

4-23-1981

## Trial Transcript, Vol. 45, Morning Session

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File 152  
4403  
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case # 4993

File # 152

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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 WYO- )  
MING. )

Civil No. 4993

**FILED**  
\_\_\_\_\_ 5/1 \_\_\_\_\_ 1981  
*Margaret V. Hampton* CLERK  
\_\_\_\_\_ DEPUTY

VOLUME 45

Morning Session

Thursday, April 23, 1981

**ORIGINAL**

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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

1 THE SPECIAL MASTER: We will please come  
2 to order.

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

5 MR. MEMBRINO: Yes I do, Your Honor.

6 REDIRECT EXAMINATION

7 BY MR. MEMBRINO:

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

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

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

25 toedter-redirect-membrino

- 1 A Yes, it is.
- 2 Q That's Classes 1 through 4?
- 3 A Well, actually yes. Those standards were used
- 4 for Classes 1 through 4.
- 5 Q You also testified that of the 23 values for
- 6 hydraulic conductivity in Table 2 of Exhibit WRIR
- 7 C-241-A, only four were based on field work.
- 8 Why did you do field work for only four values,
- 9 and what did you do to determine the rest of
- 10 them?

11 MR. WHITE: The question has already been

12 asked and answered on cross-examination, Your

13 Honor.

14 THE SPECIAL MASTER: Well, I thought the

15 question has been asked and answered too, but

16 if he -- I'll permit it.

17 A Okay. The reason why just four values were

18 determined, was because of the fact that for

19 the most part these four textures were the

20 most common textures found in the field. As

21 far as the projection and the interpolation

22 goes, that information was obtained out of

23 a drainage engineering text by Luthin.

24 Q (By Mr. Membrino) Concerning the areas of

25 toedter-redirect-membrino

1 analysis, that is the gray shaded areas outlined  
2 in red that we saw on Exhibit C-231 through  
3 240, can you tell the Court how many of the  
4 holes in the areas of analysis for, not only  
5 within those areas of analysis, but also  
6 actually within the arable lands you reviewed?

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

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

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

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

21 A Yes, I do.

22 Q Would you tell us what that record is?

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

25 toedter-redirect-membrino

1 presented in Mr. Kersich's testimony.

2 Q Those --

3 A They were 1969.

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

5 A Yes.

6 Q Anything else?

7 A And the soils photos presented by Mr. Waples

8 during his testimony.

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

10 A Yes.

11 Q Any other records?

12 A Yes. The logs that were presented by Mr. Kersich

13 in his testimony and the logs that were presented

14 by Mr. Waples during his testimony.

15 Q Now, I ask you to identify what's been marked

16 for identification 231-A, 232-A, 233-A, 234-A,

17 235-A, 236-A, 237-A, 238-A, 239-A and 240-A.

18 A Yes. These are the maps which I used in the

19 development of my hydraulic conductivity and

20 depth to barrier analysis.

21 Q Were these prepared by you or under your

22 supervision?

23 A Yes, they were.

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

25 toedter-redirect-membrino



1 holes that you considered in your drainage  
2 investigation?

3 A Yes, they do.

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

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

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

14 MR. MEMBRINO: All right.

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

19 THE SPECIAL MASTER: Yes.

20 MR. WHITE: And the exhibit number.

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

25 toedter-redirect-membrino

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

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

8 THE WITNESS: Right.

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

11 THE WITNESS: Correct, all the way through.

12 THE SPECIAL MASTER: Do we need anymore  
13 than that?

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

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

22 MR. MEMBRINO: I will renumber that as  
23 231-A. It was the North Crowheart worksheet  
24 and I think for the ease of identification,

25 toedter-redirect-membrino

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that would be --

THE SPECIAL MASTER: Very well.

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

THE SPECIAL MASTER: Very well.

