County of Maui Water Supply

BOARD OF WATER SUPPLY

COUNTY OF MAUI

COMMITTEE OF THE WHOLE

Taken at the David Trask Building, Conference Room 207, Wailuku, Maui, Hawaii, commencing at 1:00 p.m. on October 22, 2001 pursuant to Notice.

REPORTED BY: GLORIA T. BEDIAMOL, RMR/RPR/CSR #262

IWADO COURT REPORTERS, INC.

Members present:

Peter Rice, Chair

Clark Hashimoto

Mike Nobriga

Jonathan Starr

Orlando Tagorda

Kent Hiranaga

Staff present: David Craddick, Director

George Tengan, Deputy Director

Herb Chang, Engineering

Fran Nago, Board Secretary

Others present:

James Williamson

Dorothy Williams

Glen Shepherd

Diane Shepherd

Doya Nardin

Alan Arakawa

Sally Raisbeck

Mo Moeller

Ed Lindsey

Steven Anthony

Steven Gingrich

John Mink

Bill Meyer

Roy Hardy

Eric Hirano

TRANSCRIPT OF PROCEEDINGS

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CHAIRMAN RICE: I'm going to call to order the meeting of the Board of Water Supply, Committee of the Whole. It's Monday October 22nd, 1 p.m. Present board members are Howard Nakamura, Kent Hiranaga, Orlando Tagorda, and Clark Hashimoto. Director David Craddick. Fran, you know staff and members of the public who are present.

Vice-chair Howard Nakamura has recused himself from chairing the Committee of the Whole and central water availability. If there's no objection from the other board members, I'll assume the duties of the chair. Hearing none, we'll proceed.

There are no minutes from the previous meeting. Is there testimony from the public at this time? We have two items on the agenda, if there's members of the public that would like to testify on Upcountry, let's do that first.

Sir, come up here, state your name and fire away.

Let the record show Mr. Starr walked in. No business has been transacted at this point.

DICK MAYER: My name is Dick Mayer, and I'm board member of the Kula Community Association. I'm the coordinator for the mauka group. I understand on the agenda was to be a statement by Mr. Craddick regarding the Upcountry situation. I know you'll be talking about water meters later on today at the meeting -- the requirements to both of those.

It was pleasing to read in the Maui News that the board obtained rights to 100,000 gallons of water from the Dowling Company. It was also reported that the water department plans to issue additional meters. The water board and water department surely knows that the Makawao-Pukalani-Kula Community Plan makes a very specific statement on the priority allocation of water.

In several places in the plan, it states that the highest priority for the allocation of water should be for the use of the diversified agriculture and Hawaiian Homelands development.

For example, on page 34 of the Makawao-Pukalani-Kula

Community Plan, it states, "Prioritize the allocation of water as new resources and improvements become available as follows: (a) for maintenance and expansion of diversified agricultural pursuits and for Department of Hawaiian Homelands projects; and then (b) for other uses including houses, commercial and public/quasi public uses."

This concept is repeated many other places in the plan. See, for example, page 11, under "Water," and again on page 28, No. 2 of the plan, it states, quote, Recognize and support the allocation of water resources for the Department of Hawaiian Home Lands projects, consistent with the State and Federal Laws, unquote.

The water board and water department is required to follow the community plan and its unambiguous clarity with respect to water use.

Existing residents of the Kula area have often been put on both voluntary and enforced water-use restrictions during the past few years. Therefore, before any new meters are issued, the department must assure the existing residents in ordinance that they will no longer be put on water-use restrictions.

If such a binding assurance cannot be given, then

you will only create a bigger problem if even more meters are issued. In other words, existing residents plus new meter-holders will be put on both -- both will be put on restricted use.

In summary, the water board, water department and water director should (a) follow the Makawao-Pukalani-Kula community plan; and (b) protect the existing residents from future water restrictions.

I was also vice-chair of the Upcountry advisory committee that helped develop the plan assigned by the mayor.

CHAIRMAN RICE: Thank you, Mr. Mayer.

Any questions from the board members? Mr. Starr?

MR. STARR: Mr. Mayer, water service usually has a certain percentile of dependability associated with it. Are you saying that there should be absolute 100 percent dependability that even in, say, a hundred -- historic drought, it would be wrong for there to be cutbacks, or is there, in your view, a limit to what degree of dependability -- because usually systems are not created for 100 percent dependability.

They are created for a little less than that.

DICK MAYER: Does the board have a percentage of dependability that they use as a standard?

MR. STARR: I don't believe we do, but I'm asking --

DICK MAYER: I'm asking a standard be set for dependability for existing residents before additional meters be put on line that would endanger the existing residents further, as well as the new people also being endangered. There's -- some standard cannot be set -- I think it should be set so that existing residents will not be impacted. If more meters continually are given out, all we do is keep adding to the problem for more and more people.

One of the things you certainly should consider would be a standard that will not allow -- if we don't have enough water to guarantee 99 percent, 98 percent, whatever that percentage would be, I think we really should question whether we should be issuing meters since Hawaiian Homelands has first priority, and agriculture as well.

CHAIRMAN RICE: Any other questions of Mr. Mayer?

Thank you.

DICK MAYER: Thank you very much.

CHAIRMAN RICE: Any other public comments on the Upcountry water situation, source adequacy? Let me make a statement at this time. The Board of Water Supply, Committee of the Whole has had two meetings on the Upcountry water situation and we would like to focus today on the Central Maui source availability. So that is really going to be more of our focus at this meeting today.

So hearing and seeing no other comments on Upcountry, we'll move into certification of Central Maui source availability. Is there any public commentary on that issue at this point? Sir? I see Mr. Williamson.

Let the record show the arrival of board member Michael Nobriga.

Go ahead, Mr. Williamson.

JAMES WILLIAMSON: Good afternoon. I'll apologize

to those who have seen most of this before; but there are a lot of people who have not, so we're going to go through the flip charts as before. And there is one being added to it.

My name is James Williamson. I am representing Maui Meadows Homeowners Association. The board is being asked by the director to confirm the water availability for the Central Maui system. He has submitted a three-page letter dated September 26th as the basis for this requested information. We find that the director's analysis is fatally flawed in a number of significant respects and results in a recommendation for water availability that is unrealistically optimistic and not "very conservative" as stated.

There are several assumptions which are questionable. However, there are two principal subjects in this report which in themselves result in the conclusions being very inaccurate as follows:

First, contrary to the report, the Iao and North Waihe'e aquifers are directly hydraulically connected, so that the sustainable yield from North Waihe'e is not 8 million gallons a day but close to zero - nada.

The statement that the water level head is so much greater than the actual head is invalid, and is contrary to the

USGS findings. It's based on unsubstantiated extrapolation of an empirical analysis for two very limited pump shutdown tests, and incorrectly assumes up to 700 feet of fresh water available over the entire aquifer.

President Williams will assist me in showing flip charts which demonstrate the impact of these assumptions on the lack of availability of water from the Central Maui water system.

Flip chart 1. This is a map that shows -- this is a map that shows the plan of the Iao aquifer, estimated plan of Iao aquifer, and also where the North Waihe'e wells are being drilled. Note how close the North Waihe'e wells are to the aquifer boundary.

There is no physical barrier between these two systems, and obviously the North Waihe'e wells are basically simply an extension of the Iao aquifer proper.

Flip chart 2 --

MR. CRADDICK: We need to let the board members see what's going on.

JAMES WILLIAMSON: This map shows highlighted location of wells, North Waihe'e, test hole A1, and the deep monitor wells and test hole B. Note the remarkable similarity in the pattern of the Iao aquifer and the North Waihe'e wells systems.

Now, of course, if there's going to be some kind of a drawdown from North Waihe'e, that early -- in early years, there was very little pumping, so you would expect that to have been close to the level and it's not level. It follows very closely the shape of the well systems, water level systems in the other aquifer. Those are all in the Iao aquifer itself.

This flip chart and the previous map demonstrates that there's no separation between the two well systems, and therefore the estimated sustainable yield of 20 million gallons a day, not 28 million gallons a day, applies to the combined well system.

Flip chart 3. This is a plan which compares -- a table which compares the water availability as posed by the director and the Maui Meadows Homeowners Association. The director has a subtotal of 30 million gallons a day and we are showing 21 1/2 million gallons a day.

Now, you'll note that we have Iao stream which shows

at 1 1/2 million gallons a day, and the director actually shows the tunnel has 2 million gallons a day. We found out later that the Iao stream is no longer connected and -- because the contract has lapsed and therefore it should be zero where we have 1 1/2 million gallons a day.

We have a real discussion about whether the tunnel is already in the 20 million gallons a day and should not be separate. Even assuming no contingency allowance, we show a deficit of 1.9 million gallons a day versus a surplus of 3.6 million gallons a day.

Flip chart 4. This is a critique of the water level head calculations, which was just done recently. This, first of all, was an empirical analysis used because the data did not fit the more exact hydraulic equation.

Second, empirical method made a number of assumptions, any of which could invalidate the results. It is to be expected that there would be some nominal increase in the water level during a pump shutdown. Further, the increase in water level could simply be the result of inflow into the aquifer.

Four, we believe it is really stretching to

extrapolate a 7-inch rise in water during a test to arrive at an equilibrium head of 17 1/2 feet.

Five, as I will discuss on the following flip chart 5, a principal erroneous and unsafe assumption is that the underlying freshwater lens is the same depth of about 700 feet as measured in the Waihe'e deep monitor well over the entire area of the aquifer.

It's also based on the ratio of the depth of the freshwater lens to the head to be 40 to 1, which is an unverified assumption for this site.

The director's assumption is that the equilibrium head for the aquifer is much greater than the existing head, 17 1/2 feet versus 7.5 feet. If this is so, why hasn't the water level increased, rather than falling, since pumping on the Iao aquifer proper has decreased over the last several years?

Flip chart 5. This chart shows the chloride concentrations for Mokuhau and Waihe'e Height wells. These are the wells which have shown chloride levels that are getting close to the legal limit. Mokuhau 1, 2 and 3, the elevation of the bottom of the holes is about minus 250 and the chlorides are around 250 parts per million.

Waiehu Heights A and B, the elevation of the bottom of the wells varies from 206 to 338 below sea level and the chlorides are around the 250 parts per million or approaching. The deep monitor well is the depth of minus 900, and at minus 605, estimated that the chlorides are around 250.

The chloride levels are determined during pumping, incidently, for the Mokuhau and the Waiehu Heights wells, so that the concentrations at the bottom of the well will be somewhat higher than the average value.

The location of the three wells described above is highlighted on flip chart 1. If you could go back. You can find Mokuhau well and Waiehu Heights "A" are right in the center of the aquifer.

As can be seen, the bottom elevation of Mokuhau is about minus 250 and Waiehu Heights is minus 338, and B is minus 206. These depths at which water is too salty for consumption are from one-third to one-half of the depth found for similar conditions in the deep monitor well. It's not prudent to consider the deep monitor well conditions apply all over the area. Far from it.

Instead of 600 to 630 feet of fresh water remaining

in the overall aquifer, a more prudent average estimate would be 250 feet, and this depth is being diminished day by day. Go on to flip chart 6. This is a discussion of the inclusion of the Iao tunnel as a separate source. Which is what the director did. We don't believe that there's 2 million gallons a day outside of the Iao aquifer sustainable yield. We thought this was an amount for the Iao stream diversion, since we are convinced that Iao tunnel pumping is part of the 20 million gallons a day amount and has been shown that way up to now.

We were corrected at the meeting of September 26th and later found, to our surprise, that the Iao stream contract with Wailuku Ag has lapsed. I hope it will be corrected and that it will end up being signed in operation again. If Iao stream is not renewed, then the water deficit by our reckoning becomes 3.4 million gallons a day deficit instead of 1.9 million gallons a day deficit.

Exhibit B shows the Department of Water Supply calculations of Iao aquifer pumpage in 1993 and '94. Difficult to see, but what was done at that time was to include a basal amount, which is the top amount, Dottie, and confined dike amount which included Kepaniwai well, the two amounts are added

up to arrive at the total pumpage of the aquifer of just above 20 megawatts -- 20 million gallons a day in mid 1994. It was this pumpage amount which brought warnings from the State Water Commission of the possibility of the state designation. This would not have transpired if the tunnel pumpage was excluded and the publicized pumping was less than 18.5 million gallons a day.

Exhibit C, the bottom exhibit, is a division of Water Resources Management map with Iao tunnel included as a Maui DWS well, No. 5332-02. This is further confirmation that the tunnel is indeed a part of the Iao aquifer. Surely, John Mink's sustainable yield calculations, which support his letter of September 9, 1995 to Rae Loui, must show whether or not the tunnel pumpage is included in the 20 million gallons a day amount.

The well levels in the aquifer continue to decline and the salt level rises at an increasing rate. In the face of this, it's inconceivable that the Iao aquifer has a surplus of water available.

In conclusion, we recommend to the board that it does not confirm the amount of water available proposed by the

director for the Central Maui water system. Thank you.

CHAIRMAN RICE: Board members, questions?

Thank you, Mr. Williamson.

You had your hand up next.

A VOICE: That was referring to Upcountry water.

That's a different subject. I think you have another meeting this afternoon?

CHAIRMAN RICE: That's a rules committee meeting.

A VOICE: Oh, okay.

DIANE SHEPHERD: Good afternoon. My name is Diane Shepherd -- you want me to sit? You are signaling to me.

CHAIRMAN RICE: I'll recognize each speaker. Okay, thank you.

MS. NAGO: I want you to stand up to be recognized.

DIANE SHEPHERD: I have a couple of questions.

CHAIRMAN RICE: Please state your name for the record.

DIANE SHEPHERD: My name is Dr. Diane Shepherd. A couple of questions and this relates directly to Wailea 670. What is the connection between the Kamaole aquifer and the Central Maui aquifer? And the next question is, how does the state designate who has access to water? Because all water is held by the State of Hawaii as a trust for the public, and so how is it decided who gets how much out of an aquifer? These are just questions that I think many people have in their minds, rather than statements I'm making. So can anyone answer those?

CHAIRMAN RICE: We're here to take your comments; we're not here to engage in a dialogue. Okay? The board is here to hear some more information on the Central Maui water availability.

DIANE SHEPHERD: Can any of our authorities tell us what the connection is between the Kamaole aquifer and the Central Maui aquifer?

