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Trial Transcript, Vol. 45, Morning Session

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File # 152

4403

IN THE DISTRICT COURT FOR THE FIFTH JUDICIAL DISTRICT

WASHAKIE COUNTY, STATE OF WYOMING

IN RE:	)
THE GENERAL ADJUDICATION OF RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING.	) Civil No. 4993

FILED

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DEPUTY

VOLUME 45

Morning Session

Thursday, April 23, 1981

ORIGINAL

APPEARANCES

FOR THE STATE OF WYOMING:	HALL & EVANS 2900 Energy Center One Building 717 17th Street Denver, CO 80202 BY: MR. JAMES MERRILL and MR. MICHAEL D. WHITE, Special Assistant Attorneys General and MR. STUART RIFKIN
FOR THE UNITED STATES OF AMERICA:	MR. THOMAS ECHOHAWK Attorney at Lat Land and Natural Resources Division Department of Justice 1961 Stout Street Denver, CO 80294 and MR. JAMES CLEAR and MR. JOSEPH MEMBRINO Attorney Land and Natural Resources Division Department of Justice Washington, DC 20006
FOR THE SHOSHONE TRIBE:	SONOSKY, CHAMBERS & SACHSE 200 M. Street, N.W. Washington, DC 20006 BY: MR. HARRY SACHSE

THE SPECIAL MASTER: We will please come to order.

I believe you said you had some redirect for Mr. Toedter.

MR. MEMBRINO: Yes I do, Your Honor.

REDIRECT EXAMINATION

BY MR. MEMBRINO:

Q Mr. Toedter, yesterday you testified that the cross-hatchings on Exhibits WRIR 231 to 240 are not meant to reflect any class. Would you explain what you meant by that?

A Okay. The cross-hatchings actually do reflect a class. The classification actually wasn't important in my analysis because I was just trying to associate a hydraulic conductivity and a depth to barrier to the arable lands within a given area of analysis.

Q In the land classification standards that you prepared relating to drainage for the evaluation of the land on the Wind River Indian Reservation, you established subsurface hydraulic conductivity of at least a tenth of an inch per hour and a soil depth to barrier of at least six feet, is that the same standard for each class of land?

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A Yes, it is.

Q That's Classes 1 through 4?

A Well, actually yes. Those standards were used for Classes 1 through 4.

Q You also testified that of the 23 values for hydraulic conductivity in Table 2 of Exhibit WRIR C-241-A, only four were based on field work. Why did you do field work for only four values, and what did you do to determine the rest of them?

MR. WHITE: The question has already been asked and answered on cross-examination, Your Honor.

THE SPECIAL MASTER: Well, I thought the question has been asked and answered too, but if he -- I'll permit it.

A Okay. The reason why just four values were determined, was because of the fact that for the most part these four textures were the most common textures found in the field. As far as the projection and the interpolation goes, that information was obtained out of a drainage engineering text by Luthin.

Q (By Mr. Membrino) Concerning the areas of

analysis, that is the gray shaded ares outlined in red that we saw on Exhibit C-231 through 240, can you tell the Court how many of the holes in the areas of analysis for, not only within those areas of analysis, but also actually within the arable lands you reviewed?

MR. WHITE: Objection, Your Honor. The question was already asked and answered and he couldn't answer it on cross.

THE SPECIAL MASTER: Well, I thought I tried to remember that on direct too, whether they were in the work area or in the actual arable area.. Let's see what he says.

A Eighty-five percent or greater are within the arable areas. I think it is an important point to consider the geology of the area, and how it relates to the arable lands.

Q Now, do you have a record of the holes you considered in the hydraulic conductivity and depth to barrier investigation?

A Yes, I do.

Q Would you tell us what that record is?

A That record consists of my exhibit on computations, I believe it was on 241-A and B, the air photos

presented in Mr. Kersich's testimony.

Q Those --

A They were 1969.

Q Those are Exhibits C-148 through 1-30?

A Yes.

Q Anything else?

A And the soils photos presented by Mr. Waples during his testimony.

Q Those were Exhibits C-56-A to 136-A?

A Yes.

Q Any other records?

A Yes. The logs that were presented by Mr. Kersich in his testimony and the logs that were presented by Mr. Waples during his testimony.

Q Now, I ask you to identify what's been marked for identification 231-A, 232-A, 233-A, 234-A, 235-A, 236-A, 237-A, 238-A, 239-A and 240-A.

A Yes. These are the maps which I used in the development of my hydraulic conductivity and depth to barrier analysis.

Q Were these prepared by you or under your supervision?

A Yes, they were.

Q Do they also form a part of the record of the

holes that you considered in your drainage investigation?

A Yes, they do.

MR. MEMBRINO: Your Honor, at this time I would move into evidence -- well, I'll hold back that offer for just a moment.

Q (By Mr. Membrino) I ask you, Mr. Toedter, before we leave, that to make clear the identification, what is 231-A?

THE SPECIAL MASTER: I believe he's referred to them during his testimony and I doubt very much if they need much more identification unless --

MR. MEMBRINO: All right.

MR. WHITE: Your Honor, we're going to have very little objection I think, to these exhibits. if we can just get them correlated between unit area or study units.

THE SPECIAL MASTER: Yes.

MR. WHITE: And the exhibit number.

THE SPECIAL MASTER: Yes. If you can identify them for the purposes of our index, we would appreciate it. Just what do they apply to?

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THE WITNESS: Okay, What we have attempted to do here is, the maps that were introduced as evidence before for each of the study areas, we have taken these worksheets and used a sub-script A after --

THE SPECIAL MASTER: So, the 231-A applies to 231 area?

THE WITNESS: Right.

THE SPECIAL MASTER: The same with 232, 233 and so forth?

THE WITNESS: Correct, all the way through.

THE SPECIAL MASTER: Do we need anymore than that?

MR. MEMBRINO: I don't think we do, Your Honor, except for one thing. We introduced one map, one worksheet, as Exhibit 243 and with the Court's permission I would like to renumber that to conform to this correlation. Yesterday we introduced --

THE SPECIAL MASTER: Well, what will you renumber it?

MR. MEMBRINO: I will renumber that as 231-A. It was the North Crowheart worksheet and I think for the ease of identification,

that would be --

THE SPECIAL MASTER: Very well.

MR. MEMBRINO: -- a preferable way to proceed.

THE SPECIAL MASTER: Very well.

* * * * *

THE SPECIAL MASTER: So you now offer into evidence --

MR. MEMBRINO: Well, the reason -- I'm going to continue. I have a couple more questions.

Q (By Mr. Membrino) In your testimony on voir dire yesterday you responded yes to a question that there was not a mathematical computation made to arrive at a 15-foot depth to barrier, and that that was a professional judgment made by you. Just for the sake of clearing up the record, does one ordinarily make mathmetical computations to arrive at depth to barrier?

A No.

Q What does one ordinarily do?

MR. WHITE: I object, Your Honor. That question was asked and answered and there was quite an extensive drawing made and calculation on which there was an original arithmatic error made. He was not cross-examined on how mathmetical computations could determine weight of hydraulic conductivity and -- but also, from these --

THE SPECIAL MASTER: I doubt if the question is

toedter-redirect-membrino

self admissive, because in so many instances as to its own set of facts and its own unique place, it doesn't need any amplification as far as I am concerned, unless you need to proceed with it, Mr. Membrino.

MR. MEMBRINO: Well, I wanted to indicate that mathematical computations are ordinarily made for this, and I think --

THE SPECIAL MASTER: But in this case, I figure it was his professional judgment that he could calculate it as he did and that is what he did, not to detract from his professional expertise.

THE WITNESS: It's not actually a calculation, It's more a review on the statistical standpoint.

MR. MEMBRINO: Then Your Honor, at this point I would move into evidence the worksheets we have just discussed, Exhibits 231-A --

THE SPECIAL MASTER: Not too fast. 231-A.

MR. MEMBRINO: -- which is the North Crowheart study unit. Since that is a two-part map, that has been labeled east half and west half.

THE SPECIAL MASTER: All right.

MR. MEMBRINO: 232-A, South Crowheart study

unit, Toedter workmap; 233-A is the Riverton East study unit, Toedter work map; 234-A is the Arapahoe study unit, Toedter work map; 235-A is the Big Horn Flats study unit, Toedter work map; 236-A is the Owl Creek study unit, Toedter work map; 237-A, Upper Wind Unit study, Toedter work map; 238-A, Johnstown Study Unit, Toedter work map; 239-A is the Ray and Coolidge study unit, Toedter work map; and 240-A is the Subagency and Lefthand study units, Toedter work map, and we have renumbered Exhibit 243 to be 231-A.

MR. WHITE: What was 238?

MR. MEMBRINO: The Johnstown study unit, Toedter work map.

MR. WHITE: The State would have no objection to those being admitted, Your Honor, for the purpose of showing what his work maps are. I hope they're not offered for the truth of their contents. I hope we can avoid a long voir dire where we have to check the location of holes against logs and in talking of the truth of the contents, we bring up the ten-day rule again.

THE SPECIAL MASTER: I would overrule your objection on the ten-day rule because you've

had the information for ten days.

MR. WHITE: That's not true, Your Honor.

MR. MEMBRINO: This is also redirect, and the ten-day rule does not apply to exhibits introduced on redirect.

THE SPECIAL MASTER: It may not apply, but if there was some startling evidence of concealment and that slipped out on redirect, I think I would be constrained to find an element of unfairness, you know. But I think the information in these, Mr. White, you have been working with them for quite a few days now.

MR. WHITE: We've had these for less than a week, Your Honor.

THE SPECIAL MASTER: I see. Are you calling in the goodies left over from yesterday's computation?

MR. WHITE: No, I'm adding to them.

MR. MEMBRINO: I think we are talking about apples and roses, since this is redirect.

THE PSECIAL MASTER: For what purpose are they offered?

MR. MEMBRINO: For a part of the record of his conclusions on hydraulic conductivity and

depth to barrier. They show the information considered, and I think it is relevant.

MR. WHITE: If they're offered for that purpose, we have no objection, Your Honor.

THE SPECIAL MASTER: The exhibits just enumerated by Mr. Membrino are received in evidence.

MR. MEMBRINO: Just one more matter, Your Honor. We went out yesterday to have a look for the additional logs Mr. Toedter prepared and we were unable to locate them. I think they're going to have to be reconstructed from his notes back in Billings, and --

THE SPECIAL MASTER: Is it necessary that this be done?

MR. WHITE: Yes,

THE SPECIAL MASTER: You require it?

MR. WHITE: Yes. They are part of the facts and data upon which he relied, and we're entitled to it. These are the 1981 logs that he did after Mr. Kerisch's testimony.

THE SPECIAL MASTER: Okay.

MR. MEMBRINO: We have no objection to supplying them. I am not sure how we'll get them into the record.

THE SPECIAL MASTER: I'm sure that if you get them supplied Mr. White will find a way to get them into the record.

MR. WHITE: That shouldn't be a problem, Your Honor. If we do it, we will agree the United States can put them in upon representation of Counsel.

THE SPECIAL MASTER: You can examine them.

MR. WHITE: Right, but they can be put in upon the representation of Counsel without foundation.

MR. MEMBRINO: I have nothing further, Your Honor.

THE SPECIAL MASTER: This witness is subject to call of the Court, as you know.

(Whereupon, Exhibits U.S. (WRIR C-231-A through (C-240-A were received (into evidence.

MR. WHITE: I have a couple of questions on recross, Your Honor.

THE SPECIAL MASTER: All right, Mr. White.

