curves look?
A. Yes.
Q. And why is that?
A. Well, what would happen, say, if we looked at a year that was drier than the one I'm drawing up here, in a drier year, absent any kind of policy, both residential consumers and farmers have higher demand for water. So these curves would be higher.
Q. Could you help us by totaling out and showing graphically what the combination of those measures would be?
A. Sure. So what I would do is add these up month by month. So I'm going to add them up this way, you know, vertically. And what I would get would be something that would look like that. So this would be the total.
Q. And can you identify, just keeping in mind your chart that says 2,000 cfs -- it's table -- I should say your table, it's table 4, where that

2,000 cfs would fall.

A. It's right there. I'm labeling that as agricultural and outdoor water use.

Q. Okay. I'm sorry. What I was trying to ask was could you put a point on that drawing that shows where 2,000 cfs would be.

A. Sure. The sum total of the reduction in consumption from these three measures in this example has a peak value of 2,000.

So when I talk about 2,000 in those tables that Mr. Perry is showing up there, this is what I mean. So 2,000 reduction in peak usage. But there are also reductions that happen in other times of the year.

Q. Now, we haven't talked about net basin exports; but you could easily -- we didn't put it on the chart yet, but you could easily factor that in, too. Right?

A. Yes. Sure. That would be another line like this red one down here.

Q. Okay, sir. Now, in various places in your prefiled direct testimony you talk about peak use. Is 2,000 the peak use there?

A. Well, 2,000 is the peak reduction. The actual usage could be much higher than that.

Q. That's a fair point. And you have used the term depletions; you defined it for me before. Is that 2,000 a depletions number?

A. Yes.

Q. And that means that that much river water wouldn't be used and, therefore, you would have that much more?

A. That's correct.

Q. Okay. Now, I would like to focus just for a moment on how this type of cap on depletions or consumption might be administered.

A. Can I sit?

Q. Sure. Sit back down.

MR. PERRY: And if I could approach, your Honor, I would like to hand out --

SPECIAL MASTER LANCASTER: Please.

BY MR. PERRY:

Q. Now, sir, what I have just handed you is our effort to capture your beautiful drawing on an exhibit. And it's Florida Exhibit 895.

But what I would like to talk about now, given your experience with all the other agricultural reduction measures you have talked about in other places, how this type of depletion or consumption cap could actually be managed. So

could you give us your thoughts on that, please.

A. Sure. Like I illustrate in these tables, I think a way that Georgia could -- could implement a consumption cap, again, Georgia has already considered itself as we have been through a few minutes ago in the last document you showed me.

What I have in mind here is a combination of permanent easements, permanent buy-backs, additional buy-backs of irrigation rights that could be put in place in dry conditions, and then limitations on amounts of water that farmers could use beyond that, if they chose, you know, not to take the buy-out and go ahead and continue irrigating.

Q. So --

A. So what -- you know, what I have in mind there would be to implement the deficit irrigation scheme. What Georgia could do is what the states do all over the country and tell farmers, well, look, you can't use 20 inches or 30 inches or 14 inches in this year given drought conditions. You only have 8 inches or 6 inches. Now, you use that the way you want, but you only have this much water per acre. And it's less than what you're used to and less than what you need to

grow at the biological maximum.

Q. So, sir, let me ask my question just a bit differently than that, if I might. You talked about Newlands and Klamath and Imperial Valley and Republican River; and I would like to get a picture, given all of your experience, as to how an independent administrator of a depletion or a consumption cap might actually, as a practical and verifiable manner, go out and ensure that Georgia, using whatever measures they chose, including among your options, actually complies. So could you help us work through that issue?

A. Sure. The big issue there, I think I would see immediately, is how do you know that whatever measures you put in place on the ground are, in fact, reducing consumption by the amount that the Court requires. So there is an element of verification, and that involves a suite of measures that in my experience are pretty commonly done. You would want to look at how much water farmers are actually using, so back to the metering issue. You would want to be monitoring that. You would want to take a look at what is happening with respect to -- you know, look around the landscape and see what areas are

being irrigated and which ones are not. But then beyond that, I would go and look at or I would think that the State would want to go and look at stream gages and actually check and see what's happening in the river and are you getting the responses that you think you should get that -- given whatever consumption cap is in place that year.