CHAIRMAN RICE: Why don't we write down your questions and get some answers for you. How about that?

DIANE SHEPHERD: Thank you.

CHAIRMAN RICE: Is there any other public testimony?

DOYA NARDIN: If I could, I would like to address the Upcountry issue, even though I know you passed it. It's a very brief statement.

CHAIRMAN RICE: Wait --

DOYA NARDIN: Sit there?

CHAIRMAN RICE: Yes, sit there, please.

MS. NAGO: Give your name for the record.

DOYA NARDIN: My name is Doya Nardin. And my only question is that I heard the end of Mr. Mayer's speech where he said he thought there should be no issuance of water meters until there's a guarantee of usage. And I'm somebody without a water meter who has been on my property since 1987 and we're requesting a meter since 1987. So I'm in conflict with Mr. Mayer's point of view.

And I just wanted to state that point of view, that I think people have been waiting, especially just citizens who are not developers, who are just sitting and waiting for water year after year, it's very difficult, and it becomes more and more difficult for everybody has it gets drier here. It's difficult for us who are on water catchment. It's impossible for us on water catchment.

It's difficult for people who are in your position to allocate water when there's a drought. I see there's a conflict of interest here. And I just wanted to express my point of view as a citizen who has been waiting since 1987 for a water meter, and that I disagree with Mr. Mayer that there

should be no more individual water meters until there's approval of usage.

I think if everybody gets a little bit of water, that's a lot better than nobody getting -- some people not getting water, not being able to bathe. Thank you very much.

CHAIRMAN RICE: Appreciate your opinion. Thanks.
Before we go on, any other Upcountry testimony?
Yes, sir.

ALAN ARAKAWA: May I? It's Upcountry.
Mr. Chairman, board members, as a chair of the Land Use Committee, we have been looking into the water issues and there are several issues we would like for you to clarify for us. This is pretty much general through all areas.
First of all, we have a state record of what we have as far as our aquifer. We're seeing more and more applicants coming in and asking to do their own wells. We would like to have quantified, to the best of the board's ability, what exactly we should be looking at as a number that are true -- as true record numbers, what are the official numbers.
I have been told these charts are the official

numbers, and at the same time I've been told I can't believe the charts. I would like to, at some point, get verified what all of the different numbers are and whether or not we can believe those numbers or not.

At the same time, the question that Diane came up with earlier is another thing we need to be able to quantify. The water that is available in each of these areas. As people are trying to put wells in more and more because of delivery system and the Central Maui area has been weak and perceived as not having enough water, when we designate water, who gets first priority, who should get first priority to the water available? How are we going to allocate that water? In other words, when we ask the water department, Do we have enough water? We're told there's plenty of water. The question then follows up is, Then why haven't we developed all of that water to make sure we have that water available? And the answer has been, We develop the water as is necessary. As we have the projects on line, they are approved, they are coming before us, then we develop the water.

Looking at the overall water picture, and if we're ceasing the water, aquifer water that's available, we have at

least three bodies that are looking at major wells to be able to take water for those projects. Are they to be allowed to just drill those wells and use the water? Or are we going to then reallocate the water for the water department to develop, as the water department's says it should be doing according to the planning process for the people in the various areas? The question will come before this board as to the cost associated to developing the water. If we're dropping wells close to the project areas, it's obviously a lot less expensive than dropping wells over East Maui or in Hana or far over as possible transmitting all of that water and pumping it up to the various levels.

So I would like to get from this board some kind of an explanation, some kind of quantification as to what the policy is and how these waters are going to be disbursed. No matter how you look at it, there are limited resources. Even if we use these numbers as the basis, we need to be able to explain, for instance, to the Upcountry residents why have you been waiting for water meters, you are on this list for some 30, 40 years, and you have not been given water meters. At the same time, I think we do need to address what is happening with the issuance of water meters in the Upcountry

area. I don't think that it's farfetched to say that people who have gotten lots have been given water meters, while those who have been on the waiting list sometimes much, much longer, have not been given water meters. And if the water meters are issued because of the need and the water sources are developed because of the need has been explained, then why isn't it that those needs have not been met to this point?

I leave with you those questions and we're going to be watching what happens, because we need to have answers to some of those questions in order to be able to quantify what we need to do from land use. Thank you.

CHAIRMAN RICE: Thank you, Mr. Arakawa.

Do you have something to say Mr. Starr?

MR. STARR: First of all, I would like to thank you for coming and sitting with us today. I would like to thank everyone who came and took their time. I think that that's a very important step for the county council, the planning -- especially the planning committee, to be looking at these questions and for us to be looking at them together. And I

hope we really come out with some good answers today or at least we know what the next step of questions to ask are. I think until we ask them and until you ask them and until we explore this together, I don't think any of us is going to have a real true knowledge of what the water situation for Maui County is. We do not know -- the water board does not know what the demands that will be placed on us in the future are; nor do I think anyone knows what exactly are the resources available.

I know that this board has made some attempts to work with the planning department to try to create more of a dialogue with the planning department and planning commission, and certainly with the council we're heading in the right direction.

Certainly, the numbers on these charts, the only one that's been tested is the Iao, and when all of the numbers were originally put on the chart, the number for Iao was 60 million gallons. And I have a letter from USGS dated two days ago that says that they don't believe the 20 is a sustainable number for Iao.

If Iao is not sustaining one-third of the number that's on there and none of the other numbers have been tested,

they could just be as suspect as the original 60 million gallon number was in its timing.

ALAN ARAKAWA: Our question to you is, as decision makers, we need to be able to depend on some numbers. The official version that we have been told are these charts. If they need to be adjusted, we need to know what the adjustments are so we can make best decisions on the number.

I understand all of these are by necessity -- depending on the situation, but we need to have some kind of policy set as you control the water, your jurisdiction to the water as to how that allocation should be met and what numbers we should depend on. We have been asking for those numbers to be able to make good decisions.

And it's not within our jurisdiction to determine what those numbers should be, rather it is in our jurisdiction to take your numbers and use them as something real to make decisions on. At this point, it's been very -- we have been very -- I've been very uncomfortable in depending on any one set of numbers. If I use the official numbers, I've been told that's what you should use, but they are not real.

Again, we need to get to some point where we can depend on those numbers and policy as to how the availability resources should best be expended.

MR. STARR: I don't want to carry it long before presentation, but is the water commission represented here today?

MR. CRADDICK: Yes.

MR. STARR: Who is that?

CHAIRMAN RICE: We're going to get information today; we're gathering information. Thank you, Al.

ALAN ARAKAWA: I'll be sitting back and watching.

CHAIRMAN RICE: More public testimony? Wait. Fran has a list here. Hold on. Everybody will have a chance.

SALLY RAISBECK: My name is Sally Raisbeck. I live in Wailuku. I strongly urge the board not to confirm these

figures since I don't believe them, and I hope we'll have testimony as to their accuracy or lack of it. I do agree with Mr. Williamson that the 2 million gallons a day from the tunnel is probably part of the 20 million gallons a day, but maybe we'll find that out today.

As far as official numbers on that map, it's my understanding that sustainable yield numbers are guesses in advance of the fact as to how much water you can expect to get out of a given aquifer. It's only a guess and, obviously, sometimes a very wrong guess.

So that to say the sustainable yield is 20 million gallons a day, if that's not being born out in practice, and to me it's not being born out in practice, because the salt is rising and we all know that the level of salt water under the fresh water in the Iao aquifer continues to rise.

Mr. Craddick's letter says, well, it used to be rising 10 feet a year, now it's only rising 5 feet a year. That's still a rise. If you are only taking what was being recharged, why would it rise? It would be a zero rise if you are only taking what was going in from rainfall. So it's my lay opinion that the aquifer now is being overpumped.

I think playing games with drilling wells just outside of the aquifer and saying that those aren't part of the aquifer and it's an independent source, I don't think that's true. I hope you will take this under advisement, get reliable information from people you trust.

And I see no reason whatsoever that you would certify that there's water available when the 8 million gallons a day that Mr. Craddick quotes from the North Waihe'e aquifer, that's just a guess. They may be getting four and five, but that may be overpumping it, and you don't know that you are going to get eight. So I don't think you can confirm that you have excess water in the Iao aquifer. Thank you.

CHAIRMAN RICE: Any questions for Sally?

Thank you, Sally.

GLEN SHEPHERD: Mr. Chairman, my name is Glen Shepherd. One thing I would like you to do, any subsequent meetings that's held is going to have numbers of people like what we have here today, I urge you to have some kind of a venue where we can all see and hear what is going on. People back here can't see; people back there can't see; people back

there can't see.

And if this is supposed to be an informational meeting, then you're not getting the word out. So I appeal to you to pick the venue where these illustrations, all the power point things can be pulled up so that everybody can see it and everybody can hear it. The acoustics in here are lousy. I have lousy hearing to start with, so I'm blanked out on many things.

Secondly, the thing I want to ask, are we going to have an expose by the USGS here today?

CHAIRMAN RICE: We're asking these gentlemen to give us information to enlighten us. The expose, I know what expose means, but we're going to get something from them.

GLEN SHEPHERD: We're going to have a show and tell?

CHAIRMAN RICE: We're going to take under advisement and decision making --

GLEN SHEPHERD: Can we come back with comments after that?

CHAIRMAN RICE: No. We're not making decisions here today. We make that clear. We're just gathering information.

GLEN SHEPHERD: I want you to get that information.

CHAIRMAN RICE: That's all we're doing.

GLEN SHEPHERD: Let me say this, then. I might be shooting off my mouth ahead of time here. I've seen maps put up on the board here that indicate the limits of the Iao aquifer. My estimation with 35 years of petroleum exploration production, we're dealing with hydrodynamic principles, different ones, different things involved, but nevertheless those principles are still there. The limits of the Iao aquifer as shown by that last map is erroneous.

Second thing is, there are too few data points which to draw any kind of conclusions about how much water is there. There may be too much water than we think, or there may be less water than we think. But you certainly cannot extrapolate good

decisions based on too few data points. You are shooting yourself in the foot sometimes by going ahead and doing things without knowing what you are playing with.

CHAIRMAN RICE: We agree 100 percent, that's why we have these gentlemen here to give us more information.

GLEN SHEPHERD: I have bones to pick with them too.

CHAIRMAN RICE: You may, sir. Thank you, sir.
Next?

MO MOELLER: Aloha, I'm the spokesperson, Mo Moeller, for our ohana Ka'Ohana O Kahikinui. We're here today (1) to educate ourselves to our present water situation; (2) to trace the origin of an old Kula pipeline that runs through the aina of Kahikinui which starts at Waikamoi and ended at Kupuna gulch; (3) to advise this board and our community that there is a resettlement movement of 105 native Hawaiian families moving onto our 22,809 acres of Hawaiian lands in Kahikinui.
The bottom line is, more native Hawaiians needing

our wai. And also to advise this board that we're in dire need of our wai, and we hope to work closely with you in making this our reality in our community. We're prepared to give you a complete presentation of our ohana's goals and desires, water needs in the near future if requested. Mahalo from our ohana Ka'Ohana O Kahikinui.

CHAIRMAN RICE: Thank you. I'm sure we'll take you up on your offer.
Is there any other public testimony?

MS. NAGO: No one else signed up with me.

ED LINDSEY: Aloha, board members and community. My name is Ed Lindsey. It was not my intent to come up here and testify, but the very fact that we're over here gathering information and checking up to see what our water situation is, is a red flag. The very fact that we are talking about recycling water is another red flag, and the numbers that we seem to be getting are off colored, it's another red flag. So it behooves us to take care of the people who are here now. A lot of the developers and people, you know, they

have every right to do what they want to do, but a lot of the people who come here, they want to live here, and that's fine, but we have to take care of our people first. And the residents who live here always seem to be getting the tail end of things. Always.

And the people who come with their money always seem to get in the front of the line. Now, what's really important, in my opinion, is that we take care of as many people as we possibly can. Including the ho'opu, the he'ewai (phonetic), the mamake and the plants that depend for water along the streams.

Now, as salt comes up and we have these peaks coming out here, you take more water from the stream, Iao stream, and that in turn breaks the cycle for the natural things that grow here, the things that make Maui special.

So what I would like for this board to do, and I have been told that the constitution, parts of the state constitution is only a paper until Hawaiian tries to violate that paper, then it's -- all of a sudden it's enforced to its maximum -- that Article 12, Section 7 be considered in your decisions that Hawaiian things are not -- right now we're at

the bottom -- come back up on the top again where it should be. Where the state constitution says it should be and where morally it should be.

Give our wai ola (phonetic), our stream wai ola a chance to survive. Right now there are only two streams that's mother loding (sic) the native plants and animals. That's one in Nahiku and one at Makamakaole. Everything else is all shut off. What does that say about us? Aloha.

CHAIRMAN RICE: Any questions of Ed?

Thank you, Ed.

Let's take a second here. You folks who are behind the screen, when we start to have the presentation, you want to move out here around us? Let's take a minute -- we'll take a two-minute recess here while people can redistribute themselves.

(A recess was taken.)

CHAIRMAN RICE: Okay. Is there any other public testimony? Okay. As I said, this is a committee meeting, we're here to gather information. We have with us some guests,

some experts who are going to give some presentation, comments, something of that nature to the board to release to the Central Maui water availability. Gentleman, is there a way -- is there an order we should do this? David?

MR. CRADDICK: I leave it up to you, the guys have a presentation ready.

CHAIRMAN RICE: You are with the USGS?

STEVEN GINGRICH: That's correct.

CHAIRMAN RICE: State your name. And down those lights, Fran, a little bit.

STEVEN ANTHONY: My name is Steven Anthony, I'm the associate district chief with the U.S. Geological Survey here in Honolulu. I would like to thank the chairman and members of the board for inviting us to speak here today on a very important subject of water availability from the Iao aquifer. Our district chief, Gordon Treble (phonetic),

unfortunately was not able to attend because he's on the mainland this week. But I brought along with me Dr. Steven Gingrich, our groundwater specialist, who will be giving a presentation after I cover a few points the board asked me to read to you here today.