MR. WHITE: Is it all right if I stand back here?

THE SPECIAL MASTER: Sure.

RECROSS-EXAMINATION

BY MR. WHITE:

Q With respect to the cross-hatching on Exhibits 240 through -- excuse me, 231 through 240, that you now indicate to reflect -- arable class, is that gravity or sprinkler arable class?

A On my exhibit maps, both --

Q How do you --

A -- gravity and sprinkler classes were shown --

Q Let me ask you --

A Where there --

Q Go ahead.

A -- where there was a difference between the sprinkler and the gravity class, the base map for gravity was used and then those additional areas that were classified as being irrigable for sprinkler were added to the map just to identify those areas and then given the appropriate class.

Q So, for example, one of the areas that Mr. Kersich testified about that would be Class 3 gravity, Class 1 sprinkler, would be shown as Class 3 in the cross-hatching on your map?

A Yes.

toedter-recross-white

MR. MEMBRINO: I think we should clarify what maps we are speaking of. The 231 series or the 231-A series exhibits?

MR. WHITE: I referred to the 231 series, but if you want to, you may ask about the 231-A.

MR. MEMBRINO: I want to point out that all that was discussed on redirect regarding these exhibits in the 231-A series, and his examination on the 231 series is beyond the scope of proper recross.

Q (By Mr. White) Did you answer with respect to the cross-hatching applied to the 231-A series or the 231 series?

A 231.

Q Is there a cross-hatching on your 231-A series?

A Yes, there is.

Q Is that the same as that appearing on the 231 series?

A No, it is not.

Q Okay. Could you explain the conventions that you used to establish the cross-hatching pattern on the 231-A series, if it is different from the 231 series?

A We just used the sprinkler on the 231-A series.

Q Okay. Mr. Toedter, on redirect you testified there was the same standard for hydraulic conductivity and depth to barrier for all four classes; is that correct.

A That's correct. Hydraulic conductivity and depth to barrier specifically.

Q And yet the standards contained a footnote 4, is that correct, which deal with Class 4?

A Yes, that's correct.

Q And do you recall the substance of footnote 4?

A Yes.

Q What is that -- okay, do you want to look at it?

A Yeah, let me look at it.

MR. WHITE: Your Honor, could I borrow the report that's got the shale standards?

THE SPECIAL MASTER: Yes. It's 7, 8 and 9.

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A Okay. Footnote 4 just indicates that in the standards a tenth of an inch per hour subsurface hyraulic conductivity has to be met, and the soil depth to barrier has to be met. However, no drainage requirement is necessary for these lands.

MR. WHITE: I'm sorry.

THE SPECIAL MASTER: That's all right. I want to make sure I get them back. Thank you.

I also want to be careful about this because I make notations once in awhile.

MR. WHITE: We didn't peak, Your Honor.

THE SPECIAL MASTER: Well, I lucked out.

Q (By Mr. White) With respect to the record of the holes which you considered, and with respect to the portion of that record that you testified about outside of Exhibits 241-A and B, would you please explain again the record of the holes considered, which were Bureau of Reclamation holes?

A Okay. Those Bureau of Reclamation holes are present within a series of Bureau worksheets. I'm not sure what the exact title is, it's Drainage Investigation for the Wind River or

something similar to that.

Q Well, they had both deep drainage holes and land classification holes, didn't they, as well as drainage pits?

A The Bureau did?

Q Yes.

A Not on those maps.

Q Okay. Where is the record for the other ones, the nondrainage holes?

Q That's shown on some Bureau of Reclamation land class sheets.

Q And those records are not in evidence, are they, if you know?

A Not that I know of, I haven't presented them.

MR. WHITE: Okay. Thank you. I have no further questions, Your Honor.

THE SPECIAL MASTER: Okay. Thank you.

This witness will remain subject to call of the Court, but he is dismissed for the rest of today's proceedings, is that correct?

MR. WHITE: That's fine with us, Your Honor.

MR. MEMBRINO: Thank you, Your Honor.

THE SPECIAL MASTER: Is that all right with

you?

Okay. Thank you very much, Mr. Toedter, for your contribution towards the problems we have to solve here and we'll give you a few moments ot clean the material from your desk and be ready for the next witness.

MR. ECHOHAWK: Yes, Your Honor, we need a few minutes.

MR. WHITE: Can I have about ten minutes, so I can run over to get my Mesghinna notebook?

THE SPECIAL MASTER: Yes. We'll take about a five or ten minute recess to get ready for Mr. Mesghinna.

(Recess, 8:35 a.m.

* * * * *

(Beginning at approximately
(8:50 a.m.

THE SPECIAL MASTER: Okay, I hope we are ready to resume.

MR. CLEAR: Two seconds, Your Honor.

THE SPECIAL MASTER: Okay. Will we please come to order.

Mr. Echohawk, would you please call your next witness --

MR. ECHOHAWK: Mr. Clear is doing this examination.

THE SPECIAL MASTER: Mr. Clear.

MR, CLEAR: Yes, Your Honor, at this time the United States would like to call Dr. Woldezion Mesghinna.

THE SPECIAL MASTER: Do I have the spelling right, W-a-l-d-e-z-i-o-n?

DR. MESGHINNA: : W-o.

MR. CLEAR: W-o.

THE SPECIAL MASTER: Wold M-e-s-g-h-i-n-n-a?

DR. MESGHINNA: -i-n-n-a.

THE SPECIAL MASTER: Fine, will you come forward, Doctor, to the witness stand or to the seat.

WOLDEZION MESGHINNA

was called as a witness by the United States and, having been first duly sworn, testified as follows, to wit;

THE SPECIAL MASTER: Thank you. Please take your seat.

MR. CLEAR: Your Honor, up to now we've been talking about arable land and, as you recall, we have split arable lands into future projects and the historic lands. We are now moving into a new phase of the trial. Dr. Mesghinna, as you probably have been made aware, is the man who took the information compiled by HKM dealing with respect to the future lands and determined what lands of that arable base can be irrigated from an engineering standpoint, and he also determined the cost of that irrigation system, and in conjunction with that, it is necessary to determine what the water duty toward these lands is and designed diversion systems. So -- and that information then is, of course, while he's working on that, it is passed on to the conomist, Mr. Dornbusch, who will eventually testify, and Mr. Dornbusch determines whether in light of the crop yields they can expect from those lands whether the --

THE SPECIAL MASTER: Irrigating --

MR. CLEAR: Which acres are economically -- which irrigated acres are economically feasible.

THE SPECIAL MASTER: Right. And does that bring us to the long, long -- along to the conclusion of the long, long road of what is a practicably irrigated acre?

MR. CLEAR: Mr. Dornbusch does.

THE SPECIAL MASTER: Okay. We are on our road.

MR. CLEAR: I think we are on the road.

THE SPECIAL MASTER: Fine.

DIRECT EXAMINATION

BY MR. CLEAR:

Q. Dr. Mesghinna,. can you please tell the Court your address?

A. My home address is 2910 Simas Avenue, S-i-m-a-s, Pinole, P-i-n-o-l-e, California, 94564.

MR. WHITE: Just a second. Let me close the window. I can't hear him back here.

MR. CLEAR: I know.

THE SPECIAL MASTER: Yeah, we'll close those, but the cool air is so pleasant we kind of like it.

MR. WHITE: Maybe Wold could speak up.

MR. CLEAR: Speak up just a little bit.

MR. WHITE: Maybe we can move our table up a little bit.

MR. CLEAR: Well, you can sit here again.

MR. WHITE: Well, I can't write backwards.

MR. CLEAR: That's why I suggested it.

THE SPECIAL MASTER: Bring your chair up closer, if you want to, Sandy. Sit there by Exhibit 41.

MR. WHITE: I need something to write on, Your Honor. That's my problem. If we can slide the desk up, why, that will be very helpful.

THE SPECIAL MASTER: I have no objection to you sitting over there if you don't speak up or pound the gavel.

MR. WHITE: I would feel a little uncomfortable doing that.

MR. CLEAR: It is a little intimidating to the witness, Your Honor.

MR. WHITE: Well, I'll do it then.

Let me sit over here in the middle.

Q. (By Mr. Clear) Dr. Mesghinna, were are you currently employed?

A. I'm currently employed with Stetson Engineers in California.

Q. And what is your position there?

A. I am a supervising engineer in Stetson Engineers.

Q. What are your duties there?

A. Well, I try to have people working under me. I do

irrigation systems design work, drainage, hydrology work, and I supervise also my people over there.

THE SPECIAL MASTER: I'm going to repeat this: Irrigation systems design work?

THE WITNESS: Uh-huh.

THE SPECIAL MASTER: And --

THE WITNESS: Drainage.

THE SPECIAL MASTER: Drainage.

THE WITNESS: Hydrology.

THE SPECIAL MASTER: Hydrology.

Q. (By Mr. Clear) Your duties as a supervisory engineer with Stetson Engineering, are they solely related to irrigation works on projects and related matters?

A. Yes, our work is mainly concerned with water resources work in general and irrigation and system -- I mean, irrigation system design is within the water resources.

Q. Uh-huh. I would like to discuss your educational background. Can you tell us something about your college and postgraduate work?

A. Well, I first graduated from a college called Ethio Swedish Institute of Building Technology in Addis Ababa, Ethiopia, in 1967. After I graduated,

I worked with an international organization called SIDA, which is Swedish International Development Authority, and I was working first as an engineer and gradually I became a deputy managing engineer for one fifth of Ethiopia in school construction and hospitals; that includes design, construction and supervision and so on.

Q. Did that involve any water resources engineering like we are talking about today then?

A. No, at that point I was mainly working in structural engineering, that is, pure civil engineering.

Q. Uh-huh.

A. Design and construction of buildings and small roads.

Q. What laymen normally think of an engineer, an engineer does, huh?

A. Yeah.

Q. How long were you with SIDA?

A. I worked with SIDA about three years, a little above three.

Q. S-E-D-A?

A. S-I-D-A.

Q. S-I-D--

A. Swedish International Development Authority.

Q. And then after you left SIDA, where did you go?

A. Well, while I was working there, I received a scholarship in the United States and came to school in the United States, and specifically, I went to Cornell University in Ithica, New York. As I have said it earlier in the Ethio Swedish Institute of Building Technology, I studied building engineering. That is mainly dealing with buildings, as I stated there. However, when I came to Cornell University, I changed a little my subject area into the field of civil engineering.

Q. Uh-huh.

A. And I continued for two years in Cornell University and received my Bachelor of Science Degree in civil engineering in 1972.

Q. Uh-huh.

A. After that I continued, I received a Fellowship from Cornell University and continued for graduate study there, and I finished my Master's in civil engineering in 1973.

Q. Was your Master's that you received, the Master's you received from Cornell, was that in civil engineering, or was that in any specialty?

A. Yes, within civil engineering, it was in hydraulics.

Q. Uh-huh.

A. And my minor was geotechnical engineering, that relates to soil mechanics and foundation design.

Q. Uh-huh.

THE SPECIAL MASTER: Is that g-e-o technical?

THE WITNESS: Uh-huh.

Q. (By Mr. Clear) And when you left Cornell, where did you go then?

A. When I graduated from Cornell, I joined a company by the name of Woodward Clyde Consultants.

Q. Uh-huh.

A. In New Jersey-New York office, which is their eastern regional office. Woodward Clyde is a consulting firm that is all over the world. Then I worked with them for over three years. Then I was working mainly as a hydrologist and also as a geotechnical engineer at Woodward Clyde.