So the combination of looking at what farmers and urban users are actually doing and then does that translate into environmental changes in the way that one would think.

Q. Okay. Sir, there's a concept that hasn't come up much yet in this trial; but I would like your help with it, adaptive management. What do those two words mean?

A. Sure. So adaptive management is a very common concept in environmental management situations. And what it involves is setting some goals, some environmental performance goals, and enacting measures to achieve those goals. And then you check and see, did things perform the way you thought? If not, then maybe we need some course corrections. Maybe we need other measures, tougher, looser, whatever. But it's adaptive.

You don't just set a set of policies in place for all time and never revisit them. It's adaptive. You check and see how the environment is responding and go back and adapt as needed.

Q. So you mentioned in particular earlier Imperial Valley where farmers could move their water around. And there was a -- I think you said a water district. Thinking about your concept of adaptive management, in that context or other context, what does that actually mean in terms of verifying that the results are being achieved?

A. Right. So in -- in that case, they actually have an extensive verification program where they will look at satellite imagery. They look at water metering in the way I was discussing to make sure that compliance is being achieved.

Q. Now, sir, I would like to come back to some of the charts that Mr. Primis examined with you. And the first of those is under a tab in the binder he handed out called Sunding Demonstratives. It's titled Sunding M & I Remedy Versus Total M & I Consumption. Can you try to find that and let me know when you have.

A. I have quite a pile built up over here.

It must be in the back.

All right. Yes, I have it.

Q. Now, when Mr. Primis was asking you about this, I think he referred to Dr. Flewelling a few times and Dr. Hornberger, too. But I think you wanted to explain in a little more depth when you were testifying about this what your response was to Mr. Primis's questions. So I would like to invite that explanation, if I might.

A. Sure. Well, the implication of Mr. Primis's question is that I'm asking for more reduction in consumption than is actually taking place, at least in most years. And I don't think that's accurate.

Q. Now, this chart doesn't include all of the relevant consumptive use; does it?

A. No, it doesn't. This chart doesn't include, for example, urban systems that are serviced by groundwater sources. This is only surface water. And groundwater is about 15 percent of the total water supply in this area.

Q. So in a hot and dry summer, what percent of urban consumption would be outdoor water use?

A. It's -- you know, it varies by sector. I would say multi-family residential will have a smaller outdoor percentage than businesses or single-family

residences. But it's in the neighborhood of 20 percent in this part of the country.

Q. Okay. Now, if you could turn with me, please, to the tab that's called -- that's marked -- that's labeled Florida Complaint.

A. All right.

Q. And there I would like you to turn with me in this tab to page 21, which was also a focus of some of Mr. Primis's questions.

A. Page 21?

Q. Yes, please, sir.

A. All right.

Q. Now, sir, I believe Mr. Primis was referring to what's labeled Prayer For Relief there. And there's an indication there of a date, January 3, 1992. Was 1992 a very wet year; do you know?

A. I don't believe so, but I don't know.

Q. And -- it wasn't a drought year though; was it?

A. No.

Q. All right. Now, in a nondrought year you're going to see substantially less consumption of water than in a severe drought year. Right?

MR. PRIMIS: Objection, your Honor. Leading.

BY MR. PERRY:

Q. What, if any, difference in the amount of water would you expect between a severe drought year and a nondrought year?

A. Well, as we discussed and what I believe is shown on the figure that we were just looking at, the amount of consumptive water use can vary considerably between average, wet, and dry years because the outdoor water use changes quite a bit between those scenarios.

Q. So let me focus just a minute on agriculture again. And when we're thinking about the amount of water used on a field, not just the acreage, it's the amount of water applied; is that fair?

A. That's right. Agricultural water demand is the product of the number of acres irrigated times the amount of water that's applied per acre.

Q. Could you explain what you would expect in terms of the amount of water applied per acre in a drought year as opposed to a normal or a wet year?

A. Sure. I actually have dry figures on this through my analysis. And this is what Georgia farmers are actually applying in different types of water years.

If you look at my direct testimony on page -- on page 15, for example, if you look at table 1, I have derived figures here for average irrigation depths for different crops grown in the ACF Basin. And I have compared them between average or nondrought years and drought years.