\* \* \* \* \*

toedter-redirect-membrino

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

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

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

14 A No.

15 Q What does one ordinarily do?

16 MR. WHITE: I object, Your Honor. That  
17 question was asked and answered and there was  
18 quite an extensive drawing made and calculation  
19 on which there was an original arithmetic  
20 error made. He was not cross-examined on how  
21 mathematical computations could determine weight  
22 of hydraulic conductivity and -- but also, from  
23 these --

24 THE SPECIAL MASTER: I doubt if the question is  
25 toedter-redirect-membrino

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

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

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

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

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

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

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

24 THE SPECIAL MASTER: All right.

25 MR. MEMBRINO: 232-A, South Crowheart study

1 unit, Toedter workmap; 233-A is the Riverton  
2 East study unit, Toedter work map; 234-A is  
3 the Arapahoe study unit, Toedter work map;  
4 235-A is the Big Horn Flats study unit, Toedter  
5 work map; 236-A is the Owl Creek study unit,  
6 Toedter work map; 237-A, Upper Wind Unit study,  
7 Toedter work map; 238-A, Johnstown Study Unit,  
8 Toedter work map; 239-A is the Ray and Coolidge  
9 study unit, Toedter work map; and 240-A is the  
10 Subagency and Lefthand study units, Toedter work  
11 map, and we have renumbered Exhibit 243 to be  
12 231-A.

13 MR. WHITE: What was 238?

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

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

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

1 had the information for ten days.

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

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

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

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

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

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

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

22 THE PSECIAL MASTER: For what purpose  
23 are they offered?

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

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

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

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

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

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

16 MR. WHITE: Yes,

17 THE SPECIAL MASTER: You require it?

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

22 THE SPECIAL MASTER: Okay.

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



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

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

8 THE SPECIAL MASTER: You can examine them.

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

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

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

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

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

22 THE SPECIAL MASTER: All right, Mr. White.

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

25 THE SPECIAL MASTER: Sure.

RECROSS-EXAMINATION

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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

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

4 MR. WHITE: I referred to the 231 series,  
5 but if you want to, you may ask about the  
6 231-A.

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

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

15 A 231.

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

17 A Yes, there is.

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

20 A No, it is not.

21 Q Okay. Could you explain the conventions that  
22 you used to establish the cross-hatching pattern  
23 on the 231-A series, if it is different from the  
24 231 series?

25 toedter-recross-white

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

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

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

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

10 A Yes, that's correct.

11 Q And do you recall the substance of footnote 4?

12 A Yes.

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

14 A Yeah, let me look at it.

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

17 THE SPECIAL MASTER: Yes. It's 7, 8 and 9.  
18  
19  
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25 toedter-recross-white

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

7 MR. WHITE: I'm sorry.

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

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

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

13 THE SPECIAL MASTER: Well, I lucked out.

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

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

25 toedter-recross-white

- 1 something similar to that.
- 2 Q Well, they had both deep drainage holes and
- 3 land classification holes, didn't they, as
- 4 well as drainage pits?
- 5 A The Bureau did?
- 6 Q Yes.
- 7 A Not on those maps.
- 8 Q Okay. Where is the record for the other ones,
- 9 the nondrainage holes?
- 10 Q That's shown on some Bureau of Reclamation
- 11 land class sheets.
- 12 Q And those records are not in evidence, are they,
- 13 if you know?
- 14 A Not that I know of, I haven't presented them.
- 15 MR. WHITE: Okay. Thank you. I have
- 16 no further questions, Your Honor.
- 17 THE SPECIAL MASTER: Okay. Thank you.
- 18 This witness will remain subject to call
- 19 of the Court, but he is dismissed for the rest
- 20 of today's proceedings, is that correct?
- 21 MR. WHITE: That's fine with us, Your
- 22 Honor.
- 23 MR. MEMBRINO: Thank you, Your Honor.
- 24 THE SPECIAL MASTER: Is that all right with
- 25 toedter-recross-white

1 you?

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

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

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

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

14 (Recess, 8:35 a.m.)

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1 (Beginning at approximately  
2 (8:50 a.m.

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

5 MR. CLEAR: Two seconds, Your Honor.

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

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

10 MR. ECHOHAWK: Mr. Clear is doing this examina-  
11 tion.

12 THE SPECIAL MASTER: Mr. Clear.

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

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

18 DR. MESGHINNA: : W-o.

19 MR. CLEAR: W-o.

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

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

22 THE SPECIAL MASTER: Fine, will you come for-  
23 ward, Doctor, to the witness stand or to the seat.

24

25



1

WOLDEZION MESGHINNA

2

was called as a witness by the United States and, having

3

been first duly sworn, testified as follows, to wit;

4

THE SPECIAL MASTER: Thank you. Please take

5

your seat.