Q. What types of projects did you work on with Woodward Clyde?

A. My main work was in flood estimation.

Q. Pardon?

A. Flood estimation.

THE SPECIAL MASTER: Flood estimation.

THE WITNESS: Yes, hydrographic preparation,

foundation design.

Q. (By Mr. Clear) Uh-huh.

A. And so, on, related with hydrology and foundation design.

Q. Okay.

A. Some of the projects that I was involved there, like the Alaska Pipeline Project, I've been there several times and I assisted in the design of the geotechnical part of it. I worked on dam design at Coff Point, Maryland. I also worked on the Yonkers city flood estimation study and so on. There are several projects.

Q. Well, yeah, we just wanted a general idea.

All right. Then you were there for a few years, and where did you go after Woodward Clyde?

A. Well, I worked with Woodward Clyde for over three years, from 1973 to 1976.

Q. Uh-huh.

A. And during my work as a hydrologist in the water resources area, I wanted to put the hydrology work to connect it with the real world situation.

Q. Uh-huh.

A. Which is mainly in need of food.

Q. Food?

A. Yeah, food production. So I wanted to relate it with irrigation because during my work in there, I found out that irrigation would be a very important subject in the future.

Q. Uh-huh.

A. Not only in the developed countries, but also in the undeveloped countries. So I decided myself to, you know, specialize more into the fields of irrigation and drainage.

Q. Uh-huh.

A. After I made this assessment, then I applied to a school called Utah State University which specializes in irrigation and drainage mainly in arid lands.

Q. Uh-huh.

A. So I went there in 1976 and continued my study in irrigation and drainage, solely in irrigation and drainage, at Utah State University.

THE SPECIAL MASTER: Where was it, in Terry-town?

THE WITNESS: The town is called Logan, Utah.

THE SPECIAL MASTER: Oh, Utah State?

THE WITNESS: Yes.

THE SPECIAL MASTER: Of course.

THE WITNESS: Yeah.

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Q. (By Mr. Clear) And did you receive an advanced degree from Utah State?

A. Yeah, I started in 1976, September, 1976, and finished at the end of 1978 with a Ph.D. in irrigation and drainage.

Q. I assume part of your work at Utah State in fulfillment of your requirements for a Ph.D., you had to write a dissertation or a thesis, is that right?

A. Yes, I wrote a dissertation; the title of my dissertation was "Crop Yield Prediction under Limited Climatic Datas".

Q. Uh-huh.

A. This relates mainly to the irrigation in such a way that by optimizing water, how much yield can we receive for a certain crop. Say, for example, if someone wants to invest a certain amount of irrigation in a certain area, you would like to determine first what kind of crop yield would you expect under different kinds of irrigation programs. So you optimize the irrigation program and you find out the yield prediction. The yield prediction technique that is developed there is not a statistical yield prediction, but it is more of a scientific that relates with the physical conditions of the soil

and climate.

Q. Uh-huh. And after 1978 you went with the Stetson Engineers, is that correct?

A. Yeah, as soon as I finished in December, it was, I think, in January I joined Stetson Engineers, the month after, January, 1979.

Q. Aside from the Wind River Project, which is the subject of this litigation, what other projects are you working on or have you worked on since you joined Stetson Engineering?

A. Well, I worked on Salt River Indian Reservation, which is the determination of crop water requirement efficiencies and so on, almost related to this.

Q. Uh-huh.

A. I worked in the Northern Cheyenne Indian Reservation. I worked on Warm Springs Indian Reservation; that was in actual design and specification work in irrigation systems design. I also worked on reservoir system operations.

Q. Pardon?

A. Reservoir system operation.

Q. Reservoir system operation?

A. Yes, reservoir system operation. That is on how to

allocate the water from different reservoirs --

Q. Okay.

A. -- in northern California.

Q. Uh-huh.

A. For the Mendocino and Sonoma Counties where they have two rivers, the Eel and the Russian Rivers.

Q. Are you a licensed engineer?

A. Yeah, I am a licensed civil engineer in the State of California.

Q. What professional societies do you belong to?

A. I belong to ASCE, American Society of Civil Engineers, although it was disconnected when I was in school. I reapplied and I haven't gotten the reply yet.

* * * * *

Q Have you ever ever testified in court before as an expert witness?

A Not except at depositions.

Q What?

A Only at depositions.

Q That is not in court. I think your depositions here may have lasted longer --

THE SPECIAL MASTER: Your depositions here were your initial baptism?

MR. WHITE: We were very gentle.

THE SPECIAL MASTER: All right.

Q (By Mr. Clear) Prior to this assignment of this case, have you done any work with respect to irrigation or hydrology problems for the Wind River Reservation?

A No.

MR. CLEAR: As I indicated, Your Honor, Dr. Mesghinna is going to give a series of opinions basically representing the water and irrigation requirements of the arable base developed by HKM and the cost of construction, consent of use and the engineering concepts involved and the practicability from the engineering standpoint of the irrigation system which he has designed and which we will go into, and I would like to offer him at

this time as an expert witness to enable him to give opinions on those matters.

MR. WHITE: Your Honor, could I voir dire very quickly?

THE SPECIAL MASTER: Yes. I thought you may want to, secondary to the depositions. Please proceed, Mr. White.

VOIR DIRE EXAMINATION

BY MR. WHITE:

Q Dr. Mesghinna what previous irrigation design work have you done in Wyoming?

A I haven't done any design work in Wyoming.

Q Are any of the irrigation projects which you described that you have worked on or designed actually in operation today?

A No, none of them is in operation, except the Warm Springs Indian Reservation might be in operation -- might be constructed soon.

Q All right. Have you ever actually, yourself, conducted sprinkler irrigation, done sprinkler irrigation, as an irrigator?

A Well, I did work when I was in school. I did what's called experiment in the field for about 1 1/2 years.

Q Did you ever move a sprinkler with a tractor?
A No, by hand.
Q Hand moved as opposed to side roll or center pivot?
A Yes.

MR. WHITE: We have no objection to his admission as an expert, Your Honor.

THE SPECIAL MASTER: All right. You are admitted, Dr. Mesghianna, as an expert witness in this case.

THE WITNESS: I would like to answer what Mr. White said. Actually, I am son of a farmer. I am from a farm country and I have worked on gravity irrigation very, very much when I was young with my parents.

MR. WHITE: I meant to ask him only about sprinkler.

THE SPECIAL MASTER: You did. You did. He thought he would add a little footnote on the experience, practical experience.

MR. WHITE: That's all right.

DIRECT EXAMINATION (CONTINUED)

BY MR. CLEAR:

Q Dr. Mesghianna, I am sure you are aware, although you have not been here, of the distinction that has

been made in the presentation of the government's case between what is called the historic lands and the future lands, or future projects. Are you aware of that distinction?

A Yes, I am aware of those distinctions.

Q And can you briefly tell me, are you going to testify now about the future projects or about the historic projects?

A I am going to testify about the future projects.

Q All right. Now, I would call your attention to U.S. Exhibit WRIR C-41, which is already in evidence. Are you familiar with that map or study? Do you know what it shows?

A Yes, I know what it shows.

Q Just briefly state what it shows for us.

A Okay. It says one the top, this is the "Arable Sprinkler Lands of the Wind River Indian Reservation", and the future lands is divided into five units. The first unit which is the largest unit is the North Crowheart Unit, which is the area in here. The next unit is called the South Crowheart Unit which is this area in here; the other unit, third unit, is called the Riverton East Area, which includes this area in here; the fourth unit is the

Arapahoe Unit, which is between Little Wind River Popo Agie River and this is the area; the other unit is the Big Horn Flats Unit which is this area, and this, points in here -- these small plots in here. So all in all we have five units.

THE SPECIAL MASTER: Let me avoid the inevitable confusion in my mind. 341 shows five units, yet 343 gives land classification of six units. Which unit is not on 341? Owl Creek?

THE WITNESS: Yes.

* * * * *

A Yes.

MR. CLEAR: It's on there, Your Honor. We're just going to concentrate on the five units he mentioned. There is some confusion about Owl Creek at this point.

THE SPECIAL MASTER: All right.

Q (By Mr. Clear) Dr. Mesghinna, can you give me a short summary of the steps you take to -- you took in your study of the five future units you mentioned and to arrive at the conclusions which you will testify to?

A In general, in any irriagtion project, whether it is the Wind River or any other project, the first thing to study is the crop consumptive requirements -- how much crops do they have, how much water do they need -- that's the first part. The second part of the study is, okay, these crops require this amount of water; how can the river provide to the point you need to irrigate. That is the study of the facilities.

The final conclusion is the costs of those facilities and the water --

THE SPECIAL MASTER: Final conclusion is what?

A The costs of the -- cost of the food and the water duty. In general, this is what we did, really.

Q Now, are there particular steps you started out on to find out what the crop requirements are?

A In dealing with the general overview that I gave, we have done through logical steps to come up with the final conclusion, and I think the best thing would be if I have a blackboard to write on so people can follow exactly what I did. Each and every point is interrelated to each other, so people won't forget in their minds once I write it down.

MR. WHITE: I have no objection to that, Your Honor.

THE SPECIAL MASTER: Why don't we take a moment off the record.

(A brief recess was (taken.

* * * * *

THE SPECIAL MASTER: Are we ready to resume? Okay.

MR. CLEAR: I think so.

THE SPECIAL MASTER: Mr. Clear.

Q (By Mr. Clear) Before the break, Dr. Mesghinna you said you thought it would be easier if you went to the board and outlined the step-by-step approach you took to the problems here. Would you do that for us now?

A. Okay.

Q. I think you will have to talk up a little louder now because we're a little further away.

A. Okay. The first thing we started was the climate of the area, and that was taken as number one. The second thing we studied was the cropping patterns in the Wind River Indian Reservation. The third thing that we studied was evapotranspiration.

Q. Would you just give us a couple of sentences on a little definition of evapotranspiration? That's a big item and I know I never encountered it before. So maybe just a couple of sentences on what --

A. Okay. Evapotranspiration is nothing but the evaporation from the soil plus the transpiration from the plants.

Q Uh-huh.

A. So that is the amount of water that is evapotranspirated from an irrigated land.

Q. Transpiration is the water the plant uses in growing, that it consumes?

A. Yes, though the plant gets its water through photosynthesis and then it transpires it.

Q. Okay.

A. So that's what I mean when I say transpiration.

Q. Okay.

A. Okay. And evaporation really means evaporation from the soil.

Q. From the soil?

A. That is something you cannot avoid whenever you apply water to the ground.

Q. Okay.

A. Okay. The fourth item that we studied was, after determining what the climate is, what the cropping pattern is, what the evapotranspiration is, is the on-farm systems design.

Okay, in one sentence, about on-farm systems design: It is the facilities and the interaction of the crop, water and soil at the farm level, just at the farm. At the farm plot. We haven't gone

out from it, we're just at the farm plot. Now, we relate all of this to this evapotranspiration.

Q. All right.

A. The fifth study is the pipe network system. Okay, we have the on-farm and then we connect pipes to the on-farm in order to supply water, so that part is -- that part has been studied by itself.

Q. Okay.

A. The sixth part is pumps and pumping plants.

Okay, we have the farm, we have the pipes, and then the next logical thing is we need pumps to supply water to the pipe and the pipes supply water to on-farm systems. The next logical thing is canals and related structures. Okay, then we have to supply water to the pumps through the canals and related structures. The related structures, like diversion structures from the rivers or streams or some syphons or drop structures and so on. And the canal is the canal that conveys water from the source to the pump stations.

The next thing that we have studied is the drainage and drainage analysis.