Q. So let me just invite your attention to the totals at the bottom for average irrigation depth in a nondrought year. Do you see that?

A. Yes.

Q. And could you compare that for us with the average for a drought year.

A. Sure. The average depth across the range of crops grown in the basin in a drought year is 15 inches per acre. So, you know, 1-foot-3-inches per acre. And in a nondrought year, the average water use is only 9.1 inches per acre.

Q. Okay. Would you regard that as a significant difference?

A. Oh, yes.

Q. Now, Mr. Primis also mentioned Dr. Phaneuf. You know Dr. Phaneuf; don't you?

A. I do.

Q. And I believe he was attempting to discuss the way that either you or Dr. Phaneuf had referred

to or valued the basin in Florida -- part of the ACF Basin in Florida. Do you remember those questions?

A. I do.

Q. All right. Could you focus with me for a moment on how an economist would look at a pristine natural area like the ACF -- or like Florida's part of the ACF Basin?

A. Sure. What we normally do to come up with an economic value for a natural area is to consider what we call ecosystem services, so a range of benefits to human beings that flow from those environmental resources.

For example, a forest could be used for cutting timber; that would be a commercial use. It could be used for hiking or bird-watching; that would be a recreational use. And it might also have some value as habitat for endangered species or, you know, other types of amenities.

Q. And you teach at California, Berkeley. Right?

A. I do.

Q. Now, has there been a change in the way that the faculty there in your department instruct students as to how to look at ecosystem services over the years?

A. There has been. I'm the chair of the Department of Agricultural and Resource Economics at Berkeley. We are, I don't mind saying, by any measure the No. 1 department in the field in the world. We produce more graduates who go on to distinguished academic careers in environmental and resource economics than any other program.

Our faculty got together a few years ago and decided that we had enough misgivings about the valuation of what are sometimes called nonuse values -- so these values other than things like recreation and commercial activities -- that we were actually not going to include that in the graduate curriculum anymore. So we do not teach that because we don't think it's reliable enough, and there is not enough scientific consensus that those methods are worthwhile.

Q. But that doesn't mean, sir, that economists don't understand the value of a pristine natural area?

A. No. Definitely not. There are things that we can look to, like I have done here. For example, conservation investments that are made by a state or by nonprofit groups here like the Nature Conservancy or Trust for Public Land as being an indicator of value.

2895

Q. And you weren't here when Secretary Steverson was presented and Georgia decided not to cross him, but are you aware of all of the investments that the State of Florida has made to preserve the pristine nature of the river and bay?

A. Yes. I think I even included some of those statistics in my direct testimony. I think the number is something like almost half a billion dollars.

MR. PERRY: Your Honor, may I approach to hand out one more item?

SPECIAL MASTER LANCASTER: Certainly.

BY MR. PERRY:

Q. And, sir, what I believe I have handed you is a page from Mr. Primis's opening statement. And part of the text on that page is gray. It -- the question posed is apart from the survey, and then it begins in black text. Could you tell us what the survey is there and why graying out that text struck you as inappropriate?

A. Sure. Graying out that text changes the meaning of the question.

I conducted actually an extensive amount of work to understand attitudes in Florida and Georgia and Alabama toward the environmental

2896

resources in the basin. And by that I mean both gauging the public's awareness of these resources and then whether or not they spend time and money to recreate at different sites in the basin.

And so, again, I think this -- this question is disappointing because to me it reads other than the part of your work where you attempted to value the environment, did you value the environment?

But that -- that was the point of doing the survey.

MR. PERRY: Your Honor, I believe I have one more exhibit I would like to hand up. Just one.

BY MR. PERRY:

Q. Now, sir, this document is something that I'm fairly -- this document was a document used with Dr. Cowie just a couple days ago when she was here. And have you seen it before?

A. I have, yes.

Q. Now, the first page of the document is labeled UGA River Basin Science and Policy Center. Do you understand UGA to be the University of Georgia?

A. I do, yes.

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Q. Now, I would like to invite your attention, if I might, to page 24 of 34. And there -- have you found that page yet, sir?