First of all, many of you may be aware that the U.S. Geological Survey is not a regulatory agency, and as such, we do not make water resource recommendations or decisions. However, it is within our mission to provide unbiased scientific information, to facilitate informed effective management and policy decisions in the public interest. As a result, there are several points I would like to make with regard to water availability from the Iao aquifer. First, it's important to distinguish between the regulatory level of sustainable yield and the amount of groundwater of acceptable quality that can be pumped on a long-term basis using an existing infrastructure. In essence, a number on paper does not necessarily translate into reality.

Second, there's no single fixed value for sustainable yield. The amount of groundwater that can be pumped over the long term depends on many factors. Some of these factors include the distribution of pumpage, the dynamic

flow of groundwater and climatic variability. The current values of sustainable yield are based on analytical model with simplifying assumptions that ignore these factors.

Three, under the current distribution of pumpage, the regulatory level of 20 million gallons a day for the Iao aquifer does not appear to be sustainable. This is based on an assessment of available water level and chloride data collected during periods of high pumpage. This information is contained in this USGS publication.

In addition, an evaluation of the method used by the Commission on Water Resource Management to set sustainable yield values in Hawaii, it's contained in this second publication.

The fourth point I would like to make is that delineated aquifers in the state water resource and protection plan are not independent, and pumpage from one aquifer can affect another. As a result, pumping from areas adjacent to the Iao aquifer will affect water levels and the availability of water from within that aquifer.

Then, finally, although the recent tests involving the shutdown of Maui Department of Water Supply wells in the

Iao area illustrates that water levels are affected by pumpage, it is not relevant to the long-term sustainability of the aquifer. These comments are offered as starting points for discussion on how better to assess the amount of water that can be pumped from the Iao area.

The presentation of existing information should allow you to judge for yourselves how the aquifer has historically reacted to different levels of pumpage and see current trends in both water levels and chlorides. Additional information can define the estimates of water availability from the area.

So at this point, I would like to turn it over to Steven Gingrich who will give his presentation. And again, thank you for inviting us to be here today.

STEVEN GINGRICH: Judging from some of the presentation I have seen already, this may be a repeat, but hopefully I can clarify some things or point out how the USGS goes about studying the groundwater system and what kind of information we need to look at.

A little review may be first. You know, any hydrologic system, you can look at it as a box. You have the

aquifer, you got an input to it, water, recharge coming in; you got output, water discharging into the ocean or pumpage. And then you also want to know stuff about that box, the geology, permeability of the rocks. Then you want to know the water in the box, how much water is in there and the quality of the water, can you drink it.

Quickly going through that, things that involve input, when you want to a study system you have to measure all these things. You have rainfall. There's new information suggesting that you can get a substantial amount of input from fog drip, which typically is not measured with a rain gauge. One of the things that goes into an input calculation would be the runoff; how much runs directly from the stream into the ocean that does not recharge the aquifer.

You have a component of what is called evapotranspiration, what the plants suck up that does not get into the aquifer. The plants use it or the sun evaporates it. You have a component of water that's stored in soil moisture. You need to understand that. You need to understand the amount of groundwater flow from adjacent systems. For Iao, that's important.

You heard a lot about the aquifer boundaries of the Iao aquifer, but very little is known about what groundwater is flowing into this system from Central Maui, from parts of West Maui, and how much groundwater is flowing out of the system. So that's another factor.

I highlighted here in red for Iao aquifer, these are the things that have not really been analyzed at all. This is more information that could be found to help refine your estimate as to how much water is going into the system. So most of this information has been based on studies in other areas. For Iao itself, most of this has not been looked at.

When you think of the aquifer, you want to know the thickness and distribution of volcanic rocks and the caprocks that top off the aquifer. You want to know how that rock can transmit water, the permeability and the storage properties. You pump a well, how quickly will the water flow into that well. That's information you have to find out if you want to know how the aquifer will react when you pump it.

You want to know what we call hydrologic boundaries, where is the ocean, where are dikes that have low permeability that affect where you pump it, where are the streams that may be gaining groundwater, where is the caprock that may be

confining the groundwater from reaching the ocean.

Again, we have a fairly decent understanding of the thickness and the boundaries of the aquifer; we don't have a real good understanding of the permeability in storage properties of the aquifer. There's a lot more standard aquifer tests that you could do using accepted methods of analysis to figure out how the rock will transmit water.

The water itself you can estimate, you can figure out how much is there based on water levels that you measure in monitoring wells, in pumping wells. And you want to know the quality of the water, the water you pump, measure of chlorides to see if it's acceptable.

You measure chlorides in transitions of wells that go down through the fresh water into the salt water beneath. You can monitor that to see the thickness of the freshwater lens supply. Then there's the possibility of other contaminants. I had not heard much about agricultural contaminants in the Iao aquifer area, but that's always a concern that you went to keep in mind too.

Then the output from the system. With the absence of any pumpage, before anybody developed the Iao aquifer, all

the groundwater that fell into the system discharged out to the ocean or possibly to streams or springs. Also, some may flow to adjacent systems. We have not looked into that too much. You can go into Central Maui where they do a lot of agricultural pumping and look how much connection there may be between that part of the island and the Iao system. Again, once you start pumping it, you will reduce the amount of groundwater that discharges naturally because you'll be taking it out of wells. The output is important both for the volume that you pump out of the system and also the distribution of your wells. If you try to pump 20 million gallons a day out of one well, it would be a bad idea, you could get -- so your distribution of where your wells are is important. You can minimize saltwater intrusion at any one place.

Again in red, these are the components of a system that I feel we really have very little understanding about for the Iao aquifer. Maybe some for streams and springs, but there's a lot more work that could be done on that. Definitely discharge into the ocean, we really don't have a number for, or flow to an adjacent system.

You have seen this picture a couple of times now.

The blue line there we call the Iao aquifer boundary. That's the state's boundary, that's the regulatory boundary, and I have shown this, but I'm not claiming that that's a true physical boundary. But that's the area that we're talking about here. Then I have highlighted in red some of the main pumping areas.

And then USGS and the other entities collect a lot of data that we can use to analyze the system. Weather service collects rainfall data. It's important to know what's going in. We collect water levels in wells. The water department collects chlorides, and from pump wells, and we also measure the chlorides in the deep transition zoned wells. Then we have a record of how much water we pump out.

When we put out our quarterly reports on a data, we get data that we collect plus fluoride and pumpage data from the Department of Water Supply. So we cooperate there and they give us timely information that we can put into our reports. Let me talk a little bit about some of that data.

Up in the upper left, I have a map of the Iao area, with five areas, different wells, where we get water level data that I want to go through here. Let me show you the top first. When

we talk about rainfall data, this is a -- my time scale did not show up yet -- but this is plot from 1983 through the present.

My rainfall graph, what I'm showing here is the variance of rainfall from the long-term average. So starting like in '83, this would be a rainfall deficit. This time period of a few years, rainfall was below average; we had an above average period. Some ups and downs. For all time, you can expect nothing will fall in the average; it will be above or below at some point.

You can see here from about '97 to the present, we have had a pretty significant deficit of rainfall. That's one major component for the Iao system, this prolonged drought we have been in. That's going to have a big impact on the water availability. Not showing the scale, just to be clear, but this is like a 50 percent deficit to this area. Almost half the rainfall for this extended period.

And then on the next graph we show a record of pumpage from '83 to the present. My green line, the top of the green line represents the 20 MGD limit, sustainable yield limit that we're talking about. So you can see pumping has increased from about 10 MGD in '83, the highest point in '96, '97, where your -- some parts of the year were over 20 MGD, but I guess

the yearly average equaled out to about 20 and the current pumping we're at right now.

Then coupled with this increase in pumpage over time and the periods of decreased rainfall, we can look at water levels. There's my time scale, finally. Water levels ranging from 0 to 25 feet above sea level. These are important when you look at a freshwater lens system. I have these kind of colored coded, so this is test hole A here, starting here at 18, 19 feet has been declining steadily over time.

Green, test hole B, test hole E, Waiehu deep well, and the North Waihe'e well across the regulatory boundary here. One thing that's pretty striking is they all follow the same pattern, both the annual variations due to higher demand, seasonal demand, and the long-term rise and decline of the water level over time.

Basically, a decline in water level occurs because you are taking water out of the system and the more you take out, the further the water levels will decline. It's pretty straightforward. Most of the water levels that we have recorded over time have been at or near the record lows in the past year or two. That's a combination of the pumping and the

rainfall deficit. So you look at water levels.

Another thing you want to look at is chloride concentrations when you pump water. That's what you are supposed to be drinking. Again, same plots of pumpage and rainfall at the top. You have four different wells here to show some of the chloride concentrations with time.

The Waihe'e well system started off around 20 and slowly increased to around 50 or 60 milligrams per liter. The green line up here represents 250 milligrams per liter, EPA recommended drinking water limit. You don't want water much saltier than that to drink. Another well, this is Waiehu 1, you can see it started off at around 60 or 70, but in the past three or four years has climbed fairly precipitously to occasionally being over the recommended limit.

Again, this is Mokuhau 1, same sort of pattern, you get some variations over time depending on pumping. If the well has been pumping for a week or something, you go out and sample it, you may get a higher chloride than if you just turned it on. So that would explain some of that variability in the data. But the long-term trend is fairly obvious, as you go along in sort of a rapid increase in the last few years.

There are some other wells I have not shown. I'm

going to guess which one. I don't know if it's Mokuhau, the area where some of the chlorides -- or Mokuhau 2 well, chlorides were 4- or 500 milligrams per liter. Then this is shaft 33, a major source here, collected chloride data not as long. You can see a bit of a gradual increase in time; last few samples have been higher than previous. So all of the chloride values show at least increasing trends of chloride concentration with time.

We also talk about chloride concentration. We can look at the thickness of the freshwater lens. We use the Waiehu deep water monitor well. We go out quarterly, we take some samples at depth. These triangles, squares, diamonds show areas where we have collected historic chloride concentration and we use that to look at the thickness of the transition zone. This is depth here in feet, sea level, the top scale was showing chloride concentration. You get up here to 19-, 20,000 milligrams per liter, that's seawater.

Let's talk about the mid point of transition, that would be about 9500 milligrams per liter of chloride, that would be right in here. And then what is actually probably the most important is your drinking water limit, which is only

250. So that's this area way in here. What I did was, for illustration here, I highlighted this area from 50 up to -- this is basically 2 percent seawater, which is very close to the drinking water limit. It's an easier number to use.

So this is the upper half of the transition zone, which is what we're looking at, how that is rising over time or how it's spreading over time. So you can see once you start to get to this point where you are hitting 250 milligrams per liter chlorides in your well, you don't have to go very much deeper to start hitting 300 and 400 and 500.

If you are pumping from here, chlorides will stay stable and slowly rise over time, but once you start to hit this point in the transition zone where it's high, it doesn't take much more to get really high. It's important to notice that.

What I did here was I took some of the wells where we have chloride data. This is the well, the deep well where I have this profile, and that pink area that I showed in the other slide is highlighted here from 2 percent to 50 percent seawater in the deep monitor well. It falls right here. Here is sea level, here is the depth of the pumping wells in the area.

If you look at the chlorides in that well, it sort of positioned -- take the position of this transition zone and apply it to all of those wells, this is kind of an approximate guess as to about where the transition zone lies when you compare it to those wells. Wells like Mokuhau pump 2, you've got a significant amount of transition zone that's probably being already penetrated by the well. Waiehu Heights 1, pretty high, and then North Waihe'e, Waihe'e 3, those there you have a little more thickness.

One thing that's important, you don't want to look at the thickness from the sea level down to the 50 percent or midpoint of the lens, because you are not going to drink 50 percent seawater. You want to look at the thickness from the bottom of your well to the 2 percent seawater and how much room you have to play with before you start to get intrusion of the well. As you can see here, two of the well fields are significantly impacted.

And another thing we hear a lot of talk about is the movement of the transition zone over time. This is a plot, same plot for the most current data in red here. Then the data collected from the well. From the first time it's collected,

sampled in that same well in 1985, as you can see, some of our sampling that's a little different, but you can draw a line through the values and estimate the position of the transition zone, and then we figure out the midpoint, you estimate how quickly is that coming up.

Again, that data is based on chloride samples at various depths in a single well. One concern with that is that it has something what is called mortal flow. If you have a single open hole and it's open to the salt flows at different levels, sometimes you can have more a permeable layer where the water can flow in, and close up the hole in another area and sometimes that can affect the values you are getting.

Occasionally, you have to be able to interpret, you have to be able to see through the data to know if you are maybe not measuring exactly what you think you are measuring. What we're seeing at some of these depths that we have measured quarterly since far back as '85, you can see how the transition zone, how the whole thing has gotten saltier over time.

If you look at the deepest well, the deepest point, at one point in '85, that was fresh water down here. But now the transition shown has moved up; it's pretty much seawater at that depth. As you go up the scale, you can see how these

trends are continuing over time. Right now, 50 percent seawater is going to fall somewhere in this 675 to 700 foot depth.

What I did was I took this data and then plotted that up, basically looked at the 50 percent seawater line based on that data. What I'm showing here is the position of that 50 percent line over time. And also, since we're not drinking that water, I plotted up 2 percent seawater, which is basically the limit of water you would not want to drink. But to show how that has risen over time as well.

This is a good way to see the rate of rise over time. What you can see is the steeper part of the curves is rising faster, flattens out here. Since the early '90s, it started to rise quicker. It's pretty much risen at that same rate since the early '90s right through the present.

I think you are probably not smart to look at one time period over another and saying it's slowing down or speeding up, because you want to look at the long-term trends to see how over time this rise is continuing.

And I think also, at least in my opinion, it would be a mistake to just throw a ruler on here and draw and say,

well, in 2023, it will hit the bottom of the well. It's not that simple to extrapolate a single line and say where it is. It's too complex for such a simplified assumption like that. Getting back again to talking about the rate of rise. This is that same 50 percent line. Again, I just kind of blew it up. What I wanted to show was this value here on the right scale, what I'm trying to show is -- I don't know if this is easy to explain -- it's basically the rate of rise. When you have value here, near the beginning of this is like 20 feet per year, rising at that rate. As the rate has slowed down, at some periods in this area here, the rate of rise is near zero. It's not as stable. Then we started pumping more, the rate of rise increases again. This is a really steep point here.