Okay, so we have the farms, we have the pipes, we have the pumps, we have the canals. Then when

we apply water, there will be some, in the future there will be some water buildup, and that water buildup should be taken care of by the drainage water. So the next thing after canals and related structures was drainage analysis. The other things that we came up is the operation and maintenance.

Okay, we have the system up to number eight, the overall system is there, but how would we operate this system, meaning that what kind of professionals do we need and how much does this cost. So that's the operation and maintenance study.

The final thing is, okay, we have everything now, so what is the water duty.

THE SPECIAL MASTER: If you had to define water duty in a sentence or two, how would you do it?

THE WITNESS: Water duty is the amount of water that is diverted, actually diverted at the water supply to the canals. Now, in the course -- that is not really what the plants need; the plants need actually much less than it. But during the course of the water travel in the canals in the pipes in the farms, there will be losses. So

water duty actually accounts to those losses. So that's what I mean when I say water duty.

The final item is the total cost. We'll go on. As we go along with on-farm systems, pipe network and so on, we'll determine the costs. But as a final thing, including the operation and maintenance, then we'll come up with a total cost.

So these are the logical steps that have been taken in order to come up with the final conclusion of water duty and costs.

Q. (By Mr. Clear) Okay. Thank you.

Well, I guess the first thing we should do is talk about climate.

A. Okay. In order to come up with water requirements, one has to first study what is the climate in the area. When we say climate, we are specifically talking about the climate that affects the crop evapotranspiration. The reason why we need climate and cropping pattern is actually in order to determine evapotranspiration.

Q. So you go to Steps 1 and 2 and you grind that in to get No. 3, which was the evapotranspiration.

A. That is exactly what we're trying to do. So when we say climate, we're talking of the temperature

in the area, the precipitation, the solar radiation.

Q. Solar radiation?

A. The solar radiation. These are the main aspects of the climate, really. However, in order to be more on the exact side, you have to study the different climatic stages in the area. When I say climatic stages, I mean the different areas where they have weather stations.

Q. What do you mean by weather station now?

A. Okay, weather station is nothing but an area where you measure at least temperature and precipitation. Somewheres that station measures other things, you know, they measure wind speed, the measure plant evaporation and some of them even solar radiation and so on, which there are very few of those.

Q. These weather stations are run by NOAA, is that right?

A. Yes.

THE SPECIAL MASTER: I presume you know, Mr. Reporter, what NOAA is?

MR. CLEAR: National Oceanic --

THE SPECIAL MASTER: Will you give it to him?

MR. CLEAR: National Oceanic and Atmospheric Administration --

THE WITNESS: Uh-huh.

THE SPECIAL MASTER: Formerly known as the Weather Bureau.

THE WITNESS: Yes.

* * * * *

Q Okay. Did you find any appropriate weather stations in or near the Wind River Indian Reservation?

A Yeah. In order to come up with the crop consumptive requirement we have to see the weather stations that is available inside the Wind River Indian Reservation or near it. And the stations that we have considered in this study are southern stations. This includes Riverton Station, Lander Station, Fort Washakie, Diversion Dam, Burris, Pavillion and Dubois.

Q And I assume from what you already said what you gathered from those stations is information relating to temperature and precipitation and wind speed and so forth?

A Yes. The main things that I needed in the stations are really actually the temperature and the precipitation. Actually, received the percent sunshine from the Lander Airport, which is used to determine the solar radiation. So the solar radiation was indirectly determined from standard formulas available that use the percent sunshine which is the ratio of actual sunshine to possible sunshine.

Q Sunny days versus cloudy days, basically is that what it is?

A Yeah, if you have a given day, if it is very clear the ratio would be very high, because you don't have clouds. The solar radiation from the atmosphere will directly come and absorb it by the soil. I mean down by the plants, and so on, so you have higher radiation.

THE SPECIAL MASTER: The word after solar is irradiation?

THE WITNESS: Yes, radiation.

THE SPECIAL MASTER: Irradiation?

MR. CLEAR: Radiation.

THE SPECIAL MASTER: Does this deal with determining the growing season or number of days in a growing season?

THE WITNESS: The reason we need solar radiation, it affects the evaporation of the crop, that is the transpiration from the crop. That is the transpiration from the crop is affected by solar radiation, so when we determine the crop consumptive use or crop evaporative transpiration, we enter into -- the formula is solar radiation.

THE SPECIAL MASTER: Do you include in your figures the total evapotranspiration losses from water consumed by beneficial crops as opposed to nonbeneficial crops?

A Yes.

Q You do, or just by nonbeneficial crops?

A Just beneficial crops we are considering. Which I will discuss later on.

THE SPECIAL MASTER: All right.

While you're doing that, I will ask the Doctor one more question. The evidence so far has led me to conclude somewhat uncertainly the evapotranspiration includes crop water which goes to nonbeneficial crops, like Russian Thistle, phreatophytes, and massive crops like that in the lower Colorado River. that consume great amounts of water but gives no benefit to anybody. Is that your understanding of losses in evapotranspiration?

THE WITNESS: No.

THE SPECIAL MASTER: Then I have much more work to do later in this case.

MR. CLEAR: We want to clear up what he's doing.

THE WITNESS: It will be clear after the certain step that we do.

Q (By Mr. Clear) Doctor, I've put on the easel what's been marked as United States WRIR C-244. Are you familiar with that?

A Yeah.

MR. CLEAR: Can you see it, Sandy?

MR. WHITE: Yeah, thank you.

Q (By Mr. Clear) Can you explain what that is?

A This map, we call it a climatic zone map. We call it that because it has seven different zones of climates.

Q Are these zones based on the seven stations you testified to?

A Yes, and these zones are based on the seven climatic stations that I mentioned before. As you can see, the blue area in here shows the Riverton Climatic Zone; what this shows is this area in here -- the blue area in here has similar climatic conditions as the Riverton area. That is what it's actually saying and this area is Pavillion, for example, and this -- all this area, the green area we see here, has similar climatic conditions as the Pavillion

climatic station.

Q You're saying in the blue area you can take the data you derived from the Riverton Station and apply it to the geographic area in the blue area, basically?

MR. WHITE: I'm going to object, Your Honor, as to no foundation. It asks for a conclusion, and there's no foundation for the facts upon which the conclusion can be based, taking the value from one station, the Riverton Station, and extending it throughout the area in blue. It may be true, but I think the foundation needs to be established.

THE SPECIAL MASTER: I'm going to overrule the objection. Proceed.

Q (By Mr. Clear) Is that what you're saying, is that the data that you derived from the Riverton Station can be applied to the area in the blue?

A Yeah. What we are saying is the evapotranspiration in these blue areas is similar in all the areas in here. The evapotranspiration in Pavillion is quite different, which is not much, but a little different from Riverton, so these areas

we used the Pavillion climatic zone for Pavillion. If we have an area to design in here, we use the Riverton climatic zone, and here we use Pavillion. As to crop consumptive use and so on and so on. We have the Diversion Dam climatic zone area here, and the Burris here, and Dubois here, although we don't have any Dubois climatic zone for future land. Here we have the Fort Washakie climatic zone and here the Lander. If we have land in here, then we use -- the amount of evapotranspiration that we apply for this specific land will be from Lander, rather than from Burris or Diversion Dam or anywhere else.

THE SPECIAL MASTER: Is one of the factors in determining the criteria of the climate within a given climate zone the wind factors?

THE WITNESS: Okay. Let me go into -- let me explain more how we came up.

A So far, we've only shown the climatic zone map, and now I will try to explain how we came up with this, okay. One thing we have to consider is -- the logical thing we have to consider is as one goes from low elevation to

higher elevation, the temperature decreases. I think this is a general rule in the profession that I have, and I think it's logical for everyone. So this is one basis. So in a sense what we are saying is elevation affects climate and climate affects evapotranspiration. So what we are saying in a sense is elevation indirectly affects evapotranspiration because as you go higher with elevation the temperature decreases. So one of the criterias in coming up with climatic zones is the elevation.

The second criteria that we have come up in determining these climatic zone boundaries next to the elevation is the area and distribution area. Let me explain that a little bit. If two areas have no differences in elevation that make significance in change of temperature and so on, then what we have to see is there distribution, meaning that if a certain climatic station is X miles away from another, then we take the proportion between the two climatic stations. Here, the one that has that kind of consideration, there is no appreciable difference in elevation between Lander and Fort Washakie

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climatic station. So instead of using the elevation in order to come up with a boundary of the climatic zone, we used the area distributions. So you can see that the area of Fort Washakie, here, and Lander, here, have a line between them since they failed to make any difference in elevation. We take the porportion difference between them, which is almost half the distance between them. This third consideration that came into the climatic zone map is studies that have been done before this time by agencies. Unfortunately, there has not been much studies made when we started to do this job. The only study of importance that we found was a study that had been done by the Soil Conservation Service in 1974.

However, the Soil Conservation Service's study is done -- was done for a different purpose than what we are doing. Although it has some relationship, it does not have a direct relationship with the kind of work we're doing. We are trying to see the differences in evapotranspiration in the different zones. But the Soil Conservation Service came up with

a line, if you can see it in here, this straight line, come up like this and goes something like this. What they show in here is the mesic soils --

Q What kind of soils?

A Mesic, M-e-s-i-c, versus frigid soils, these are the --

THE SPECIAL MASTER: Versus frigid soils?

THE WITNESS: Frigid soils.. The mesic soils are nothing but soils which have a soil temperature higher than 47 degrees Fahrenheit and frigid soils are soils that have soil temperature lower than 47 degrees Fahrenheit but higher than 32 degrees Fahrenheit.

THE SPECIAL MASTER: At what different times of the year or day?

THE WITNESS: Annually.

THE SPECIAL MASTER: Oh, on an annual mean. I see.

THE WITNESS: So what we're trying to show in here is there would be indeed difference in the growing season between soils that have -- that have mesic soils and frigid soils, so the frigid soils will certainly have a lower growing

season, like 100 days; like on the other side it might be 120 days. So that is information that we got from them. We entered that starting here near Hudson and it goes up here near Diversion Dam as a straight line. Then from here onwards, we consider with the 5,900 elevation which divides Burris from Diversion Dam.

A (By The Witness) So, to sum up this thing, the criteria used in order to come up with the climatic map here are three main things. The most important thing that affects evapotranspiration is the elevations. And that is, as you go higher and higher, the elevation increases, and your evapotranspiration decreases as a result of the decrease in pressure.

The second criteria was the area distribution that I mentioned that was done at one point between Fort Washakie and Lander.

The third is studies that have been made by agencies in the area. Now --

Q (By Mr. Clear) Do you want to take a break and get a glass of water or just keep running along?

THE SPECIAL MASTER: Do you want to move

ahead?

THE WITNESS: Let me finish this.

THE SPECIAL MASTER: All right.

MR. CLEAR: Okay.

A So if we can see in here, the elevation criteria indoctrinates in here and the elevation between Pavillion and Riverton, which is the boundary between those two climatic zones, is about 5270; ~~5270~~, 5,270.

Q (By Mr. Clear) That's an elevation contour line?

A Yes, an elevation contour line. And the other boundary that divides Pavillion climatic zone from Diversion Dam climatic zone is about 5,600 feet. And the elevation that divides Burris and Diversion Dam is 5,900 elevation and so on. And the elevations that divide Dubois climatic zone and Burris is about 6,500.

Now, one might ask how come the Diversion Dam is so far away in here while Diversion Dam climatic zone is here. I think that is an appropriate question and it needs some clarification.