A. I have it, yes.

Q. Okay. There I asked Dr. Cowie, during the exam earlier this week, about the last two sentences there -- it's actually the last sentence. And in particular the sentence begins with, quote, the issue of what is practical will cost. Do you see that, sir?

A. I do.

Q. And then it ends with at least 3.5 million for each million gallons of water per day. Do you see that?

A. I do.

Q. Now, your report goes through in some level of detail, as we have discussed, a wide range of options for Georgia; and you assigned costs to them. Do any of your options approach that type of cost level?

A. No. They're far less than 3.5 million per mgd -- per million gallons per day.

Q. All right. Thank you, sir.

MR. PERRY: Your Honor, just give me a moment while I gather my things to sit down.

2898

SPECIAL MASTER LANCASTER: Sure.

RECROSS-EXAMINATION

BY MR. PRIMIS:

Q. Hello, Dr. Sunding.

A. Hello.

Q. Mr. Perry gave you this slide from my opening. Do you remember that?

A. I can't see the slide.

Q. It's the one with the picture of you.

A. Yes.

Q. And just to be clear and also to be fair, when I asked you the same question today, Dr. Sunding, I introduced the survey. And I said, apart from the survey, have you attempted -- and then the rest of the question. You recall that. Right?

A. I recall you spoke those words today, yes.

Q. And so your sworn testimony reflects this entire question and the same answer. Correct?

A. Yes.

Q. Now, with regard to this survey, you did the survey; and then you gave it to Dr. Phaneuf. Right?

A. That's right, yes.

Q. And Dr. Phaneuf relied on it for his testimony. Correct?

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A. Yes.
Q. And Dr. Phaneuf isn't coming to trial. Correct?
A. That's my understanding.
Q. Now, Dr. Sunding, we talked about the scenarios where you had four at a thousand back in February; and then you ended up with 2,000 in May and in your trial testimony. Do you recall that?
A. Yes. That's -- it's not quite the full picture. But I also had 1500 in my first report.
Q. Right. And I'm just trying to be efficient.
I acknowledged you had 1500 in your first report when I crossed you before. Is that right?
A. Yes, you did.
Q. So, Dr. Sunding, when I asked you at your deposition why you went from 1,000 to 2,000 cfs, you refused to answer that question. Correct?
A. Yes. I couldn't divulge conversations with counsel.
Q. I said, why did you do it? You said, I can't answer that question without disclosing conversations with counsel; it's privileged. Correct?
A. That's right.
MR. PRIMIS: No further questions.

2900

SPECIAL MASTER LANCASTER: Mr. Perry?
MR. PERRY: Nothing further, your Honor.
SPECIAL MASTER LANCASTER: Doctor, I don't believe you have been here when I explained I'm not trying to be rude, but I have to look into the microphone so that Claudette can take down what I'm trying to say.
So --
THE WITNESS: Okay.
SPECIAL MASTER LANCASTER: So, first, welcome back.
THE WITNESS: Thank you.
SPECIAL MASTER LANCASTER: You had the privilege and the pleasure of appearing before my former partner, Bill Kayatta, who is, for his brilliance and other characteristics, now on the 1st Circuit. I'm about to prove that there is a reason that I'm not Bill Kayatta.
In doing your work and making your recommendations, did you consider the possibility of disengaging the Upper and Lower Flint?
THE WITNESS: Could you -- could you

2901

explain what you mean by disengaging?
SPECIAL MASTER LANCASTER: By that I mean cutting off the two stretches.
THE WITNESS: I'm not sure that that would factor into my -- I'm trying to think how it would factor into my economic analysis. Most of the agricultural water use that I considered is in the Lower Flint.
But, no, I don't think I considered that specifically, the Upper and Lower Flint.
SPECIAL MASTER LANCASTER: I'm sorry. What was your answer?
THE WITNESS: Oh, that most of the agricultural water use I looked at was in the lower part of the Flint River Basin. So if you meant disengaging the upper and lower parts of the Flint; or did you mean upper and lower parts of the basin -- the overall basin?
SPECIAL MASTER LANCASTER: Not necessarily.
You didn't consider the possibility of disengaging them in any way?
THE WITNESS: Well, if -- I want to make sure I'm understanding your question. Most