Again, what's important to show is how it's kind of maybe a little bit cyclic. You can't look at one month to the next and say it's slowing down. It's speeding up. You want to look at the long-term trend to see how variable it is. This curve here is based on -- kind of took each quarter's position and looked back a year, plotting a rate of rise over a year average. And what I also did was I looked at it over a single quarter.

If you measure it today, we get a value, then we go back three months, look up what we measured and see it rose a foot per year or something like that. You got to look at the green line to see how variable that can be from quarter to quarter.

I think that's for the state to look at. You need to look at the long-term trend. It shows the importance of continuing to collect data over time to see the long-term trends. Not just the vagaries of a rainy month, or heavy pumping that month, or we did not turn that well on that month, something like that. So it's important to keep looking at the long-term trend of the system.

Another point with these deep monitor wells, for the Iao system there's only one. So we're measuring the thickness of the transition zone so we get one point. Perhaps in another area where you have heavier pumping, it's probably going to be thinner; you might go to the back of the aquifer where there's not much pumping, it could be thicker.

So, again, you are using one point to figure out the whole system and that's not the best way to do it. Ideally, you have more of these wells that you would monitor on a

regular basis to see what's happening.

I think that's all the data I have for now. That's basically the presentation I am going to give, so if you have questions.

CHAIRMAN RICE: Board members, questions?

MR. NOBRIGA: Is the USGS report dated to 1997 still valid?

MR. CRADDICK: Water budget for Iao?

STEVEN GINGRICH: I would say it's valid until we refine it. It's probably the best water budget we have for the island, but I would not say it's the final answer to the island. For one thing, it doesn't incorporate the boundaries -- so that actually might provide more recharge in the system.

Basically, as time goes on, we refine ways of estimating the water budgets. Like I say, at the time it was done, it was probably the best estimate, but more refined techniques could be used to give you a better idea.

CHAIRMAN RICE: Is that it, Mike?

MR. NOBRIGA: Yes.

CHAIRMAN RICE: Jonathan?

MR. STARR: I would like to thank you for the good presentation. Waihe'e aquifer segment, have you done any work on Waihe'e?

STEVEN GINGRICH: Not really. The only thing I had was the plot I showed here of the water level. Given the same trend as the well in Iao aquifer system. But not real -- I had not done much with Waihe'e, no.

MR. STARR: I know some years ago I had seen a report that was part of a water commission staff report. I believe that was about '97, and I thought that that was a USGS report regarding some rejections for availability for the north and south segments of Waihe'e. Does that ring a bell?

STEVEN GINGRICH: Not for me.

STEVE ANTHONY: I don't recall USGS.

MR. STARR: Within a couple of miles of Iao aquifer, there is probably a hundred million gallons a day of other pumping taking place. In your opinion, do you think that that may be affecting Iao in any way, or do you think that the water budget for Iao, which is definitely showing downward trends and not equilibrium, do you think it's affected by pumping outside of the aquifer?

STEVEN GINGRICH: I think it's definitely possible. Like I say, we have not looked at that issue exactly to prove it or not, or see how much affect it would have. That's something that's easily looked at, but the water budget does not account for any pumping outside of there. That can be a concern.

I'm not quite familiar with the geology that -- I'm sure it's not a direct influence depending on the salt flows and the sediments of the rocks, there is some degree of -- not

disconnected -- what's the word -- there's probably a low degree of connectedness between the areas, but with that great amount of pumping, there's almost bound to be some affect.

MR. STARR: I know on the central aquifer segment that includes Kahului and Paia and Makawao and Kamaole, sustainable yield of 27 million gallons a day with pumpage of maybe four or five times of that. I know I have gone to the water commission and asked them how much pumpage is taking place. They don't know.

What would be a mechanism if members of the board or the public wanted to have a better understanding of how the water is flowing and whether the aquifers are distinct or whether we really are having a case of water flowing from one aquifer into another?

STEVEN GINGRICH: What you want to do is expand the existing monitoring program, first find out how much is being pumped. You want to measure -- stay with same hydrologic data in the Central Maui area, the water levels. You can do things like aquifer tests where you would turn on the heavy pumpage

for a while and measure water levels throughout the Central Maui area to see if you can analyze that to find out what's going on.

But ultimately, you probably use that for a system like this with a complex geology of East Maui and West Maui coming together, with the caprock above it, rainfall and distribution and all the pumping, you probably have to go to something like a numerical model that can incorporate all of that.

Put in new information about the geology, permeability, rainfall distribution, pumpage distribution, and then you can try to match the water level and the chloride levels that you see in the area, then you can use the model, turn on the -- look at how the freshwater lens would sink with time under different pumpage distributions.

And once you have that model worked out, calibrated, approved, you can try to use it for like "what-if" scenarios. What if we turn on a lot more pumping here, or what if we spread out the pumping, maybe we can get 20 MGD, but we have to stop pumping here and we can move the well back here. There's all sorts of games you can play that way, and basically with this kind of system you almost have to go to that level of

complexity to figure out what's going on.

MR. STARR: Is that what is called a head-and-shoulders model? Is that the right term?

STEVEN GINGRICH: For Maui, yeah, you would probably model from the shoulders to the neck and to the head, including the Lahaina area and the whole thing. Because you want to know the affect of groundwater from East Maui flowing towards Central Maui.

You want to know -- by including the whole head, you avoid the idea of drawing an aquifer boundary and saying this stream to this dike, that's a boundary. If you model the whole head and shoulders, you let the model decide what the boundary is. You don't tell it -- this is a boundary, you basically test the model and see what is most important.

You might find out that you need to put a boundary in at a certain stream to match the hydrologic data that you collect, and then you would say yeah, that's probably right, this stream is a boundary and affects don't cross it, but without really testing that scenario, you are not quite going

to figure it out.

MR. STARR: Would this be a project that the USGS could do if they were asked to do it and if it would help with the budgeting for --

STEVEN GINGRICH: We certainly could do it. There's a lot of hydrologists that do that sort of thing. That's something we have done in cooperation with a lot of state or county agencies all across the United States. Most of the groundwater modeling software, a lot of it has been written by USGS researchers. So we have that expertise that we can draw on.

MR. STARR: Is that kind of system the standard throughout the United States now, or does most of the country still go on an aquifer-based-water-budget type model like we're using now?

STEVEN GINGRICH: It's a combination, I think, of the whole range from small towns, you know, going by the seat of their pants to huge L.A. County kind of -- they have a huge

model. I know someone has been working on a Santa Barbara model where they incorporate the ditch flow, reservoir flow, saltwater intrusion.

It's a major entity doing this model and they use that to manage and optimize the system where they know to pump more during the winter and bring more reservoir water in during the summer, and things like that. So there's a lot of areas that use big models to manage --

MR. STARR: How would you characterize what we're doing now, is that seat of the pants or --

STEVEN GINGRICH: I would not want to use that.

STEVE ANTHONY: At the same time, we should compliment the board, that all the data you are seeing here today is collected in cooperation with the board and we would not know what we know without it. It's limited, but it is good to have.

CHAIRMAN RICE: Go ahead.

MR. NAKAMURA: In your presentation, you indicated there's quite a bit of information that you don't have and that was pointed out by some of the people that testified. What would be the -- I'm sure it would be difficult to obtain all this information that you don't have, but do you have some feel for what would be involved?

You talk about a model, but in order to have a model, you really need the information. I would think that would be a pretty formidable task.

STEVE ANTHONY: It's a large task with the existing information we have today. One could put together a numeric model, but that would then lead you to ask more questions about what additional information you would need to refine that model. So it's an imperative process one has to go through.

MR. NAKAMURA: What are the resources available through USGS to do this? Or what kind of assistance, I guess, primarily financial, would be looked at between the state and the county to get into something like that?

STEVE ANTHONY: As with our current monitoring program, we interact with the Department of Water Supply. USGS has matching funds available. Our budget is uncertain at times and we have demands from other cooperating agencies as well. So I could not say to you today that if you wanted to embark on a particular investigation, whether or not we would have the funds available to match it 50 percent; but given the importance of this issue, I'm sure Gordon Treble would rank it very high and do his best to make funds available.

MR. NAKAMURA: Thank you.

CHAIRMAN RICE: My colleagues have leapt ahead in their terrific thinking. But just so everybody understands, the aquifer boundaries drawn on that map are estimates by someone at some point in time; correct?

STEVEN GINGRICH: Yes.

CHAIRMAN RICE: And given all the information we

have heard, it's likely that some of those boundaries may not really exist. The two aquifers could be one, or they could be two flowing into each other because of the geological strata of that point; right?

STEVEN GINGRICH: Right.

CHAIRMAN RICE: Or the boundary could be slightly at a different place; is that correct?

STEVEN GINGRICH: (Nods head.)

CHAIRMAN RICE: But the information you are showing us and you have seen so far, lends you to be very cautious about any continued pumping in that area. Is that the correct statement to make?

STEVE ANTHONY: Yes, that's correct.

CHAIRMAN RICE: What my colleagues have done was jump ahead to a bigger modeling program so we can refine our predictions going forward and you would be cooperative in

helping us.

STEVE ANTHONY: As well as some other people would be willing to help too.

CHAIRMAN RICE: Sure.

MR. TAGORDA: Mr. Chair, may I ask a question. In your presentation on hydrologic system components input and output, why is it that on a groundwater discharge, you guys did not make any studies or gather information?

Because I think by having those information, you would say clearly to us that aquifers are independent or not -- are independent or dependent from each other. Meaning to say that without those information, because I am facing with the problem of whether Iao aquifer and North Waihe'e aquifer are independent from each other or not.

And on Mr. Treble's letter it says right here and it doesn't really say on the -- on the fourth point that was mentioned about water availability from Iao aquifer, it says that the delineated aquifers in the state water resource

protection plan are not independent and pumpage from one aquifer can affect another.

In the absence of those information, like I said, you guys didn't pick up groundwater discharge, do you think it would be hard to pinpoint exactly with clarity whether those aquifers are independent or not?

STEVEN GINGRICH: On the absence of looking at water level, seeing water levels in one aquifer corresponding with different water level changes in another separate aquifer, they do the same thing.

MR. TAGORDA: May I ask a question, because I'll ask the same question to Mr. Mink and people of your -- people like you. Can you say with clarity and leaving us no doubts that the Iao aquifer and the North Waihe'e aquifer are two independent aquifers?

STEVEN GINGRICH: No, I would not begin to say that, no.

MR. TAGORDA: Thank you.

CHAIRMAN RICE: Let's move it along on the other presentation.

MR. STARR: I have a question.

CHAIRMAN RICE: We have to get more information quick.

MR. STARR: The latest data I have is for August of this year, our pumpage is from Iao aquifer 19.476 million gallons a day and from Waihe'e and this is just a southern portion of Waihe'e. We have five million four hundred and some odd million gallons a day. Do you feel that we can expect to increase those numbers, or do you feel that there's a certain amount we should be looking to decrease those numbers?

STEVE ANTHONY: I think that's a decision that you have to make. As an agency, I think it's not appropriate for us to recommend how you should proceed based on the information that you've seen and heard. I think you have to draw your own

conclusions and decide what is best.

CHAIRMAN RICE: Sir, you are with the Commission of Water Resource Management?

A VOICE: I'm a private citizen, but I was invited by the board to give a presentation.

CHAIRMAN RICE: You are next, then. Let's go down the line.

JOHN MINK: I wonder if I can get up next. I have to catch a flight.

CHAIRMAN RICE: It doesn't matter to me. You want to go ahead?

JOHN MINK: Yes. My name is John Mink. And in many respects, I'm responsible for all the controversies that have arisen about the Iao aquifer. Let me start by saying a little bit about these aquifer systems as they are drawn. They were never meant to be drawn as precise aquifers. That's a

misunderstanding that has been propagated.

If one were to read the water protection plan for the state, they would understand that these are very qualitative. Also the sustainable yield values given in those aquifer systems have been qualified very greatly within that plan and they are not precise numbers and they can change. In only a few places are they held in high confidence. So there shouldn't be any argument or any discussion about what the meaning of those things are. They change with time. When you are dealing with water resources, the best gauge on what the availability of the water is, what the size of the aquifer, etc., is experiments. It's a matter of developing within certain constraints, and then find out what's happening as you go along.

I must admit I'm responsible for setting up the sustainable yields for all of the islands' systems throughout the state when we did the water protection plan, and I feel very offended that people misinterpret them and in many ways use them as an instrument to diminish the utility of these things. These are meant as management systems, as a guide to management. Not as absolutes. So I want that to be clear to

everyone.

Now, when it comes to the 20 million gallons per day sustainable yield, that came about as a result of a study I did in 1977. Prior to that, both the USGS and the state had concurred with a number which was extraordinarily high for the amount of recharge coming into the Iao -- what is now the Iao aquifer system.

When I was hired by C. Brewer to take a look at it, this was after the joint venture signed all of its contracts, on the basis that the Board of Water Supply would get the 19 million gallons per day first, and then a remaining 36 million gallons can be developed. When I looked at those numbers, I was very puzzled by how they could possibly come about with that until I started reading the reports.

When I submitted my report to Brewer, and I was hired as a consultant, when you are hired as a consultant and you have a client, you want to tell them things that maybe they would like to hear, but I told them things that they certainly did not want to hear, that it was not anywhere near the amount of water that had been bandied about, and I set as an estimate a yield of about 20 million gallons per day.

Let me say one more thing about the yields, the

sustainable yields, they are based upon optimal development that is the best means of extraction. The most optimal development in any aquifer is to have a billion syringes and take one drop of water out of a billion points. There's never really a way that can be done, but that's what the sustainable yield as they are written means. Optimal development.

Every development has to be suboptimal. So it's a degree of suboptimality (sic) that you are willing to contend with as to what you can actually get out of a system. So instead of a hypothetical sustainable yield, you can say an allowable sustainable yield which takes into account depth of the wells, the spacing of the wells, all of this is implicit and the amount of water that you can take out.

But I do believe that the sustainable yield of 20 million gallons is very reasonable for the Iao aquifer. This aquifer has been under development since 1948. It's had its ups and downs.

Measuring the water table as the indicator of the health of the aquifer is sort of like a phrenology, you feel the skull of a person, the bumps and the depressions, then you make a judgment about what the brain is like. Well, isn't it

far better to plunge a needle into the brain and find out what the brain is really like?