The area here, the Owl Creek area does not have a climatic station to represent it. The

only closest climatic station to it is the Thermopolis climatic station --

Q Thermopolis?

A Thermopolis area, but that is in a low elevation area and it has very high temperature, so if we use Thermopolis' climatic station we are not representing the area in here which is about in the range of 5,600 elevation. What it means is if we use the Thermopolis climatic station for this area, we will unnecessarily claim more water, which is not true. So the climatic station that represents this area is the climatic station somewhat similar to Diversion Dam which is about 5,600 elevation, and we use the climatic station of Diversion Dam to represent that area, although we have very small acreage there.

Oaky. One thing that has to be pointed out in here is I have seen studies that have been made that they said only there are two zones about 5,900 and below that and we could have gone through this, but what we are trying to do is come up with a more accurate estimation of the evapotranspiration, not that it makes much

difference between this. It makes probably an inch of difference between Riverton and Pavillion, an inch between Pavillion and Diversion Dam, and so on. But we believe while we are doing this work we would like to leave -- since I believe in research, also -- we want to leave some work for the future. Anyone who wants to make further studies can start from this and go on.

So in here also we can see some spots in the Diversion Dam area, which show the Burris climatic station.. There are spots in here. The reason for that is because these areas are very high altitude areas. They relate to the Burris rather than Diversion Dam. However, they are about 2,000, 3,000 acres in here in the Stagner Ridge -- this is called the Stagner Ridge, and although that is arable area, we have eliminated it due to the high cost and so on. So we are not doing any work in here and there are a few acres in the Pavillion Ridge and Mud Ridge area in here. There is one pump station here so we used the climate of Burris rather than Diversion Dam, although as

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I said, the differences are not substantial. So in a sense, this is our climatic zone map, and the climatic zone map is a prerequisite of evapotranspiration --

Q Is --

A A prerequisite of evapotranspiration.

* * * * *

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Q. (By Mr. Clear) Prerequisite.

A. So, if we have to go a little bit farther into it, one unit, as an example, if we take the North Crowheart Unit that I mentioned before, the North Crowheart Unit encompasses three different climatic zones. There is Burris, some of it in Burris climatic zone, some of it in Diversion Dam, some of it in Pavillion. So when we determine the crop water requirements, we proportion the different acreages in the different climatic zones and we separately determine the crop water requirements for each one of them and then we weighted them out. We weighted them together to come up with one unit requirement at the end. Although we see it later on, it would become clearer and clear as we go along with this.

Q. Okay, Dr. Mesghinna, you are obviously familiar with that map. Is that map made under your direction and control or did you make that map yourself or what?

A. Well, when you work, you work in a team.

Q. Uh-huh.

A. And this was done under my supervision, you know, you can't -- back and forth, you change the map,

you know, several things come up, new information comes up. For example, the last criterions that I discussed came up towards the end and we entered it as -- I mean, this one, the information from the Soil Conservation came at the end, and we entered it. As new information comes up, we try to make it more accurate as much as we can. So we worked first. This map might have been done several times, you know, probably without exaggeration, four or five times, you know, then we finally came up with a final one after a rigorous study in the whole office under my supervision.

MR. CLEAR: Your Honor, I would move the admission of Exhibit WRIR C-244.

THE SPECIAL MASTER: Do you wish to voir dire on the exhibit, Mr. White?

MR. WHITE: Yes, sir.

THE SPECIAL MASTER: All right.

MR. WHITE: Could I do it from counsel table?

THE SPECIAL MASTER: Sure, you certainly can. Maybe we'll take a short break after your voir dire.

MR. WHITE: Thank you.

VOIR DIRE EXAMINATION

BY MR. WHITE:

Q. Doctor, could you show the location of the Pavillion station, weather station?

A. Okay, Pavillion (witness indicating)

Q. It's very near the western edge of the Pavillion climatic zone?

A. Yes.

Q. And yet, as I understand it, you applied the climatic information which you get from that station to the entirety of the zone, is that correct?

A. Yes, for the green area I used the Pavillion climatic zone.

Q. Doctor, what was the basis of extending the data available for the 5-foot or so microclimate around each weather station to the areas of hundreds or perhaps thousands of square miles that appear within each of these zones?

A. Okay. As I have stated it earlier, the main criterion was the elevation differences, and, as you go down with the elevation, the temperature increases, meaning there will be higher transpiration. What we are saying is, for example, the Riverton area is one of the warmest or hottest areas. If we use the

Riverton area to determine the water requirements in here, it would be unfair because this has really lower crop water requirements. So elevation has played really a big role because elevation has a direct effect on temperature.

MR. WHITE: We have no objection, Your Honor.

THE SPECIAL MASTER: All right. Thank you. The United States WRIR C-244, a climatic zone map of the Wind River Indian Reservation, is admitted into evidence.

(Whereupon the instrument identified as Exhibit U.S. WRIR C-244 was received into evidence.

THE SPECIAL MASTER: Why don't we take a short break for ten minutes or so.

(Recess, 9:56 a.m. to 10:07 a.m.

THE SPECIAL MASTER: All right, shall we resume?

MR. CLEAR: Yes, Your Honor.

THE SPECIAL MASTER: If the self-commendation and mutual admiration society will now break up and we'll go back into the real world.

MR. WHITE: Do we have a reporter?

THE SPECIAL MASTER: Yes.

MR. WHITE: Oh, there you are.

THE SPECIAL MASTER: Mr. Clear.

MR. CLEAR: Your Honor, with respect to Exhibit 244, there was only one copy of that, a black and white copy, was given to Mr. White in a deposition in January, but he doesn't have a color copy. He has asked if he can remove that from the courtroom so his experts can, you know, magic marker the boundary paths.

MR. WHITE: Thank you.

THE SPECIAL MASTER: Yes, sir. Mr. Salazar will ride herd on these exhibits; and if it is not back in a week or two, you will be hearing from him.

MR. WHITE: We'll get a bench warrant for body seizure.

MR. CLEAR: You'll be hearing from Dr. Mesghinna, too.

THE SPECIAL MASTER: All right. Proceed, Mr. Clear.

DIRECT EXAMINATION (RESUMED)

BY MR. CLEAR:

Q. Are we done with the climate now or did you have more to discuss on it? You don't have to stand up, why don't you use the pointer if it will be of any help to you.

A. I think for the time being that is enough, and

probably if we need it in connection with evapo-transpiration, we'll refer to it and we'll hammer it down as we go along, you know, in different areas of it.

Q. Okay. Well, shall we go on to cropping pattern then?

A. Okay.

Q. Are you ready to do that?

A. Sure. No problem.

The next item after we studied the climate, what we studied from the climate is all these five units that we have, the future irrigated areas that we have which are situated in different climatic zones, as I said. For example, North Crowheart, part of it is in Burris, a substantial part of it is in Diversion Dam and a small part of it is in Pavillion - the North Crowheart.

So when we determine the evapotranspiration, which I'm going to explain in toto later on, we determined the crop water requirements in each of the climatic zones and then we weighted them up and averaged them.

Let's say we go, for example, to South Crowheart Unit. There are two South Crowheart Units,

it has two climatic zones, Riverton East -- I mean, Riverton climatic zone and the Pavillion climatic zone. So part of the acreage is in the Riverton climatic zone and part of it is in the Pavillion climatic zone, and we determined the crop consumptive use and other necessary things based on those climatic zones and so on.

The only area that has one climatic zone, one climatic zone, is the Riverton East Unit. That is totally situated inside the climatic zone of Riverton. All the others have, you know, several or more than one climatic zone, all the other units.

So, as you go along, I think it would be more and more clear.

Q. Uh-huh.

A. So, now, from the climatic study, we know where each unit is located and now let's see what kind of crops can we grow in these areas? Okay, we have the climate, we've classified the climate, we have different climatic zones. So what kind of crops do you expect to grow in here? Because without the crops, you don't have a project.

Okay. In that study of cropping pattern the important thing with cropping pattern is that the

gross water requirement of a given area depends on the cropping pattern.

Q. Why is that?

A. Okay, the reason is -- the reason is because, say, the cropping that grows in the -- let's take any unit for that matter, South Crowheart: the crops that grow in that area is, let's assume, which is also true, are alfalfa, corn and small grain. Now, alfalfa has a longer growing season; it has also a higher crop water requirement, while small grain is probably -- is almost half of alfalfa.

Q. With respect to water requirements?

A. With respect to crop water requirements. And corn is a little higher than small grain. Now, if we have a certain percentage of alfalfa, it makes a difference if we have higher percentage of alfalfa than small grain. It means that we'll have higher crop water requirements, so the cropping pattern is very important in both the peak consumptive use and also --

Q. Peak consumptive use of water?

A. Peak consumptive use of water. Yeah, peak consumptive use and also in gross water requirement. When I say "gross water requirement", it is almost

related to --

THE SPECIAL MASTER: G-r-o-s-s?

THE WITNESS: Yes.

THE SPECIAL MASTER: Gross water requirements?

THE WITNESS: Yes, gross water requirements.

THE SPECIAL MASTER: Relate to consumptive use of growing the crops?

THE WITNESS: Yes, the amount of water that is delivered to the pump -- to the farms.

Q. (By Mr. Clear) Diverted from the diversion point on the river?

A. Yes. So all these things depend on the cropping pattern.

The other thing is the Reservation is not a small area.

Q. Uh-huh.

A. Because it is somehow a big area, we -- all the crops that grow in a certain area do not grow in another area. So we have to identify this. What I mean by this is, let's say, corn, for example. Corn is a crop that requires, although its growing season is short -- although its growing season is shorter than alfalfa, it requires heat units.

Q. Heat units?

A. Heat units. The heat units are the temperature maximum. It is a function of maximum and minimum temperatures, so it requires certain amounts of heat units during its growth, for example. At 86 degrees Fahrenheit it can grow very vigorously; above it, it doesn't grow. And when you come to 50 degrees Fahrenheit; below it, it doesn't grow very vigorously. It doesn't die, but it doesn't grow very vigorously. So it needs this temperature between 50 and 86, the better if it's higher.

THE SPECIAL MASTER: In the soil or above the surface?

THE WITNESS: Ambient temperature.

THE SPECIAL MASTER: Ambient temperature?

THE WITNESS: Ambient temperature. When we talk about evapotranspiration, from now on we are going to relate everything in ambient temperature. The soil temperature, I just brought it in just to identify what the mesic and the frigid soils are.

Okay. So now, what we are saying is we'll do, we have this kind of temperatures that range somehow between 50 and 86 degrees in all over the Reservation. Do we have that? Okay, the answer is no, we don't have everywhere. If we go to the Burris

area to the higher areas, we don't have that kind of temperature. So we cannot grow corn there.

Okay. Now, let me make things clear in here. It doesn't mean that there are varieties who cannot make it in the Burris area. It has been found out by the economists that they, indeed, grow corn and they get good yields in some of these areas. But, as a general rule, we cannot take corn in the upper areas because if you -- to have growth in the upper areas, you require higher management, good farmers who know what they are doing who can, you know, exactly plant at a certain time and irrigate at different certain times. Because corn is a very, very -- it is not an easy crop. You know, it has different growing stages, like it goes from planting to emergence, from emergence to tassling, from tassling to milk, from milk to maturity and so on. And all these different growth stages require different water requirements. And if you don't give, for example, water during tassling, your corn is almost dead no matter how much you give it after tassling and before tassling.

So in those areas, coupled with the temperature deficiency in the upper areas, if you don't

manage it very carefully, you won't get that yield of corn that you might need. So we have eliminated corn from the upper areas.