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of the urban water use occurs in the upper part of the ACF Basin. And most of the agricultural water use occurs to the south of that in the lower part of the basin. I considered measures that would reduce consumptive use in both; but I have some measures that only impact use on the Flint. So if that's what you mean by disengaging, then I did have some scenarios that were Flint only.
SPECIAL MASTER LANCASTER: Are you familiar with the -- the Georgia agricultural metering program?
THE WITNESS: Yes, your Honor. The metering data was the basis for my analysis of, say, the excessive irrigation and deficit irrigation.
SPECIAL MASTER LANCASTER: Are you familiar with the 2006 Flint River Basin Plan?
THE WITNESS: Yes, your Honor, I am.
SPECIAL MASTER LANCASTER: Are you familiar with the ACF Stakeholders Sustainable Water Management Plan?
THE WITNESS: I'm less familiar with

that, but I have seen it.
SPECIAL MASTER LANCASTER: And what's your opinion on it?
THE WITNESS: My -- my read of the Stakeholders Plan was that it was not definitive. It had a number of ideas for measuring drought, developing drought indicators, potentially reducing consumptive use. So it did address a range of measures; but I'm not sure I have an opinion on it beyond that. It did not seem like a complete conservation strategy.
SPECIAL MASTER LANCASTER: Are you familiar with the terms of the ACF -- of the tri-state ACF Compact?
THE WITNESS: Only in a general sense.
SPECIAL MASTER LANCASTER: Are you familiar with the Stripling Irrigation Research Project?
THE WITNESS: Yes, your Honor, I am.
SPECIAL MASTER LANCASTER: Are you familiar with the Flint River Partnership?
THE WITNESS: That, no, I'm not.
SPECIAL MASTER LANCASTER: Are you familiar with the Flint Soil and Water

Conservation District?
THE WITNESS: Yes.
SPECIAL MASTER LANCASTER: And you took those into consideration in making your -- writing your opinion and making your recommendations?
THE WITNESS: I believe so, yes.
SPECIAL MASTER LANCASTER: Now, doctor, you testified to a huge volume of resources that are available from federal and other national sources. Correct?
THE WITNESS: You mean money resources or --
SPECIAL MASTER LANCASTER: I mean all kinds of resources. You testified to satellites and other things.
THE WITNESS: Oh, sure. Those are programs that are undertaken by the USDA and other federal agencies.
SPECIAL MASTER LANCASTER: And would it be possible to apply those items to Florida as well as to Georgia?
THE WITNESS: Absolutely. Those satellites see everything.
SPECIAL MASTER LANCASTER: But you

weren't asked to do that?
THE WITNESS: No. No. The contribution of the streamflow depletion resulting from Florida agriculture in this part of the basin is an order of magnitude less than what occurs in Georgia. I think it's less than 50 cfs in total.
SPECIAL MASTER LANCASTER: Would your proposed M & I remedy exceed the total M & I consumption?
THE WITNESS: It absolutely would not. In fact, the M & I measures that I proposed have already been accomplished once before by Atlanta when they imposed that outdoor watering ban. The reduction in consumptive use that actually occurred in 2008 is almost exactly the number that I calculated in my report.
SPECIAL MASTER LANCASTER: Further cross?
MR. PRIMIS: No, your Honor.
SPECIAL MASTER LANCASTER: Mr. Perry?
MR. PERRY: No, your Honor.
SPECIAL MASTER LANCASTER: You're off the hook.

THE WITNESS: Thank you.
SPECIAL MASTER LANCASTER: Why don't we take our recess now.
MR. PERRY: Yes.
(Time Noted: 3:25 p.m.)
(Proceeding adjourned to Friday, November 18, 2016, at 9:00 a.m.)
(End of day)
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CERTIFICATE

I, Claudette G. Mason, a Notary Public in and for the State of Maine, hereby certify that the foregoing pages are a correct transcript of my stenographic notes of the Proceedings.

I further certify that I am a disinterested person in the event or outcome of the above-named cause of action.

IN WITNESS WHEREOF, I subscribe my hand this 10th day December, 2016.

/s/ Claudette G. Mason
Claudette G. Mason, RMR, CRR
Court Reporter

My Commission Expires
June 9, 2019.

THE REPORTING GROUP
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