That's what the monitor well -- although there's -- only one has been done. The water table measurements really are so transient and so frivolous, in a sense, that they don't really tell you what the condition of the aquifer is.

Now, the aquifer of -- the Iao aquifer, the transition zone, the 50 percent point which is equivalent to -- in the standard hydrology analysis -- the 40 to 1 ratio, is at about 700 feet now. It started off maybe 850 or so feet. The transition zone has been rising.

Now, somebody, I think Sally Raisbeck said the transition zone is rising, therefore we're overdrawing. Just remember that the moment you take one drop of water out of an aquifer, the transition zone will rise. There's no way that you can take any water out of an aquifer and keep the transition zone in its original position, because you are disturbing that initial condition, and the initial condition in the Iao aquifer was a maximum head, at least down near the Iao section of 28 feet.

Once you disturb it by extracting a little bit of water, the head goes down. The transition zone comes up one --

40 times the drop in the head. These are fundamentals, and they have to be recognized when we are talking about the allowable sustainable yields that can be employed.

The other thing is the nature of the connection between Iao and North Waihe'e. It was never said in any of my reports, certainly, that this was an absolute boundary. The boundary -- there is a suppressing boundary that reduces the hydrologic continuity between Iao and North Waihe'e.

Remember now, when we talk about North Waihe'e, we are not talking about that sliver where the development is taking place, North Waihe'e has been defined as the aquifer going all the way up to Kahakuloa. Which is a pretty big chunk of land. And there is, of course, connection.

But if you look at it, the wells on the immediate eastern side of Waihe'e Valley or southern side of Waihe'e Valley have a head probably 10 feet higher than they do on the immediate northern side of the valley, which indicates that there is a suppression in the hydrologic connectivity between these two things.

If you are going to include North Waihe'e as part of Iao in your management, then you have to add to the sustainable

yield. You can't add North Waihe'e and say that all of the water is coming out of the Iao. That's not true. There's a tremendous amount of recharge that feeds to the North Waihe'e aquifer.

I think the main matter of -- well, I won't say contention -- but disagreement between myself and the geological survey is in the nature of what we use as the measurement for the health of the aquifer. I use as the measurement the depth to the transition zone which is about 600 feet. That means 600 feet of fresh water. That is a very inertia bound boundary. It does not move very much, because so much water has to move up or down for that boundary to change.

The USGS has been using the water table. And I think the water table in my experience is a trivial -- much more trivial parameter to use to determine the health of the aquifer.

Now, I've done work in many, many places in the world. I just want to give you one example. In Sri Lanka, the northern part of Sri Lanka, the Jaffna peninsula, which is an aquifer very similar to our caprock limestone.

The usual agriculture and irrigation starts in January and at the end of the monsoon, the water tables are

high, it's all groundwater up around 4 to 5 feet. And the farmers plant their crops, their peppers, potatoes, and what have you, they irrigate and pump heavily.

By June, the water table is below sea level. If that's the case, you should be getting salt water, but they get fresh water for the next three months until the monsoon comes again in August. So that the water table itself is not the criterion upon which we should base the decisions -- the management decisions that have to be made.

One last comment Jonathan brought up about the matter of whether the pumpage in the Central Maui area has an affect upon the Iao aquifer. Just remember that the pumpage in the Central Maui area has been going on for a century practically, virtually at the same rate. In 1946, the initial head of the Iao aquifer is 28 feet. The pumpage in the Central Maui was at the same rate, if not higher, as it is today.

The fact that the heads in Iao are going down -- this is the true head, based upon the transition zone -- means that even if there was water moving off into the Central Maui, it's being reduced as the head goes down. The other thing is that the only way that you can get an increase would be for the

pressure in the Central Maui aquifer to draw very precipitously and that would be a change in the water level there.

Well, the water level change under that heavy pumping is only a few feet, and changing the pressure relationships by 1 or 2 feet is not going to increase the amount of water coming out of Iao through the caprock and all the impediments to enter into the East Maui volcanics. So that's a problem that deserves some attention, but I don't think it's a primary problem that we have to face at this time. Any questions?

CHAIRMAN RICE: Mr. Starr?

MR. STARR: You mentioned the water level not decreasing. I have never seen the water level -- the head measurements for central. I know in Iao, you are right, they started at 28 feet and now we're looking at between 7 and 11 feet. You don't feel that that's some source of concern?

JOHN MINK: Let me give you an example. In 1953, when there was a very severe drought year, the Wailuku sugar company pumped shaft 33 between 11 and 12 million gallons per

day as an average. The water table elevation dropped from 28 feet to 14 feet within a year. That's a total of 13 feet. When the pumping ceased or did not cease but it became smaller, the water table began to increase again. But in order to have a drop of 13 feet in one year, if we're dealing with standard hydraulics of the saltwater, freshwater systems, and we're dealing with it because they apply to everywhere in Hawaii, you would have had to have had 13 times 40 movement of the bottom of the lens coming up. Well, that's just impossible. There's no way that that ever happened or could happen.

MR. STARR: First of all, I didn't -- I disagree with you when you seem to feel that your work is being attacked, Mr. Mink. In my opinion, it's not, you brought us this far and you have been very brave in the past. I know when you came up with the 20 million gallon figure for Iao in the '70s, that must have been a very difficult and brave move and certainly one that I respect.

Our real point is where do we go from here? And I think you would agree with us that knowledge is the best thing

we can have and more data points and more use of technology to gain that is good, and that's our thrust. Not to attack anyone's work in the past, but rather to find the best direction to go in the future.

JOHN MINK: I appreciate that and I agree with you. There's a lot more that has to be learned, because from Mr. Gingrich's presentation, you notice all the variables that have to be taken into consideration and the number in which there is insufficient data.

So in order to fit those things into any kind of a model, numerical, analytical or word model of any sort, you have to make assumptions. Unless you can get data to somehow make those assumptions more real than they might be, just as if they are opinions, it's going to be very difficult.

MR. STARR: I want to ask you about Waihe'e a little more. I've seen reports where they divide Waihe'e into two segments, northern part and a southern part, and I believe all the wells we currently have are in the southern part.

JOHN MINK: I think what you are referring to,

C. Brewer owns the land up to the boundary on the southern part of Makamakaole drainage. Since a lot of the decisions made were on the basis of the land, who owned the land, that's the line you may be referring to. There's no difference.

MR. STARR: I know we're currently pumping 5 1/2 million gallons out of the wells we have.

JOHN MINK: We shouldn't think about 8 million gallons as coming from that southern part. I didn't realize the public was so high -- David, what are you doing?

MR. CRADDICK: It's not that high.

MR. STARR: It says daily average. This is your report.

MR. CRADDICK: I'm going by a 12-month average.

MR. STARR: The 12-month average is only 5.14.

JOHN MINK: Even that is a little --

MR. STARR: Didn't I see a report from you saying that it should be kept at three?

JOHN MINK: At four.

MR. STARR: Wasn't there a three -- some number out of four on a long-term average?

JOHN MINK: Yes. When you are dealing with the yields of an aquifer, you really are dealing with what you can pump from day-to-day and it has to be an average for some period of time. The bigger the aquifer the longer the period of time that you can do the averaging.

MR. CRADDICK: Jonathan is including Iao tunnel, which is -- the actual pumpage is 3 1/2.

JOHN MINK: That's what I thought it was.

MR. STARR: 3 1/2?

MR. CRADDICK: Yes.

MR. TAGORDA: Before you go, Mr. Mink, may I ask you again about the relationship of the North Waihe'e aquifer and the Iao aquifer. There are three things that I read in this book about the North Waihe'e aquifer that says that two aquifers are quasi independent and the North Waihe'e aquifer is an uninterrupted extension of Iao, and the North Waihe'e aquifer is -- the connection is quick from Iao aquifer. Would you explain that to us?

JOHN MINK: Well, at least the way I have interpreted it, because of the differences of the head change, then if you do some mathematical modeling of why it should be that way, when you have a valley like Waihe'e, you have, first of all, a lot of alluvium that accumulates, particularly in the lower part of the valley.

And then there's the phenomenon of as the water percolates through the valley, through the bottom of the valley, the weather -- the soil is a weathering -- if you get

down a little bit, it's clay. It's not soil. This is what happens as you go down below a stream valley; therefore, the permeability increases and so that becomes the partial impediment of the reduction in the permeability.

And although the water can move, it will lose its potential energy as it goes at a much greater rate, so that when you are on the south side you have a potential energy, say, in terms of head of 10 feet on the north side -- 7 feet, which is far greater than the normal gradient in the aquifer. That is why we call it a weak connection. But there's a connection amongst everything.

MR. TAGORDA: You are not certain that the recharge of North Waihe'e aquifer is not from Iao?

JOHN MINK: No, it's not likely.

MR. TAGORDA: Thank you.

MR. STARR: Just to clarify, it's -- dropping of Iao tunnel is about 4.6 is what we're pumping out of the wells and in the southern part of North Waihe'e?

JOHN MINK: Even that is a little high.

MR. STARR: Do you have any suggestions on what tact we should go to gain more knowledge, what kind of test points, what kind of monitor wells we would like to see?

JOHN MINK: I think what Dr. Gingrich said is important, that you do have a more extensive data collection. The monitor well in North Waihe'e would be ideal. Another one south of Iao, but that's the sort of thing that we know we need them, but insofar as the details and the particularities, you would have to deal with the study to determine where the best sort of information would come from.

MR. TAGORDA: One more question, Mr. Chair.

CHAIRMAN RICE: Go ahead.

MR. TAGORDA: One more question, Mr. Mink. Would you say, then, Mr. Mink, that the 8 MGD sustainable yield that

I have been seeing floating around from the North Waihe'e is not a prudent recommendation from you or it should be less?

JOHN MINK: No, you would have to spread the wells all the way up to Kahakuloa. Because that's what is defined as the North Waihe'e aquifer system. So it would include Makamakaole, Wailena, up to Kahakuloa, and you can't take everything out of one spot, as has been said earlier.

MR. STARR: One more question. The Iao tunnel, what do you consider that? Is that part of an aquifer, or is that surface water?

JOHN MINK: That's high level dike water that comes out. So it's not part of the lens aquifer.

MR. NAKAMURA: One quick question. The 8 million gallon estimate for North Waihe'e, Mr. Mink, that was based on the work that you had done?

JOHN MINK: Yes, I had done that some time ago. I can't emphasize too strongly the fact that all of the numbers

that we talk about have a pretty wide margin of uncertainty at this time, and that they can be refined greatly.

But I have found from the experience of reading the history of water development and being involved in Hawaii, that the best lesson is the experience of the developing water.

Certainly, that's the way the Honolulu system developed and that's one of the best systems in the country.

CHAIRMAN RICE: Any other questions? Mr. Craddick?

MR. CRADDICK: John, the pump test that was done, there had been some comments that it somehow didn't provide information, or I think USGS said it's not related to long-term pumping, but then later on they said you need to do pump testing to calibrate the model. Can you say what information you got out of that test?

JOHN MINK: Out of the shutting down the well, the curve of recovery is very beautiful. If you carry out that curve to its -- whatever extent, you would get back to the correlation of the water table elevation with what the

transitions are. That would occur in about three months. So it's a question of whether you are going to use the water table as your central variable, or whether you are going to use the depth of the lens. This all relates to a pressure relationship, which I have done analysis, which I didn't plan to give to you, but the true hydrologic head, which is the driving head, is measured at the interface between the salt and the fresh water, not at the top of the water table.

CHAIRMAN RICE: Any other questions for John? We can move along. Thank you very much. You have to catch a plane?

JOHN MINK: Yes.

CHAIRMAN RICE: Bill, you want to go next? Commission is the last guys. You guys don't mind, do you?

GLEN SHEPHERD: Mr. Chairman, before John leaves, can we attack him?

CHAIRMAN RICE: No. Absolutely not.

JOHN MINK: You have five minutes to attack.

GLEN SHEPHERD: They attack one another, they seek the truth.

CHAIRMAN RICE: One thing I want to avoid, we won't attack anybody in this meeting. I know you are laughing.

GLEN SHEPHERD: You have to know what attack means.

CHAIRMAN RICE: I don't understand it, I'm not an earth scientist. I don't want the whole group here to start commenting at each presentation. You want to go outside with him?

GLEN SHEPHERD: I want to understand Jaffna. That's a permeability barrier, the limestones.

JOHN MINK: It's limestone. But the point I was making, and I have encountered this elsewhere, is that you can

draw a basal lens below sea level and still get fresh water. Now, if you were depending upon the water table as your criterion, you would be pumping salt water. Now, that's something they learned over 3,000 years of growing chilies and things like that. I learned --

GLEN SHEPHERD: The other thing I want to attack him about is the use of these boundaries for the particular aquifers. Boy, they are fuzzy and they are significant in that you flash a map up here that showed the boundary between the Iao aquifer and central aquifer, that's as phony as can be. Because listen to this now, we have three wells out there in Keopuo-Lingle park that's sucking the hell out of the groundwater. It's against the line between the two aquifers, so it's affecting the Iao aquifer.

JOHN MINK: No, Iao aquifer is much deeper than that.

GLEN SHEPHERD: I know, it's an antiquler (sic) thing; right?

JOHN MINK: It's separated, as you should know, it's separated from a bunch of sediments and what have you.

GLEN SHEPHERD: There's no structural or stratigraphic interruptions between those wells and the Iao aquifer?

JOHN MINK: Depends on which formation the wells are in. Are they in the East Maui volcanics or the West Maui volcanics?

GLEN SHEPHERD: I don't know.

CHAIRMAN RICE: Nobody knows what you two guys are talking about and you are not going to agree, so go outside.

GLEN SHEPHERD: Can I attack him on one other point?

CHAIRMAN RICE: No, you cannot, sir.

GLEN SHEPHERD: Can I attack the USGS?

CHAIRMAN RICE: No, we have two more presenters.

GLEN SHEPHERD: I didn't know that.

CHAIRMAN RICE: We're not done.

GLEN SHEPHERD: You ought to give us a score card.

CHAIRMAN RICE: We'll take five minutes for the court reporter. You guys can go outside together.

(A recess was taken.)

CHAIRMAN NOBRIGA: We'll call the rules committee of the Board of Water Supply to order. At this time the rules committee will be recessed to Thursday, room 207 at 11 a.m. The meeting is recessed.