Q. Let's go back a minute. We were talking about crops that can grow, I guess, in these various areas. How did you determine the crops that can grow on the Reservation?

A. Okay. Now --

THE SPECIAL MASTER: I think he pretty much answered that question with a very excellent description of his work contained in his statement just concluded. Mr. Clear, I wonder if that -- isn't that about -- Do you see it that way?

MR. CLEAR: Well, Your Honor, like he was giving corn as an example.

THE SPECIAL MASTER: All right.

Q. (By Mr. Clear) And where did you get the example of corn or whatever -- how do you know that, aside from using corn as a general example, how did you determine what crops actually do grow on the Reservation in these areas?

A. Okay. Okay. What we did is before you do any irrigation system design or anything of that sort, one has to relate historically what has been going on in

the area, what kind of crops have been growing in the area. The kind of crops that grow in a given area depend mainly on climate and, secondly, on the preference of farmers, that is, with their experience what kind of crop can they manage well and what kind of economics do they have. If you have a livestock operation, then you will go more towards corn silage and alfalfa and pasture and so on. So while, if you are on a cash crop, then you will go to cotton or what do you want to call -- bananas or anything of that sort. That is in terms of preference of farmers and the economics and so on.

So cropping pattern, in general, is a function of climate, the most important thing. The second most important thing is the economics, such as ease of transportation, such as demand of the crop in the area and the preference of the farmers as such.

* * * * *

Q Did you make any study to determine the preference of farmers in the area?

A Yes. So in order to see this combining together, you have to see what has been going on in area, so in order to know this you see published data and you go and see for yourself the kinds of crops growing there and I have gone there myself several times and I have seen what kind of crops grow. But beyond that, I have studied published data such as, for example, the Wyoming Agricultural Statistics.

THE SPECIAL MASTER: The what?

THE WITNESS: Wyoming Agricultural Statistics.

A They show the acreage that grow in different areas by counties and the Fremont County and Hot Springs County are in the reservation so we studied the kind of crops that grow there. After we have seen that, then we make ourselves more definite to the area that is overall county. Okay.

Now, we have to enter into the reservation itself. Then we have to see published datas and we went in to see the published data from Midvale Irrigation and we saw there and found out and quantified what kind of crops they grow there in

Midvale Irrigation District in the reservation and we have seen that. Then we enter into the cropping patterns or crops statistics of the Wind River itself, the Indians themselves, what have been growing, and we got that from the BLM office. From that we determined what kind of crops are adaptable in the area, so now this is from experience. But when we see, we don't have to go all the way to 1910 or even 1970 or something like that. What one should see is since we are looking for future works, we have to see what's in the immediate years, how is that trend going. What kind of trend, what kind of crops are they growing.

So we -- so we studied the crops they grew starting from about 1975, '76, '77, and so on. And then we found out actually what kind of crops they grow. That is reality and reality now we know the kinds of crops they grow.

After that, we see in a more scientific way. Okay, these crops grow there; there could be more crops that grow there. Why don't we see in a more detailed manner? In order to do that, we related with the requirements of temperatures and so on. And

we used published information or published data by the Soil Conservation Service, which I think all of you are aware of the famous technical lease number 21, discussing the range of temperatures needed for the crops and the number of days of a certain crop to mature, and we used also that to relate that and to see whether that is really true, although we know the crops they are growing. We have to relate it in a more scientific way.

So we accumulated all the knowledge together and we gave it to the economist and we showed him together with him and we found out what kind of crops are indeed adaptable in the area. So we found out, for example, you can't grow cotton there, or bananas, or other fruit crops, and so on. So after we gave to the economist, he came up with the cropping pattern of the area.

But as I made it clear before, on -- although the reservation has, you know, grows many crops, different kinds of crops, there are crops that are not adaptable above 5900 elevation. In general, we have seen -- I found out there are corn crops growing about 59 elevation, but we don't want to take that as a general, because scientifically

speaking that requires a good management and a careful attention of the weather. So for an average farmer that may not be true.

So we excluded it above the upper elevation. We are talking about 43, more or less.

THE SPECIAL MASTER: Did it limit you in the upper elevations to virtually only small grains and alfalfa?

THE WITNESS: Yes.

THE SPECIAL MASTER: All right.

THE WITNESS: Exactly. That is what I'm trying to say. In the Burris area we have only small grain and alfalfa, and in the other areas which include Diversion, Pavillion, Ft. Washaki, so forth, we have alfalfa, corn, and small grain.

THE SPECIAL MASTER: Is that all silage corn or is there some grain corn, too?

THE WITNESS: There is some, yes.

If necessary, I can give the cropping pattern of the higher areas versus the lower area.

MR. CLEAR: I think we should do that now, because I think it would relate to the other things.

MR. WHITE: Your Honor, I object to the question because the cropping pattern, according

to this witness's testimony was developed by the economist and not him.

MR. CLEAR: Your Honor, again, we're as he has testified already, he has taken the arable land base developed within HKM and used that and he has also taken in consultation with Mr. Dornbusch developed a cropping pattern. He testified he went out on the ground to see what grows there. He studied the literature to come up with the crops that grow, and he has consulted with Mr. Dornbusch to come up with a cropping pattern. It's kind of a chicken and egg situation. Who do we put on first? We could put on Mr. Dornbusch and he'd say that he got the figures from Dr. Mesghinna and Mr. White would object, "Wait a minute." So I think we have to go through this. The cropping pattern is important because it determines the percentage of crops that grow in a certain area. Dr. Mesghinna testified that the evapotranspiration and eventually the water duty will depend on a mix of crops. He could say, "I didn't consult with Mr. Dornbusch at all," so we assumed that it's economically feasible to grow corn all over the reservation and the water duty for

corn is 12 billion gallons." But there has been consultation back and forth. They have a cropping pattern; Mr. Dornbusch will testify how that was arrived at from an economic standpoint. Dr. Mesghinna testified to his input from the factual standpoint, and it is vitally important to his testimony to determine the water duty for the irrigable ranges on the reservation, which is the point of the government's case.

MR. WHITE: This is the old opinion based on the opinion problem. His testimony was provided information with respect to crops' adaptability and received back from the economist a cropping pattern. It seems to me there is no question he can testify as to the crop adaptability information he developed and we would encourage counsel to ask him about that information. But we would object to his testimony or his opinion based on an opinion of a third person who is not in this court who has given that opinion.

MR. CLEAR: The third person will be in court, Your Honor.

MR. WHITE: And it's the rankest form of hear-say. The rule with respect to expert opinion states

that they may rely on facts and data which may not necessarily be admissible, but expert opinions have not, according to the notes of the advisory committee, been included. In the facts or data period we submitted briefs on that with Mr. Kersich, and we will stand on our briefs.

* * * * *

THE SPECIAL MASTER: We, as Mr. White said, have been down this road before and we've tread it quite well and thoroughly, and there's something to be said for the two positions, and I appreciate that. But the distinctions are not too great between the testimony of the two and there is an overlapping in the work that each did regarding the need for cooperation with the other; that I don't think the question is objectionable. I'm going to overrule the objection at this time.

MR. CLEAR: I forgot the question now.

MR. WHITE: You asked him what the cropping patterns were.

Q (By Mr.Clear) Yes. Would you give us the cropping patterns?

MR. WHITE: Let me make sure I understand the question. Are these the cropping patterns the economist gave to Dr. Mesghinna or the crop adaptability patterns that Dr. Mesghinna --

MR. CLEAR: These are the cropping patterns --

THE SPECIAL MASTER: Ask him what cropping patterns they are and let the witness tell us what they are rather than the counsel.

MR. WHITE: I didn't mean to --

THE SPECIAL MASTER: That's all right.

MR. WHITE: I was just curious about which ones you were talking about.

THE SPECIAL MASTER: Yeah, I appreciate that.

Mr. Clear, why don't you just ask Dr. Mesghinna where the information comes from that he's about to testify?

Q (By Mr. Clear) Doctor, where does the information come from on which -- as to the cropping patterns which you used in determining the remaining nine points of your outline there? Where did you get the information?

THE SPECIAL MASTER: That's a little departure from what I had in mind. I was limiting my inquiry to No. 2, not all of the eleven points on the presentation. We are all familiar with where the information came from; it is a lifelong work of his expertise that has it. But where did the information come from on No. 2,which you're now proceeding with, called cropping pattern?

MR. CLEAR: All right.

Q (By Mr. Clear) Where did the information on cropping pattern come from?

A I think in order to make it clear for all of us

here, this work is interrelated. You know, it is very hard to distinguish one from another. And if we don't discuss about what cropping patterns we used, we'll not be able to know what the irrigation requirement is, what the water duty is and so on.

But to answer your question in exact terms after we discussed back and forth several times with Dornbusch people, they came up -- it was their decision to come up with this cropping pattern. It was their decision. We gave them -- these are the kind of crops that are adaptable in the area and they verified it also themselves that, indeed, the crops that we told them that these are adaptable in the area. They went to the area themselves. Dornbusch himself went over there and verified it himself.

So there is no doubt in any way about this. But as a procedural matter, the economist is the one who came with the final answer of the cropping pattern.

MR. WHITE: Just for clarity, Your Honor, then the cross-examination as to how the cropping pattern would be developed is probably directed

towards the economist then rather than Dr. Mesghinna.

THE SPECIAL MASTER: Well, he said it was interrelated, however, but he accepts their conclusions.

MR. WHITE: Okay. I guess we've got another day then.

THE SPECIAL MASTER: Well, that's all right. All right, if we need it, we'll take it.

MR. WHITE: Thank you.

THE SPECIAL MASTER: Go ahead, Mr. Clear.

Q. (By Mr. Clear) Well, the question now is, Dr. Mesghinna, what is the cropping pattern that you're using?

A. Okay, the cropping pattern in the lower areas --

Q. What's the lower area?

A. Lower areas are below 5900; that includes Diversion Dam, Pavillion, Fort Washakie, Riverton and Lander.

Q. Okay. Uh-huh.

A. The five climatic zones, this is the lower area. And the cropping pattern there is alfalfa, 67 percent; corn, 12 percent; small grain, 5 percent; small grain nursing alfalfa, nursing alfalfa, small grain nursing alfalfa, 16 percent.

THE SPECIAL MASTER: What does small grain nursing alfalfa mean?

THE WITNESS: Okay, when one plants alfalfa for the first time, alfalfa requires a lot of attention and it has to be protected from winds and other problems, terribly hot sunshine and so on. So what they do is they plant small grain together with alfalfa, they mix them.

THE SPECIAL MASTER: I remember that.

THE WITNESS: And in a sense, it is nursing it, it is protecting it until it grows.

THE SPECIAL MASTER: Yeah.

THE WITNESS: For one season. They they cut or they harvest the small grain and the alfalfa remains there.

Okay, on the upper areas, which is above 5900 elevation, we have 67 percent alfalfa, 16 percent small grain nursing alfalfa and 17 percent small grain. So these are the cropping patterns that have been used in the studies which will follow later on in our discussion.

One thing that should be made clear in this is that when we delineate this area, higher areas and lower areas, it is not only crop adaptability there, there are some other small fine points that come into play. And, although this was going to

be discussed by the economist, there will be differences -- a difference in yields in the upper areas and the lower areas. But that I will leave to the economist.