A VOICE: Until when?

MS. NAGO: Thursday, 11 a.m.

CHAIRMAN RICE: Immediately following our regular board meeting.

A VOICE: That's the rules committee?

CHAIRMAN RICE: Yes. The Committee of the Whole is back to order. We'll call the meeting back to order. The Committee of the Whole. For those of you who wondered what happened, we had a rules committee meeting scheduled at three and we have to be out of this room at 4:30. That meeting was considered opened and recessed until Thursday. So those of you who are interested, Thursday at --

MR. NOBRIGA: 11 a.m. Immediately following your meeting.

CHAIRMAN RICE: What meeting?

MR. CRADDICK: Board meeting.

CHAIRMAN RICE: Bill Meyer. Let's go, Bill. You've got the floor. Thank you, Bill, for coming.

BILL MEYER: It's a pleasure to be here. Thank you for asking me. I think I would like to start my discussion this way. I think that Mr. Mink hit the heart of the matter that at least I believe this -- brought this meeting together, from what I have been told, and that's whether or not one wants to use the head determined by looking at the mid point of the transition zone or the actual elevation of the water table in the aquifer, which determines the health of the aquifer. It's very important that that issue be discussed, I think.

Now, every textbook in hydrology that deals with the subject of the freshwater and saltwater interface states that, given the guide in the Hertzberg (phonetic) principal assumptions that if you have -- for every foot that the elevation of the water table is above sea level, the freshwater, saltwater interface is 40 feet below sea level. I think that's a number we have all heard and are familiar with.

It relates -- the Gyben Hertzberg relates the depth of the interface to the elevation of the water table, not to

the elevation -- not to the mid point of the transition zone that you might measure at some point in time.

Now, the basic assumption of the Gyben Hertzberg principle, 40 to 1 principle, is that the system is in a steady state, meaning equilibrium. Nothing is changing with time. That says if you have a 10 foot water level, the water level stays at 10 feet, doesn't change with time, then the freshwater, saltwater interface would be 40 times 10, 400 feet below sea level.

The Gyben Hertzberg principle also says if you change the fresh water that -- the water table by 1 foot -- say you reduce it by 1 foot by pumping, the freshwater, saltwater interface will come up 40 feet. Now, why doesn't that work here? It's very simple and I think it's been made very complex.

If you drop the water table 1 foot, that happens very fast. On the other hand, at a very deep depth in the aquifer, the midpoint of the transition zone, the entire transition zone has to move up 40 feet. That process takes time. It doesn't happen as quick as they change in water level. You are replacing drop by drop fresh water with salt

water and that's a slow process. That process can take years.

So the movement of the transition zone lags behind the movement of the water table, whether the water table goes up or down. And if you want to know what the depth of the freshwater, saltwater interface is, you need to look at your water level in terms of its elevation above sea level and only calculate the depth of the interface only when the water has stabilized.

Or you can make an assumption that if my water level is at this point, say, now the water levels here are 7, 8, 10 feet above sea level, generally declining. You can say, well, what if they just stay at 7, 8 or 10 feet, where would the interface ultimately be? You multiply the 7 to 8, 10 feet by 40 and that's where it will ultimately be. It doesn't mean it's there now.

So, in my mind, what is really going on, when you look at the midpoint of the transition zone, calculate the water level based on that, when you say that water level is higher than the actual water level, no surprise. It should be, given the way the system works.

Let me go to the water resources protection plan. This is the state document that -- it's a document published by

the state that sets the sustainable yields for all the aquifers in the state, and what I don't think most people know is that when it sets the sustainable yield of the aquifers in the state, it also sets an item called the minimum allowable head. It also goes on to say that head is the elevation of the unconfined water table above sea level. So for every sustainable yield value in this book, there is a minimum allowable elevation of the water table above sea level. Iao aquifer has such value. That value is 14 to 15 feet. 14 to 15. The water table should not go, according to this document, 14 to 15 feet above sea level.

Let me read this. Sustainable yield refers to the force withdrawal rate of groundwater that could be sustained indefinitely without affecting either the quality of the pump water or the volume rate of pumping period. It depends upon the head selected as the minimum allowable during continuous pumping, you must be pumping when you measure this head. You don't turn the wells off.

I have never known anybody that wanted to see if a well was going to be intruded with salt water that turned the well off. Turned the well off. There is not a unique value

for sustainable yield. The value depends on the head that will preserve the integrity of the groundwater resource at the level decided by the manager.

The manager in this case is the state, and the state has selected this head and this head is 14, 15 feet for the Iao aquifer. You can determine that head from this document. It doesn't state it directly.

Now, with that as background, and it's my position on this discussion, I think that -- I looked at this report on the recovery of the Iao aquifer system recovery test that was provided by Mr. Mink.

By the way, I would point out that this document was prepared for the State Water Commission, the water resources protection plan was prepared for the Commission of Water Resources Management by Yuen & Associates, which is John Mink and George Yuen. So when I quoted it, I was quoting what I believed to be John Mink's writing.

Let me go further. When I read the conclusions of the Iao aquifer system recovery test, I think these conclusions are stated in this sentence. The importance of the recovery test has been to demonstrate that the ambient water level is a function of pumping rather than a head and balance with

underlying seawater.

I don't think you have to run this test to figure that out, data already tells you that. The reason for that is the lag time between the movement of the transition zone, it lags behind the movement of the water table. So if that's the conclusion of this test, then I don't disagree with it.

If, on the other hand, the conclusion of this test is -- the sustainable yield of Iao aquifer is 20 million MGD, then I think you asked the wrong question, you ran the wrong test. If you look at the water level in the Iao aquifer today, and what they have been for the last several years; in fact, what they have been since 1996. If you look at them today, then it's clear that the following things will happen.

If you assume those water levels remain steady over time and that ultimately the transition zone gets equilibrium with the water table, which it will do, the following things will happen. Shaft 33 will be fully intruded by the transition zone; Mokuhau well will be fully intruded by the transition zone, it will be fully salted; Waiehu Heights, the deepest well at Waiehu Heights will be fully intruded; at Waihe'e well, the deepest well will be potentially intruded. That's because you

don't know the thickness of the transition zone.

Then the North Waihe'e, the interface is just potentially just below the bottom of the well. So if you continue with existing water levels, that's my conclusion as to what would happen to you.

Now, you can say and you can say correctly that current water levels are not only affected by pumpage, they are also affected by the drought. So the question becomes, how much current water levels are affected by the drought? My answer to you is, not enough to totally correct this problem.

When I look at the water level history over time, it's clear, as Dr. Gingrich put up here, that you have periods when recharge is above, precipitation is above normal, precipitation is below normal. When you look at and you see the precipitation is above normal, you'll see what happens to the water level. They don't rise enough to offset the problem you have.

So I think it's clear, I think it's clear that the existing pumpage that I looked -- was your average pumping from January through June, so six months. About 17.4 MGD from the aquifer, as I recall. And your current water levels are indicating that you cannot sustain this much pumpage. But

again, I will admit expected by drought. And some improvement would be expected, the question is how much.

So I would like to just briefly talk a little bit of history on this point, starting from about 1980. Groundwater withdrawals from the aquifer during the 1980s ranged from about 9.7 to 15.3 million gallons per day. Water levels were not a problem. The rate of groundwater withdrawal increased in 1990 to 17.3 million gallons a day and water levels began to fall. This was during the period of high rainfall.

The rate of withdrawal generally continued to increase during the early 1990s and peaked in 1995 and 1996 at 20.5 and 20.3 million gallons a day. Those years were a good test of whether or not you can sustain 20 million gallons a day. Rainfall was generally not followed in the early 1990s. Groundwater levels during that period fell abruptly, and by 1996 had fallen to the point that saltwater intrusion into all wells -- was ultimately possible.

Water levels had fallen to elevations that range from 8.9 to 10.2 feet above sea level and the well fields were continuing to decline with pumpage at 20, 20.5, 20.3 million gallons a day. Conditions were only getting worse because

water levels were continuing to decline.

The Commission of Water Resources Management held hearings on the status of the Iao aquifer and required the Department of Water Supply to -- withdrawal the value below 20 million gallons a day or they said, as I recall, that if you reach 20 million gallons a day, they would come back and institute the procedure to have this area declared a groundwater management area.

Now, given this, the annual rate of groundwater withdrawal was decreased in 1997 to -- and the last 6 months, the 12 month -- the last six months moving average to June 2000 was 17.4 million gallons a day.

Now, data you have just seen the USGS did on water levels, the transition zone between fresh water and salt water and the Waiehu monitor well, chloride concentrations of the Waiehu well indicate that water levels have declined since 1996, and have not increased despite lower rates of groundwater withdrawal. The interface continues to rise, chloride concentrations -- have risen above 1996 levels at Waihe'e, Waiehu Heights, Mokuhau well fields, and shaft 33.

Several of those wells, it's apparent that, as Dr. Gingrich showed on the slides, you are already experiencing

saltwater intrusion. It's getting close to being the point where you don't want to get it any higher.

I would stop that point for now and I would like to go to the subject of recharge. The sustainable yield value that's given in the water resources protection plan, that value of 20 million gallons a day is based on a value that was provided by Mr. Mink to the Water Resources Commission in 1995. That value recharge is 31.6 million gallons a day and based on that again, the sustainable yield is 20 MGD.

In this Iao recovery system test, I was startled to find that John had said that the Iao aquifer is recharged at a rate of approximately 20 to 23 million gallons per day. So in 1995, John felt it was 30, 31.56, and in 2001, September 2001, he writes that it's 20 to 23 million gallons a day.

If you use the equation and the methodology provided in the water resource protection plan, you calculate the sustainable yield for the Iao aquifer of somewhere between 13 to 14 million gallons a day. That can't be ignored, because if the equation used to calculate sustainable yield is accurate and if this new value is better than the previous value, then the same person who put this plan in place is now saying that

the sustainable yield of the Iao aquifer is less by a substantial amount.

Staying with the subject of recharge, I would like to point out that, as John did earlier, that there had been other estimates of sustainable yield, and when you use the equation to allocate sustainable yield, that's given again in the water resources protection plan.

I'll go through them. 1968 groundwater recharge estimates varied from 1.6 million gallons a day to -- by one author, and not to belittle that person, they were using techniques in comparing results, I think. The sustainable yield value for Iao aquifer ranged from 1 to 20.7. The Department of Land and Natural Resources in 1970 estimated groundwater recharge as 60 MGD, which would result in a sustainable yield of 38.4.

USGS in 1970 estimated groundwater recharge at 35, which would give a sustainable yield of 22.4. John Mink in 1977 estimated groundwater recharge between 20 and 30 MGD, and if you use his methodology, that would result in a sustainable yield between 12.8 to 19.2 MGD, based on the 1977 work. Yuen & Associates, which is this document, actually estimated groundwater recharge for the Iao aquifer 15 MGD. That gives

you a sustainable yield of 9.6. Although in here it says 20. When the Commission on Water Resource Management asked for clarification, that was the 1995 letter that increased groundwater recharge of 15 to 31.6. In 1995, that's when Mink came up with 31.6. In 1997, USGS calculated groundwater recharge of 29 MGD, which gives a sustainable yield of 18.6. In 2001, Mink has given another number for sustainable yield that ranges from 20 to 23, which gives you sustainable yield values of 12.8 to 14.7.

My purpose in going through that is I think all of this is reputable work; it's not meant to belittle anybody. But the point should be clear that you really don't know what the sustainable yield of the Iao aquifer is. I think -- will clearly tell you that's not going to be. History tells you that since 1996. Slightly before that, current water levels tell you that it may not be 17.4.

I can't sit here and tell you what it is. I can only tell you that I think anybody that sits here and tells you what it is, I would view that number with some caution. So I think you need to be aware of the fact that the number has changed through time. When you use this equation and you use

different recharge rates, the number has changed through time with the same entities. USGS, for instance. John Mink. And again, that's not to criticize; it's just to point out the uncertainty in this type of work.

I guess, finally, I would like to address several things and I'll try to be brief. I think that in this document on Iao recovery test, the point is made that the technique of analysis did not follow fundamental equations of hydrology or groundwater hydraulics, but using empirical analysis. I think the reasons why the -- why you could not follow the fundamental equations is explainable, but you'll have time.

I would only say that if you are going to not follow the fundamental rules of science to reach a conclusion in that science, you ought to view that conclusion with some caution, at the very least. And I certainly do. So that's, I guess, my complete set of comments on that issue.

I have heard a question raised as to whether or not the water from the Iao tunnel should be considered part of the Iao aquifer. My opinion in terms of that is similar to Mr. Mink's. The water that comes out of the tunnels comes out of the dike system above, based in part of an aquifer -- it came out naturally before the tunnels were there.

The tunnels only made it easier, if you will, for the water to be collected at that spot all the time, but that water came out naturally before anybody pumped anything. It's naturally discharging water. Given that, it should not be counted as part of a sustainable yield, whatever that value is for the Iao aquifer. That's my opinion on that. With that, thank you.

CHAIRMAN RICE: Questions? Mr. Starr?

MR. STARR: Yes, first of all, thank you for coming over here, I really appreciate hearing what you had to say. I would like to know if you have any knowledge about the Waihe'e aquifer.

BILL MEYER: The only real knowledge I have about it in terms of factual is, you know, I continue to get the quarterly data workup that the USGS provides to the board and to the water commission, and I look at that, and so I'm aware of the water level declines in the North Waihe'e well field that occurred with pumpage and that's really the extent of my

part in factual knowledge.

MR. STARR: I know we have been going -- the actual basis for this meeting was the certification by the director of water availability for the Central Maui water system. I don't know, have you seen this?

BILL MEYER: Yes, I have.

MR. STARR: I know that uses a number for 8 million gallons for Waihe'e aquifer. And I was wondering if you might have any comments, especially considering our development plans only include the southern portion of it where we have drilled a number of wells in the southern part of that North Waihe'e aquifer. We don't have any plans to drill in the northern part by Kahakuloa.

BILL MEYER: I do have some comments I could make. Number one is, I have looked at -- I have looked at information on water levels from pumpage particularly from the North Waihe'e well field and the water levels in Iao aquifer to see if I could determine whether or not pumping the North Waihe'e

well field affected water levels of the Iao aquifer.

It was quite clear to me that they did. So in my mind, there's absolute connection between the two. You can say it's diminished, you can say it's this or that. The fact is, if you pump water from the North Waihe'e we'll field, you are affecting water levels in the Iao aquifer. So there's a hydrologic connection there.

The other thing I looked at is that -- I have to see if I can find it. I know that when the water levels -- when pumpage at North Waihe'e -- in the calendar year 1999 and early into calendar year 2000, water levels in the North Waihe'e well field declined to the lowest level. That corresponded to -- that level would not have been sustainable. The well field would have been intruded at those water levels.

The pumpage was slightly above 3 million gallons a day. So it's clear to me that it's -- I would say it's unlikely that you would be able to sustain a development of something like 3 MGD out of the North Waihe'e well field, given that set of information.

The pumpage rate that I see is back up there and if what I'm saying is accurate, then water levels should back down

again. If not, something else is going on. It's a short window to look at something for a year and a half, check it out, that's not the best thing to do but that's at least an observation.

MR. STARR: What do you think about the transmissivity of Iao into the Central Maui aquifer, is that a possibility that perhaps some of the reason why Iao is performing as badly as it is, is because some of the water may be travelling into this Central Maui aquifer and being pumped up through the numerous wells over there?

BILL MEYER: The first question with regard to the transmissivity, or what I would say, the hydrologic connection between the Iao and the area south of it, I think there's a connection. I think that's obvious. Given that statement, pumpage south of the Iao would definitely affect Iao to some extent.

Now, I think that some of what Mr. Mink said is probably accurate, that the pumpage has gone on for a hundred years. By his knowledge, not mine, the pumpage has remained relatively stable, which suggests that whatever affect that

that pumpage is having on Iao aquifer, that pumpage was long ago established and is there. I mean, it's not changing now as long as the pumpage itself does not change. Which is what Mr. Mink said, I believe, and I would agree with that.

MR. STARR: How about sugar cane recharge with drip has gone way down?

BILL MEYER: That would definitely change things. If that goes down, then definitely water levels in the central part should go down, and that means the water levels in Iao starts to go down also. How much, I don't know.

MR. STARR: One other question. You mentioned that, I believe, 15 to 17 feet was the minimum water level for Iao as per the state water resource plan. Where is it now?

BILL MEYER: It's -- depends on where you look. Let me try to find my notes here. It's test hole E. It looks like it's about below 10, between 9 and 10; at test hole B it looks like it's about 8; at the Waihe'e deep monitor well, it looks

like it's between 8 and 9; test hole A1 looks like it's between 10 and 11.

MR. STARR: Theoretically, that should -- that would be grounds for designation and management if that document were being followed?

BILL MEYER: I think the commission already has grounds to designate, if they chose. There are eight set of criteria. Before I came over here I looked at how, in my estimation, the Iao aquifer fits within that criteria. At least three of the eight you meet already. So the commission, in my estimation, could decide to Iao groundwater management if they chose.

MR. STARR: I promise this is my last question. What would you suggest as a course of action that we could take so that a year from now we would be a lot more knowledgeable about the true state of our resources?

BILL MEYER: A year from now?

MR. STARR: Five years from now? Six months from now?

BILL MEYER: I guess what I'm telling you, and it's just my opinion, I don't have people to bounce it off of anymore. I don't think you have surplus water in Iao to give out. So I think one action would be to think about that. I think another action in terms of science, I would look for ways to start collecting more data on the Iao aquifer and the surrounding area.

Given the position that I formally held, I would suggest that the board would turn to the U.S. Water Commission, turn to the U.S. Geological Survey and try to see if there are funds available to enter some kind of a mutually cooperative program to collect that data, and I think I would let that grass grow under my feet to try to get that done.

MR. STARR: Thank you.

CHAIRMAN RICE: Orlando?

MR. TAGORDA: You talk about recharge. I have with me a different information on the long-term average groundwater recharge on -- from 1996 to the present, which is very -- sometimes I like to believe your number, but the number that I have was pretty high. It says 51 MGD from 1926. Are you saying land use -- data and up to present is 37 -- 35 million of recharge --

BILL MEYER: This is Iao?

MR. TAGORDA: No, your numbers are low. But the one I have are kind of high on recharge rate. And it says right here, the recharge rate for natural condition is 34 million gallons per day. Don't you think that's too high with the drought condition that we have for the past three years?

BILL MEYER: Well, I don't know what the recharge is. I really don't. I have tried to illustrate to you how different authors who have put some time and effort into that have come up with a whole set of different numbers. The range in that numbers is pretty severe, 1.6 being the low and 60 being the high. I personally have not made a study.

MR. TAGORDA: I know it's declining, but to look at it from the past way back in 1926 to the present, it was 51, come down to 41 and 37, 35, now it was 34. And I still kind of believe that it probably is too high, but I don't know. You tell me whether that number is too high as a recharge rate or not.

BILL MEYER: I guess I don't know, again. I would tell you that I think the recharge rate -- what is happening in your aquifer -- and what is happening in your aquifer is not good and in that case it doesn't matter what the recharge rate is. It's just not good.

MR. TAGORDA: I'm just kind of thinking, if there is a recharge rate of 34 MGD, where does the water go when we only draw 19 or 18?

BILL MEYER: Before you start pumping, all water in the area is discharging into the ocean or to the streams. When you start pumping, every drop of water you take out of the

ground is water that doesn't get to the ocean or doesn't get to the streams. So if there's 34 MGD and if you are pumping 19, then the remainder from 34 is still going out to the ocean and is still going into the streams.

MR. TAGORDA: Thank you.

CHAIRMAN RICE: Any other questions?

Thank you, Bill.

Last but not least, Eric Hirano and Roy Hardy.

ROY HARDY: I'm not sure what to present, we came under the impression we would be here to answer questions today. But just to offer one observation that I'm sure you all probed and challenged. One thing that has gone on from the perspective of the water resource management over the past ten years, really, has been the very issues that you are entertaining today.

There had been a number of reports that have been quoted, numbers thrown around, water resource protection plan by the commission done in 1992, study done in 1997 on new recharge. A later one for -- versus a numerical model. One

report, which has not been mentioned today, has been the commission's findings of facts which has tried already to incorporate all of these things. Albeit there had been some reports that have come out later.

This findings of facts was the culmination of designation proceedings which was instituted, again, back in the 1990 period. The commission has entertained many of the things that you are discussing today. But if I were to reduce everything which has been discussed today, something simple, sustainable yield, shaky number; water levels, which one do you use; data, is there enough.

So from the audience, Mr. Shepherd I think rightly points out there are too few points for you to come up with an accurate number that you can have 100 percent confidence in.

If we reduce all of this down into one thing, it's the action the commission took back in 1996 which was basically -- I'll say two things, draw a line in the sand saying 20 million gallons, which has been past or exceeded in the past, that's the limit. Really what comes out of that line in the sand, if I can call it that, is the time has come to look outside of Iao aquifer or alternative sources to relieve

pressure on that aquifer system.

Another piece of hydrologic jargon to throw in is optimization. You need to optimize your pumpage. It's basically too concentrated in one spot. I know there's been a lot of analogies handed out today, but looking at it from a flip side, I like to use this quite often, you cannot pump all of your sustainable yield.

Or look at it this way, you can just as much pump all of your sustainable yield, in this case, 20 million gallons a day out of one well as it is possible for all the rain in that area to fall on that same well. It's just absurd. It's absurd. So what you have to do is spread out your pumpage, and that's what the attempt with these maps and aquifer systems attempts to do. There is some geophysical reason to it.

But this question that comes up today about this one aquifer, independent or dependent aquifers, that's a bridge that I think that you crossed a long time ago. Water resource protection plan. It's stated, these aquifers interact with one another. USGS, I think, concurs with that. So that's something that really we're kind of puzzled as far as why is that being debated here today.

Again, I think the question, and what I think board

member Starr was saying, where do we go from here? I submit to you that it's somewhere outside of Iao aquifer. You should not be looking at Iao aquifer for your future needs. You've already gotten there. Of course, the commission back in 1996, and as Mr. Meyer pointed out, had plenty grounds for designating the aquifer as a management area, which basically the state comes in and you start regulating how much water you can pull from your wells.

The commission at that time decided not to do that, even though the staff recommended designation was in order. So instead, the fact that the commission in their wisdom -- again, there's a line in the sand, you need to look outside of the aquifer. So that's just, I think, a starting point as far as any comments from our ten years of experience of what you guys are going through right now.

MR. STARR: The findings of facts, was that what was summed up in the staff report document in '96 or '97?

ROY HARDY: There's a submittal that went to the commission that referred to the findings of facts report.

MR. STARR: I remember that document and I have been searching for it. Could I request that the board members get copies of it?

ERIC HIRANO: I'll leave a copy with Director Craddick today.

MR. STARR: Can you leave it with the board secretary?

ERIC HIRANO: Sure. There's been many reports, and I brought a copy of the findings of facts report and I'll be happy to leave it for the board.

For the record, my name is Eric Hirano. I think there's a few policy questions. You know, Roy and I, of course, we don't speak to the commission themselves; but as a policy, as Roy was pointing out, the commission has adopted a sustainable yield for the Iao aquifer system of 20.

And back in 1996, of course, the commission did take action saying that they didn't want to see the board or an aggregate pumpage from Iao system to go over 20 or else the

commission would come back and it definitely would have to go for designation of the Iao aquifer system.

Within the findings of facts report, on page 8, you'll also find the commission's policy which they accepted the findings of facts before, that they do not count the approximately 1.6 or 2 MGD that's coming from the Iao tunnel. We don't count it towards the 20 MGD or sustainable yield from the Iao aquifer system.

The other commission policy is, at this time, is that the Waihe'e aquifer system be set at 8 MGD. Both in Iao and Waihe'e. And as John Mink pointed out, the sustainable yield numbers are based upon, hopefully, optimal development. You need to spread out the pumpage, you need to drill the wells at a proper depth.

In other words, as Roy was also saying, you can't just pull it out of one spot or else you induce the outgoing thing. The sustainable yields that were derived are to be optimally developed. So if you are not going to optimally develop that aquifer, you may not get the type of numbers that we have stated in the plan.

Of course, within the plan based upon the best

available information, the board has to realize that it is an estimate. The commission realizes that. And we want to thank the board and the Department of Water Supply for your foresight in helping us to monitor the situation. I mean, we don't have the funds to do it all by ourselves; so we appreciate your support in that effort, because it is very important not only to the commission but it's important to the entire community of Maui.

I want to also say, where do we go from here? Within the governor's $1 billion CIP proposal, which I don't think is going to fly right now after reading this morning's paper, but we did put in for 12 more deep monitor well projects. Our number one priority was the Iao aquifer. It went in last legislative session; unfortunately it did not make it. We put it back in for this $1 billion CIP proposal right now.

We also -- we did those 12 wells maybe -- I think it must have been in our priority four. We were asking for a deep monitor well in the North Waihe'e aquifer system. We think that's important. If we are going to put -- if we do get the CIP funds for a deep monitor well project within Iao; of course, our number one priority.

We have already talked with Director Craddick and he has offered to use your Wailuku Heights booster pump station, I think, Dave? That's kind of in between shaft 33 and the Waikapu wells, which would make it an excellent area. So we have a deep monitor well in the northern part of that aquifer and we have one in the south, and away from the pumping centers. So those are some of the things that we're looking at and which, unfortunately -- hopefully we'll get the funds. And we'll be looking for the board's support in helping us find various locations for those wells.

The board also helped us with our last CIP project which was putting in a deep monitor well in Lahaina. Besides finding a land area, they also offered about $100,000 in funding. So that we did put that deep monitor well in the Mahinahina area and we thank the board for that and the department.

The commission, you know, we're -- unfortunately, we're not like the Honolulu Board of Water Supply or the Maui County Department of Water Supply that has -- I would say at least they have a revenue stream that let's these types of projects go forward. Way back in 1990 when the Maui County

came out with their water use and development plan, they targeted the East Maui area and they also looked at the Lahaina area.

That's one of the reasons why with our limited funds we actually did a cooperative with the U.S. Geological Survey and the Maui County Board of Water Supply, and the State Water Commission. We put in approximately 120,000 to 150,000 to do the East Maui water study. I don't know if the board may remember. The board also put in the same amount of money and the USGS matched our funds and that study went ahead.

We met maybe three or four years ago -- about three or four years ago with the USGS on an Iao aquifer groundwater model development proposal. Unfortunately, the commission didn't have the funds to go ahead with that proposal and we chose the route to basically go over there and collect more data in the area so that when we are -- or when we do have the funds and hopefully in conjunction with the board, we would be able to fund a type of endeavor such as that.

That proposal was, if I may recall correctly, was for about three years it would have cost 600,000; 300,000 in matching funds from the U.S. Geological Survey; 100,000 per year from the water commission; 100,000 per year from the Maui

County Board of Water Supply. We had comments -- we never did finalize the proposal, but we had comments with the U.S. Geological Survey and because we told them our funding fell short, they didn't even bother to revise the proposal. Those type of talks were in the hopper four or five years ago.

But the key thing right now is getting the data that would help us to improve or develop a groundwater model. Also, as the U.S. Geological Survey mentioned, there are things that are missing, one of the key things missing is a recharge analysis. Fog drip is a very important component within that input factor. We're missing that very important component.

You think, and it isn't directly commission policy, but on a staff level we have talked amongst ourselves and with the U.S. Geological Survey and we would like to develop recharge analysis on a statewide basis.

In other words, develop it for the entire island, whoever wants to come in and model an island. At least they will start off with the same base. You know, we're not going to -- not everybody is going to be grumbling about that input factor. Everybody uses the same common base. Unfortunately, we don't have the funds to do that, but that's our next major

endeavor that we would like to proceed with the U.S. Geological Survey.

Interconnected between the aquifers. As Roy pointed out, yes, that is definitely within the research protection plan. We say the aquifers are connected. I might want to make an example, in Honolulu, for instance, these boundaries are established as management boundaries for us to keep track of where the pumpage is occurring and how to try to limit certain pumpage within certain areas also.

For example, in Oahu, in the Schofield area, in the very middle of the island, we call it the high level Schofield aquifer. We call it the central aquifer, actually. Within that high level area, we could probably pump over a hundred million gallons per day.