Q. (By Mr. Clear) You're not going to discuss the crop yields then?

A. No.

Q. Okay, are you done with the cropping pattern or do you have anything more to add to it?

A. Well, I think for the time being this is enough, but in the cropping pattern if some clarification is needed in connection with the other things that would come, we'll hit the cropping pattern many, many times later on because we need it. I mean, right now we are just discussing it in a sense what is -- when -- how to apply it on the diversion requirements and, you know, and the other things. Then it will come later on in the future.

Q. So should we move on to what everybody has been waiting for: evapotranspiration?

A. Okay.

Q. I think we should lead off by defining again what evapotranspiration is and perhaps very generally relate it to the cropping pattern you testified to

just in a very general manner.

A. Okay. First of all, it has to be very clear that when I talk of evapotranspiration, I'm talking about evapotranspiration due to the crops that I mentioned before: alfalfa, corn and small grain - nothing else, no other plants are included. In fact, not only that, in a given unit only those acreages that are designated to be irrigable and those that we have designed a system, only those acreages. So it has to be clear from now on that when I talk of evapotranspiration, I'm talking only for those areas, for those acreages that I have considered to be irrigable, and I have put systems on them.

To start with, let's define first what really evapotranspiration is. Evapotranspiration, as I said it earlier, it is a combination of evaporation from the soil and from the plant foilage and transpiration from the plant itself. So it is a combination of both evaporation and transpiration.

But one may ask how do we determine evapotranspiration. I think evapotranspiration is -- to talk about it, it looks easy, but it is one of the complex things. So I will start from the very beginning and go all the way, and you can stop me if

there are -- if some needed clarification is on the way.

Q. Okay.

A. Evapotranspiration, as defined by Penman, who is a leading fellow in evapotranspiration work, which he calls it potential evapotranspiration. Potential evapotranspiration is the amount of water transpired from a reference crop, which I will define later on what reference crop is, which is well-watered, meaning that there is ample water; that there is no stress in the crop, it gets water as it wishes, of about uniform height, which is usually about 25 centimeters in height, and completely covering the soil. So this is what you call potential evapotranspiration. The reference crop that I mentioned before - the usual reference crops that are used in the world today in determining evapotranspiration are alfalfa and grass. It is predominately alfalfa, but there are people who use grass as a reference crop.

Okay. Now, I would like to make one more point in here. There is no imperical equation or a direct equation that uses climate and soil that can directly determine evapotranspiration of a crop. There is no

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equation in the world so far. Then what do we do? How do we determine the evapotranspiration of corn? How do we determine the evapotranspiration of small grain or alfalfa? We determine it indirectly. There is no direct determination except by measurement, such as a lysimeter or other instruments for measuring it.

Okay. The first thing we do is we determine potential evapotranspiration, that is, we determine an ideal condition that the crop is completely covering the soil, it is of uniform height and well-watered. We determine evapotranspiration of the reference crop.

Q. Of the reference crop, not the actual crop?

A. Not the actual crop, of the reference crop. The actual crop will come on later on. So we determine the potential evapotranspiration. Its potential, really.

Q. Uh-huh.

A. The ability of it to get that amount of water to transpire, evapotranspiration of that crop.

Okay. Now, there are several methods of determining crop evapo-- I mean potential evapotranspiration. To mention a few: There is what

we call the Blanney, B-l-a-n-n-e-y, Criddle, C-r-i-d-d-l-e, Blanney-Criddle method, that came up somehow towards the 1940s and it was developed by the people, Blanney and Criddle. One of them is still alive in Salt Lake, I guess.

Another method of determining potential evapotranpiration was by Christensen in California, and that fellow is still alive, too, together with Hargreaves. And then there was another equation that was developed later on by Mr. Hargreaves himself, who is still alive at Utah State. And there is the Lowery-Johnson, there is the Penman equation. There are many, many equations and later on came the Jensen-Haise equation.

Q Spell that for the reporter.

A Jensen is J-e-n-s-e-n; Haise is H-a-i-s-e. Jensen-Haise, which it was first developed by Jensen and Haise and then modified by Jensen himself.

His main work was done here in Idaho. And he is still alive, and, as most of you may well know, he has written a book on this evapotranspiration for the ASCE. It is a kind of a manual for the American Society of Civil Engineers. And we are using his equation, which is called the modified

Jensen-Haise equation.

The other direct methods, as I said, are methods which utilize experiments in the area of work, but there are not many experiments that would give us enough data for the Wind River Indian Reservation. So we, instead of using the direct methods, we used the indirect methods, which are imperical equations, and that is the Jensen-Haise equation.

* * * * *

THE SPECIAL MASTER: I wonder if we are not learning a little more about evapotranspiration than we really want to know, but go ahead. If you can condense a little bit, we would appreciate it.

THE WITNESS: Okay. I'll come to it.

Now, evapotranspiration is determined by an equation developed by Jensen-Haise, as I said, and the equation, if necessary, is ETP, which is potential evapotranspiration = C_T times, in brackets, $(T - T_s)$ times RS. And let me explain what each of these terms are. They ETP is potential evapotranspiration --

MR. CLEAR: Excuse me, Your Honor, I'm going to report that Dr. Mesghinna has prepared -- he will be talking about equations quite a bit from now on. I think he has most of these equations in his report. The report was given to Mr. White on Monday, and to introduce the report at this time would be --

THE SPECIAL MASTER: Blatant.

MR. CLEAR: Blatant.

THE SPECIAL MASTER: Is it possible Mr. White might not object to its introduction at

this time?

MR. WHITE: No chance, Your Honor.

MR. CLEAR: If I could work out something where we could --

THE SPECIAL MASTER: If I could look at it, I would appreciate it.

MR. CLEAR: Just for the equations. Is there a way we could do it?

THE SPECIAL MASTER: Could it be identified now and offered for evidence but not introduced until ten days is up so I might be looking at it to follow some of the testimony?

MR. WHITE: Your Honor, if you want to look at it for the purpose of following the equations, I have no objection.

THE SPECIAL MASTER: That's all I want.

MR. WHITE: I would object to the substance of it being used within the ten-day rule because this is a steamroller effort here.

THE SPECIAL MASTER: I want a copy for purposes of following the testimony. I think it will help me.

THE WITNESS: If necessary, I can just write it on the blackboard and we can go ahead

from there.

MR. WHITE: Your Honor, I trust implicitly you aren't to take a copy of that and refer to the equations, and that's fine.

THE SPECIAL MASTER: I appreciate it, and that might save the witness a little extra work.

MR. WHITE: It might make things a little easier for the Court if we get a copy of that report, jerked out the pages that have --

MR. CLEAR: I have extra copies.

THE SPECIAL MASTER: If all of you will agree, I can have one copy called the T.R. copy for a copy I can tear up and use in my report, and after ten days I'll start tearing it up and using it and I'll keep it in my copy rather than -- it will have nothing to do with the exhibits in the case, it will not go on file with that, it will go in my work papers.

(Off-the-record discussion.

THE SPECIAL MASTER: I could ask a question or two, but maybe I better not until we get all Counsel's attention.

MR.CLEAR: Your Honor, I have one copy. I think I left the extra copies over in the

U.S. Attorney's office.

THE SPECIAL MASTER: Well, that being the case, if we can't all have it --

MR. CLEAR: They have copies already.

MR. WHITE: We have a copy, Your Honor.

MR. CLEAR: And we will get more for them at the break. It's already been marked as Exhibit --

THE SPECIAL MASTER: United States Exhibit WRIR C-245 is to be described as what, the Conceptual Irrigation Development Plan and Report of Dr. Mesghinna?

MR. CLEAR: Yes, Your Honor. Again, we are not introducing this report at this stage, we are just using it, and I'll have Dr. Mesghianna refer to the pages on which his equations are found, and you can follow along.

MR. WHITE: Your Honor, it might make it even easier, I have an extra copy and I'll just pull out the pages with the formulas on it. If we could have a minute, Dr. Mesghinna can tell us what pages he wants and we will pull them out.

THE SPECIAL MASTER: The witness' name does not appear on the report.

THE WITNESS: It doesn't.

THE SPECIAL MASTER: Stetson only.

THE WITNESS: Yes.

THE SPECIAL MASTER: This is not a military operation. All right. Let's take a short five minutes.

(Whereupon, a short recess (was taken.

THE SPECIAL MASTER: Is it okay to proceed with the U.S. table?

MR. ECHOHAWK: Yes, Your Honor.

THE SPECIAL MASTER: The State of Wyoming's table?

MR. WHITE: Yes, Your Honor.

MR. CLEAR: Do you want these marked as an exhibit?

MR.. WHITE: No, just give it to him.

THE SPECIAL MASTER: We will please come to order. I do not have a copy yet, and I have given back -- let the record show I have given back Dr. Mesghinna's report to you, Mr. Clear.

Q (By Mr. Clear) Dr. Mesghinna, do you have a copy of the report?

A Yes, I do.

Q I think you have already read or recited the Jensen-Haise formula. Can you state on what page of your report that formula is found in written form?

A It is on Page 3 of the summary report.

Q Well, I don't think we want to run through the entire Jensen-Haise formula and work that all out, but can you tell me what information you need to work the formula properly?

A The information that you need in the formula, the first thing is temperature, mean temperature, average mean temperature. Secondly you need the solar radiation data.

Q Solar radiation data?

A Solar radiation data. And to a lesser extent you need also the mean maximum temperature and mean minimum temperature of the warmest months, which is usually is July the warmest month. So by getting the mean maximum temperature and mean minimum temperature one can determine the maximum saturation and the minimum saturation. The other things that are necessary in there are other coefficients or constants such as, for example, in the formula

where C_T is a reciprocal of C_1 + C_2 times C_H.

Q Is what?

A Reciprocal.

Q Reciprocal?

A Reciprocal, yes, of C_1 + C_2 times C_H, and C_2 is equal to 13, and C_H, which is humidity index, is equal to 50 over E_2 - E_1, where E_2 is the saturation vapor pressures at maximum temperature, and E_1 is the saturation vapor pressures at minimum temperature.

Q What I think we are interested in is where you obtained the factual information that you have to crank into this formula.

A Okay. The temperature data is from NOAA, and I have stated it eariler. However, I think it would be a good idea to discuss a little bit the soil addition data. as I have stated it earlier. However, I think it would be a good idea to discuss a little bit the solar radiation data. As I have stated it earlier, the soil radiation data is not easy to get, I mean in the whole world, I mean -- it's -- because the kinds of instruments required to determine soil radiation are new, and they haven't been put into

solar radiation stations, plus they are expensive, and you have to adjust them every now and then. They are not like thermometers, they are hard to use them and we don't have solar radiation data per se of long range or historical, to speak of. There are a few solar radiation datas from the Midvale district, but they are of very recent years and we cannot rely too much on them because, first of all, as I said, the instruments are quite new and the data itself is quite new, you know, to people and this requires some time in order to stabilize the instrument inteelf. We tried to use it in experiments and so on myself, and we had several problems in it because it required several adjustments now and then. So instead of -- instead what we used to determine solar radiation data, available data, indirect solar radiation data.

One thing that we know about solar radiation is the extraterrestrial radiation. The extra-terrestrial solar radiation is the radiation on top of the atmosphere before it hits the clouds and so on, before it comes to the soil

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surface. But extraterrestrial radiation is a function of latitude of the earth and also a function of the time of the year. So that is really constant for a given time and a given latitude, so we know that. Okay.

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A Now, how can we relate it to the solar radiation on the surface? We are really looking at the solar radiation at the surface when it hits the plants itself, which helps the photosynthesis of the plants, transpiration of the plants and so on. In order to come up with that, we need another parameter.

Q Pardon?

A Another parameter.

Q Okay.

A And this parameter is the ratio of actual to possible sunshine. This data is available from 1931 -- from about the 1930's to about 1975, and so on. In fact, up to date, in the Dubois Airport -- not Dubois, sorry, Lander Airport.

Now, there are quite a few formulas that would determine the solar radiation at the earth's surface based on extraterrestrial radiation and the percent sunshine that I just discussed. Now, there is also another way of determining -- very close to this of determining solar radiation and that is the one given by Jensen himself. That uses the RSO instead of the -- that is the solar radiation on a cloudless day, and that

can be related to the percent sunshine and determine solar radiation out of this. So what we did is in order to find out the solar radiation or determine the solar radiation, we determined it in several methods. We used four different methods to determine it, and we made an average of all those different methods and came up with a solar radiation, and they are all related to the extraterrestrial radiation and possible sunshine or to the cloudless day solar radiation vis-a-vis the percent sunshine. So we determined all -- using this we determined the solar radiation from months of April to September, which plants start to grow in April up to and harvested sometime in September.

So that's how we came up with solar radiation. And for the temperature, I have discussed it. We used the NOAA and so on.

Q What?

A NOAA.

Q So now you have everything you need to do the formula?

A Yeah. Then you crank out the formula. For mesghinna-direct-clear

example, you determine all the things which are there, the T_X, the test of which is the temperature intercept which is 27.5.-0.25 $(E_2 - E_1)$ - elevation/1000.

THE SPECIAL MASTER: Do you write that °F./mb? Is your formula given from the top of Page 4?

A Yes.

So using this formula, now, what we determined is really not our actual evapotranspiration. We are still in the determination of the reference crop potential evapotranspiration.

Q (By Mr. Clear) Right.

A Right.

Q By working this formula we have arrived now at the potential evapotranspiration of a reference crop?

A Right. So that we determine the reference crop potential evapotranspiration for the seven climatic zones.

Q Okay. Now what do you do?

A Now we have to go to business and that is we have to relate this to the crops, actual crops

that are of interest to us.

Q Those are the crops in your cropping pattern?

A Yes.

Q Okay. Now, how do we do that?

A Okay. We have to define certain terms before and that is we have to define what crop coefficient is first. The crop coefficients are different for different crops and different during the growth season. The crop coefficient is mainly a function of the crop itself, the makeup of the crop and also season or climate. But mainly, the function of the crop itself. Crop coefficient is nothing but the ratio of crop evapotransporation to potential evapotranspiration.

THE SPECIAL MASTER: Boy, this is getting complicated. The crop coefficient is nothing more than the crop evapotranspiration to potential transpiration?

THE WITNESS: Yeah. It is the ratio of actual crop evapotranspiration. Let's say corn, to make things simple. The actual evapotranspiration of corn is divided by the potential of a reference crop, which gives us

the crop coefficient. In a sense, what I am trying to say is we know the potential evapotranspiration of a reference crop. If you multiply it by a crop coefficient of corn, we get the actual corn evapotranspiration.

THE SPECIAL MASTER: I think I understand.

MR. CLEAR: It's just a ratio between the two.

THE WITNESS: Right, it's just a ratio between the two.

But since we don't know that ratio, we have to determine the crop coefficient for each of the crops for the whole season.

Q (By Mr. Clear) Okay.

A Okay.

Q Now, can we use another formula for that? If we do, do we have it in your record? I don't think I saw it in the report.

THE SPECIAL MASTER: Could it be at the top of Page 14?

THE WITNESS: It's not there, but I can just write it on the blackboard if necessary.

MR. SACHSE: I wonder whether we need all the formulas and working out all these formulas,

whether we could get a little more quickly to the end results.

MR. CLEAR: I think if we don't go into it now -- I don't mean it critically -- but I think it will be gone into to some extent in cross-examination, because Dr. Mesghinna has been deposed and this has been a subject of discussion in the deposition. So I think maybe if we go into it now, we may save some time on cross-examination.

MR. WHITE: For the most part, Your Honor, the formulas themselves are not in dispute. Maybe the selection of one over another, but the various variables and constants that occur within the formula and plus and minus signs and the brackets really are not a subject of controversy, and I agree with Mr. Sachse. Let's get this show moving.

THE SPECIAL MASTER: I can't believe what I'm hearing, Mr. White. It's a rare occasion.

MR. WHITE: It's toward the end of the week, Your Honor. We're wearing down and the redheads can probably agree.

THE SPECIAL MASTER: We'll skip writing it

down on the blackboard. Go on to the next point, Mr. Clear.

Q (By Mr. Clear) Well, I just wanted to -- without going into the formula, why don't we -- it will be sufficient -- well, is there a formula by which you can take a potential evapotranspiration of the reference crop converted into the actual evapotranspiration of the crop you're interested in?

A When Jensen developed his equation, he also discussed in his book and also his lectures and so on of this coefficient, one thing that has to be clear is these coefficients, crop coefficients, all the formulas that I stated before for determining reference crops determine potential evapotranspiration. All of them have different crop coefficients and the crop coefficient I am discussing right now relates only to Jensen-Haise. They have nothing to do with others. It is a specific to Jensen-Haise.

So Jensen has provided certain methodology in determining these crop coefficients and in doing so, the Midvale Irrigation District has

determined the constants that enter into the equation for determining crop coefficients.

Q Could you speak up a little, please?

A Okay.

* * * * *

THE SPECIAL MASTER: He said the Midvale Irrigation District developed the crop.

MR. CLEAR: Yes. All right.

A. Yes, yes. And there is a polynomial equation to the third degree which is used to determine this crop coefficient, and it has different what you call constants, and each of the constants have been provided to us by Midvale Irrigation District and we used those coefficients in order to come up with the crop coefficient of each crop.

Q. (By Mr. Clear) Each crop in your cropping pattern?

A. Each crop in the cropping pattern.

THE SPECIAL MASTER: Regardless of climatic zone?

THE WITNESS: Each climatic zone we have a different potential evapotranspiration. We determined the evapotranspiration of corn, small grain and alfalfa in the Riverton --

THE SPECIAL MASTER: Okay.

THE WITNESS: -- climatic zone. The same thing we do for Pavillion and so on and so on and so on. So so far, we are determining things for different areas. We'll combine them later as we go on and it will become more clear and clear.

Q (By Mr. Clear) Okay. So with the Jensen-Haise results of the potential evapotranspiration of reference crop, then you crank in the crop coefficients and you use the formula you just spoke about. What do you get?

A. And then we get by multiplying the potential evapotranspiration of a reference crop by crop coefficients during the whole season for a given crop for a given climatic zone.

Q. Uh-huh.

A. We determine ETC.

Q. Uh-huh.

A. What I'm referring when I say "ETC" is evapotranspiration of a crop.

Q. Okay.

A. ET meaning evapotranspiration, C standing for a crop. For each specific crop, for small grain, for alfalfa and for corn.

Q. Uh-huh. And for each climatic zone?

A. Each climatic zone.

Q. Okay. So we have the evapotranspiration of the crop?

A. Yes.

Q. Now, what do we need?

A. Okay. Now, we have the evapotranspiration of the crop starting from April to September for each climatic zone for each crop.

Q. So you have an evapotranspiration for every month?

A. Yes.

Q. For every climatic zone for every crop?

A. Yes.

Q. Okay. You don't have to go into that now. That's what you have?

A. That's what I have, yes.

Okay. Now, this is really what the crop needs, this evapotranspiration that we just determined. There is one thing that enters into it because there is some additional water that comes from nature.

Q. Uh-huh.

A. That is through precipitation.

Q. Rainfall?

A. Rainfall. So that part of rainfall that helps the crop consumptive use should be subtracted from the crop consumptive use.

Q. From the evapotranspiration of the crop?

A. Of the crop --

THE SPECIAL MASTER: When you say "crop comsumptive use", is that synonymous with evapotranspiration

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of the crop?

THE WITNESS: Yes, evapotranspiration of crop?

THE SPECIAL MASTER: Of the crop.

THE WITNESS: Of the crop.

THE SPECIAL MASTER: Is synonymous with crop consumptive use?

THE WITNESS: Yes.

THE SPECIAL MASTER: What is the unit of that, is that so much per --

THE WITNESS: An inch. Inches of water.

THE SPECIAL MASTER: In inches of water?

THE WITNESS: Yes. Everything is in inches. And then we'll change it to acre-feet at the end.

THE SPECIAL MASTER: Well, I'll go back to my old chart, I guess. I haven't looked at it for six weeks or so.

Go ahead, Mr. Clear.

Q (By Mr. Clear) Okay, we have evapotranspiration -- well, we were talking about subtracting the rainfall from the evapotranspiration of the crop?

A Okay. The one thing that we have to make clear in this matter is the rainfall that comes, you know, every month cannot be subtracted, all of it.

Q Uh-huh.

A. All of it to determine the net irrigation requirement.

Q. Why is that?

A. Well, when the rainfall comes to the areas,to the surface of the areas, part of it is lost through surface runoff before it is used by the crops. You know, it is lost by surface runoff. Part of it is lost through deep percolation.

Q. Deep percolation?

A. Yes, deep percolation. And those losses due to deep percolation, runoff and other surface losses cannot be accounted. So --

Q. They don't -- the crop doesn't get them?

A. The crop doesn't get them. So it cannot be accounted for the crop. So what we have to determine is we have to determine the effective rainfall, meaning effectively to be used by the crop.

Q. Uh-huh.

A. Meaning that those are -- that amount of water that is, indeed, stored in the soil reserve, in the soil reserve of the crop. Okay. How do we determine that? Okay, there is a methodology that has been given by the Soil Conservation Service in determining the effective rainfall. This is based on their

experience and also based on, you know, really climatic facts. The effective rainfall is a function of two things. It is a function of evapotranspiration of the crop that we just determined --

Q. Uh-huh.

A. And also a function of the total rainfall. So, based on these two parameters, they have given a table in there: TR-21. They gave it in the equation --

Q. That's Technical Release No. 21 that you spoke about yesterday?

A. Yes.

Q. From who? Who put that out?

A. The Soil Conservation Service.

Q. Soil Conservation Service?

A. So we used that equation or that methodology to determine the effective rainfall. After determining the effective rainfall, then we subtracted it from the crop consumptive use or crop evapotranspiration and we determined the net irrigation requirement.

Q. Net irrigation requirement?

A. Yes. I sometimes also call it, which will be synonymous with the irrigation consumptive use.

Q. Okay. Now, have you done this for each crop in each climate zone?

A. Yes.

THE SPECIAL MASTER: In what units is this determined, still inches?

THE WITNESS: Inches, yeah. We are still in inches.

MR. CLEAR: Your Honor, he's been on the stand quite some time now.

THE SPECIAL MASTER: He's had a tough long morning.

MR. CLEAR: Should we take a --

THE SPECIAL MASTER: That doesn't show on him.

MR. CLEAR: Would you like a lunch break?

THE SPECIAL MASTER: Do you want to take a break or shall we go until 12:00?

THE WITNESS: I wish I could take a little break.

THE SPECIAL MASTER: All right, why don't we just take a break now then and come back at 1:30?

MR. CLEAR: That's fine.

MR. WHITE: How about 1:00? The problem is if we take a two-hour lunch, it keeps eating into our trial time. If we take an hour and a half, that

should be enough for everyone.

THE SPECIAL MASTER: I think that's good enough since we're starting a little earlier than usual. If we're not all set at 1:00, we'll start as soon thereafter as you're all here.

All right, we'll stand in recess until 1:00.

(Recess, 11:25 a.m.

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