Unfortunately, we have limited the sustainable yield to that aquifer to only 23 million gallons per day, and why? Because of the interconnectedness of the aquifers. Within that high level of aquifers, water spills over and goes to Wailua, Haleiwa side of the island, to the north side, and it also flows down into our major aquifer, Pearl Harbor aquifer.

If we let unlimited pumping go on in the Schofield area, we affect the sustainable yields on both sides of the

island. So yes, there is interconnectedness, we need to keep that in mind where we are.

But the important thing is that we need to monitor the situation, because in many areas of the state, we do not know exactly -- we don't have a camera that goes underground and takes a look and says yeah, I have 20 million gallons of water here. Unfortunately, we're not at that point in our technology or in our science to -- if you ask me, you know, for a 100 percent guarantee, I'm sorry, we can't do that.

The other situations on Oahu, for instance, we did set sustainable yields for Nuuanu, Palolo, Moanalua, all along the Honolulu area. So far the sustainable yields have held pretty well. Although we know they are all interconnected. But in each of those aquifer systems, and they are all right next to each other, just like here, just like on Maui, we know they are all interconnected but we have limited the pumping to a certain amount within the aquifer systems.

And thanks to the Honolulu Board of Water Supply, who has a lot of observation wells and has many deep monitor wells in the area, we have been watching the situation and it appears through the operational effects that the draw of the

water is somewhat matching the sustainable yields in those areas. But we need to watch it.

We're here on a drought on Maui. We know Iao is sensitive to the rainfall component, we didn't input the component of rainfall. We are expecting to see the type of results where we're still looking over the results that the U.S. Geological Survey has collected. And our staff goes out to the Waihe'e monitor wells and we try to collect information also. We need to take a look at all of that.

The commission is planning on holding their meeting next month in November, November 14th in Maui, to address the Maui Meadows petition to designate the Iao aquifer. But we still are gathering our information, looking it over, and the commission will be taking up that subject matter next month at their commission meeting here on Maui.

CHAIRMAN RICE: Probably the flavors for the kind of testimony you're giving.

ERIC HIRANO: I'm not sure if I covered all the points. Like I said, I think we need to bring out what the commission's basic policy is. As far as the recharge for the

Iao aquifer that has been used in the resource protection plan, another question by a board member, the 31 million gallons per day that's being currently utilized in the resource protection plan is predevelopment.

In other words, it does not take into account any return irrigation component. So if it appears low to the other recharge figures that you may have, that is probably the reason. In other words, the commission is taking it where the natural recharge that was occurring in that area before any pumpage, before any agricultural irrigation went on the land. We just revised the Pearl Harbor sustainable yield to take out all of that return irrigation component because the commission is not sure if agriculture is still going to remain in that area. We went on a more conservative approach, we revised the Pearl Harbor sustainable yield in March of 2000, just the other year, to take out all of that return irrigation component.

Of course, there's still agriculture occurring in that area, and if there is some water that's going down and recharging, well, it's just a little blessing for us. But we're not exactly sure about the total -- or we don't want the

City and County of Honolulu to be relying upon an inflated number.

CHAIRMAN RICE: Mr. Starr?

MR. STARR: Do you keep a record of how much water is being pumped by every well that's been permitted?

ROY HARDY: As much as they record, yes.

MR. STARR: I know I've gone to the commission, I've gone over to your office, and I have asked for pumpage data on wells in the Central Maui aquifer. I believe that some other members of the public have asked for that as well, and we're told basically what you just said, what they report.

But it's my understanding that it's imperative for a well operator to report it, and I know that inquiring minds would like to know how much water is being pumped in the Central Maui aquifer all the way from Kahului out to Wailea, Makena and up to Ulupalakua, because there are a lot of new wells, large wells that are going in.

And the latest -- the latest '91 water plan, I

believe that had a figure of 140 million gallons of pumpage. There's been a lot of wells drilled since then. The sustainable yield is 27 million gallons a day. I guess there's some agricultural recharge, but there really is a suspicion that perhaps there's a lot more pumpage. And as you say, you do not know what that pumpage is.

I really feel that the time is coming when the public and entities such as this board should be able to know how much water is being pumped. So I beg of you to please do what you need to do to make sure that you have pumpage data up-to-date for every well on this island and make it available so that we can use that in our planning. May I ask if that's feasible.

ROY HARDY: Yeah, that's what was reported.

ERIC HIRANO: One of the keys things about that is we have a limited staff. It's granted that any well owner should be reporting the pumpage to us on a monthly basis or unless the commission deems it on an annual or semiannual basis, whatever the reporting requirements. Unfortunately, our

staff is limited as in receiving data and going out. We try to keep on top of the well owners and for them to report their water usage to us. But because our staff is limited, we have been concentrating basically on the critical water management areas on Oahu, Molokai, for example, and in certain other areas. But we'll make every attempt to do that.

MR. STARR: In other words, you are only getting it in designated places you designated --

ERIC HIRANO: We get reports of water use statewide. It's just that if you want it in certain particular areas, we may have to chase the people, you know, because they have not reported it to us for a while.

MR. STARR: Please chase.

CHAIRMAN RICE: I think that's what board member Starr is suggesting. A few letters might be written to encourage people to be more timely in their reporting. We appreciate your limited staff. Yes, Howard.

MR. NAKAMURA: Couple quick questions. One just to clarify. The findings of facts that you are going to provide us, they deal with the 20 million sustainable yield for Iao and also establish the 8 million for North Waihe'e? Or is that some kind of a separate finding?

ROY HARDY: Anything outside of Iao was not considered.

ERIC HIRANO: The 8 for Waihe'e was in our original water resources protection plan. The blue book.

ROY HARDY: The '92 report.

MR. NAKAMURA: The findings also dealt with the issue of -- the two aquifers were in fact connected, or was that also a separate finding?

ROY HARDY: That was not an issue.

MR. NAKAMURA: It was dealt with --

ROY HARDY: Strictly with the Iao aquifer.

MR. NAKAMURA: Not to put you on the spot or trigger a debate among the experts, but there's been a couple of different observations on how you determined the health of the aquifer, and I was wondering if you had any thoughts on that issue.

ROY HARDY: I guess there's two perspectives to look at the situation, one is the health of the aquifer. Are you talking about the body of water which is in the rock, the fresh water floating on top of your salt water, is that what you are saying by the health of the aquifer? Or are you saying the health of your infrastructure, meaning your wells which are pumping from that aquifer? Those are two, I think, often confused ways of looking at --

MR. NAKAMURA: The health of the aquifer in a sense that there was one approach which is to look at the transition zone and the other to look at the actual level in the well.

ERIC HIRANO: Perhaps maybe I can -- the commission staff, what we do is we look at -- it's hard to say whether you manage by one or the other. We take a look at all the information, because as Mr. Meyer pointed out, you know, the criteria for designation is, you know, is your projected use going to go above the sustainable yield or hit 90 percent; is there excessively declining water levels; is saltwater intrusion possible.

We look at all of the data at one time. Whether it's one trigger or not, because any one of those triggers could -- it doesn't have to mean that all eight criteria have to be met. It can't just be one criteria and we would recommend designation to our commission or start the proceedings. So we look at all the information.

It's kind of clear -- or in the same position as the Pearl Harbor sustainable yield, we looked at three different models. We looked at all the chloride water level information, the deep monitor well information, and we used all of those tools in making a determination of whether we were going to adjust the sustainable yield and what direction -- one of the

key criteria we did hold within revising the sustainable yield is to try to set a sustainable yield where we would not affect existing infrastructure.

Of course, on Oahu, there's hundreds of wells within that area, so we looked at the depths of the wells, where the transition zone may be and where it may rise to, and we try not to affect any existing infrastructure or utility of the infrastructure. And sometimes the infrastructure is a limiting value to how much water you can draw.

As you drill a well too deep the salt water will encroach into that well sooner than a well that's optimally drilled at a certain depth. So sometimes it's your own infrastructure that's holding you back, per se.

MR. NAKAMURA: Thank you.

CHAIRMAN RICE: David?

MR. CRADDICK: In Pearl Harbor, there's a lot of people that pump out of that aquifer. How did you allocate the water per person pumping? Did you do it by the groups, so much for A? So much for B? So much for C? Or did you do it by the

well?

ROY HARDY: Well by well.

ERIC HIRANO: Well by well. We took the current allocations for each of the wells and we basically -- utilizing several groundwater -- use of groundwater models, we pumped each well at their allocated amount and we tried --

MR. CRADDICK: When you say "allocated amount," what do you mean?

ERIC HIRANO: Whatever the commission permitted -- if the commission permitted that well could pump 1 million gallons per day, we used that allocation.

ROY HARDY: There's a water use permit associated with every well in Pearl Harbor, which is an allocation that doesn't exist on Maui.

MR. CRADDICK: But you did not get that until you

designated it; right?

ROY HARDY: True. The original designation was --

end of the borderline of natural resources.

MR. CRADDICK: Thanks.

CHAIRMAN RICE: Board members, any other questions

of the experts?

MR. TAGORDA: One quick one.

CHAIRMAN RICE: Yes, sir, Mr. Tagorda.

MR. TAGORDA: Now, you just mentioned that the north

Iao -- Iao aquifer is 20 MGD sustainable yield, the north is 8,

the other is 2. So is it safe to say here that we have 30 MGD

in that area, optimizing the pumpage and all that?

ROY HARDY: In that configuration, yeah.

MR. TAGORDA: After you meet with the petitioner of

Maui Meadows, would you think -- I don't know if you guys can answer this. Would you think the sustainable yield would be adjusted to a lower number or higher number or lower number? Based on what you saw presented in front of you by USGS, by Mr. Mink, by Mr. Meyer, all the facts that you gathered now, would you think there's a possibility that the sustainable yield would be adjusted?

ROY HARDY: Always a possibility, and it really depends upon what the commission decides. It will go before the commission, they will hear some of the testimony and they may want to revisit sustainable yield again. Which maybe that's an update that would be kind of counter to what they did in '96, where, I guess, had so many uncertain terms. They were tired of trying to guess based on limited information of what the sustainable yield was. And instead, again an issue. What you have now is enough for what your present needs are. If you want future needs, you have to start looking elsewhere.

ERIC HIRANO: I think because there is some

uncertainties associated with the sustainable yield, we have not fully analyzed all of the latest information, but where the Iao aquifer seems to be holding pretty well. Because I think you are pumping 17.9 or 18 MGD, which is 2 below -- we see the transition zone slowing as far as its rise. Water levels and chlorides may still be rising at this point.

And we have to take into consideration the drought conditions that have been going on for the past four years, and so that's somewhat expected. We need to take a look at the types of rates that it's declining at. Has that been slowing up. When you guys work -- as you guys were pumping from over 20 and came down to 18, the rates have declined as far as the rise in transition zone. And we need to take a look at the water levels and the chlorides also. It seems like the 18 is kind of holding right now.

I can't see in the near future that we lowered the sustainable yield to 18 at this point. I think we need to gather and monitor the situation a lot more. Unless we see something really come up in the data that we were collecting, that we're going to have to take action sooner.

ROY HARDY: If I may add one other thing. The

question in terms of will they relook at the sustainable yield. Instead of relooking at the sustainable yield, and this is just a guess on what the commission may do. But based on what they recently did in 2000 with Pearl Harbor, when they reset the new number for sustainable yield, again the two issues of monitoring or data so you can see what's going on. More monitor wells, deep monitor wells and also the optimization issue.

Those are two components of the Pearl Harbor side of the sustainable yield that the commission required of the county. They had to come up with some kind of optimization plan, are you going to backfill some of the wells to address the vertical optimization, are you going to spread out, go horizontal and drill some wells to address the optimization issue.

Again, the monitoring, are you going to put more deep monitor wells in so we can assess what's going on. Use our numerical models, what the models have predicted, are they correct, is that what we are observing. We need more data points. Those might be two things that the commission may add, rather than say change the sustainable yield, it needs

optimization monitoring. Some deadline, I'm guessing that's what they did to Pearl Harbor.

ERIC HIRANO: Let me add something to that. Because of the commission's relook at the Pearl Harbor's sustainable yield, and I know the Honolulu Board of Water Supply has a much larger revenue base than the Maui Board of Water Supply. But since that time, we actually put in -- I think it's between 10 to 12 deep monitor well projects in the islands. And like I said, we just put in another one in Halawa Valley on Oahu, but I mean, the board of -- because, like I said, they have so much more revenue than the commission can generate, because of the Pearl Harbor sustainable yield, they put in about 10 to 12 -- not just in Pearl Harbor, but around the island, you know, from their windward aquifers also.

CHAIRMAN RICE: I think this board is on record as recognizing the need to develop new sources and we intend to do that, move towards that end. And we would ask that you work with us in that regard, given what you know and what you've heard today. We're going to be looking at other areas of the island for source development.

You are not really looking at other places on Maui, you are not up to speed on that kind of expansion, are you? Viability of East Maui or wherever.

ERIC HIRANO: We did our priority list. I believe we had three or four deep monitor well projects which, of course, one was -- our top two priorities was Iao and North Waihe'e. But in our proposal, we also had one for East Maui also. I'm not sure if we were going to put in another one in West Maui on the Lahaina side also. I'm not sure, I would have to relook at our proposal.

But like I said, right now after reading the newspaper this morning, it looks a little shaky there.

CHAIRMAN RICE: I don't know, the legislature -- I won't comment. I should not comment. Okay, we have only got a few more minutes. Board members, you've heard -- anything else you need to ask these gentlemen? We've had a lot of information to sift through as we begin to formulate a plan to move forward. Gentlemen, members of the public, thanks for coming out.

GLEN SHEPHERD: I have one comment.

CHAIRMAN RICE: One minute?

GLEN SHEPHERD: Less than that. I want to point out a jurisdictional problem that needs to be rectified. I'm glad there's two council people in this meeting. It has to do with the limits with the particular aquifers.

I just point this out in the case in point is this one here. It runs right through Keopuo-Lingle park, these three wells right up against this -- that are sucking the hell out of the Iao aquifer. David doesn't have any jurisdiction over that whatsoever. What should be happening here is that the water department under its director should have absolute control over all the wells and the aquifers on this island.

CHAIRMAN RICE: Thank you. The meeting is adjourned.

(The proceedings were concluded at 4:20 p.m.)

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