6

MR. CLEAR: Your Honor, up to now we've been

7

talking about arable land and, as you recall, we have

8

split arable lands into future projects and the historic

9

lands. We are now moving into a new phase of the trial.

10

Dr. Mesghinna, as you probably have been made aware, is

11

the man who took the information compiled by HKM dealing

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with respect to the future lands and determined what lands

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of that arable base can be irrigated from an engineering

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standpoint, and he also determined the cost of that irri-

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gation system, and in conjunction with that, it is neces-

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sary to determine what the water duty toward these lands

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is and designed diversion systems. So -- and that infor-

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mation then is, of course, while he's working on that, it

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is passed on to the conomist, Mr. Dornbusch, who will

20

eventually testify, and Mr. Dornbusch determines whether

21

in light of the crop yields they can expect from those

22

lands whether the --

23

THE SPECIAL MASTER: Irrigating --

24

MR. CLEAR: Which acres are economically --

25

which irrigated acres are economically feasible.

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

5 MR. CLEAR: Mr. Dornbusch does.

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

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

8 THE SPECIAL MASTER: Fine.

9 DIRECT EXAMINATION

10 BY MR. CLEAR:

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

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

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

17 MR. CLEAR: I know.

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

20 MR. WHITE: Maybe Wold could speak up.

21 MR. CLEAR: Speak up just a little bit.

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

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

25 mesghinna - direct - clear

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

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

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

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

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

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

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

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

16 Let me sit over here in the middle.

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

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

21 Q And what is your position there?

22 A I am a supervising engineer in Stetson Engineers.

23 Q What are your duties there?

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

25 mesghinna - direct - clear

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

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

5 THE WITNESS: Uh-huh.

6 THE SPECIAL MASTER: And --

7 THE WITNESS: Drainage.

8 THE SPECIAL MASTER: Drainage.

9 THE WITNESS: Hydrology.

10 THE SPECIAL MASTER: Hydrology.

11 Q (By Mr. Clear) Your duties as a supervisory engi-  
12 neer with Stetson Engineering, are they solely re-  
13 lated to irrigation works on projects and related  
14 matters?

15 A. Yes, our work is mainly concerned with water re-  
16 sources work in general and irrigation and system --  
17 I mean, irrigation system design is within the water  
18 resources.

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

22 A. Well, I first graduated from a college called  
23 Ethio Swedish Institute of Building Technology in  
24 Addis Ababa, Ethiopia, in 1967. After I graduated,  
25 mesghinna - direct - clear

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

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

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

12 Q Uh-huh.

13 A Design and construction of buildings and small  
14 roads.

15 Q What laymen normally think of an engineer, an engi-  
16 neer does, huh?

17 A Yeah.

18 Q How long were you with SIDA?

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

21 Q S-E-D-A?

22 A S-I-D-A.

23 Q S-I-D--

24 A Swedish International Development Authority.

25 mesghinna - direct - clear

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

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

12 Q Uh-huh.

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

16 Q Uh-huh.

17 A After that I continued, I received a Fellowship from  
18 Cornell University and continued for graduate study  
19 there, and I finished my Master's in civil engineer-  
20 ing in 1973.

21 Q Was your Master's that you received, the Master's  
22 you received from Cornell, was that in civil engi-  
23 neering, or was that in any specialty?

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

25 mesghinna - direct - clear

1 Q Uh-huh.

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

4 Q Uh-huh.

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

6 THE WITNESS: Uh-huh.

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

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

11 Q Uh-huh.

12 A In New Jersey-New York office, which is their  
13 eastern regional office. Woodward Clyde is a con-  
14 sulting firm that is all over the world. Then I  
15 worked with them for over three years. Then I was  
16 working mainly as a hydrologist and also as a geo-  
17 technical engineer at Woodward Clyde.

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

20 A My main work was in flood estimation.

21 Q Pardon?

22 A Flood estimation.

23 THE SPECIAL MASTER: Flood estimation.

24 THE WITNESS: Yes, hydrographic preparation,

25 mesghinna - direct - clear

1 foundation design.

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

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

5 Q Okay.

6 A Some of the projects that I was involved there, like  
7 the Alaska Pipeline Project, I've been there several  
8 times and I assisted in the design of the geotechni-  
9 cal part of it. I worked on dam design at Coff  
10 Point, Maryland. I also worked on the Yonkers  
11 city flood estimation study and so on. There are  
12 several projects.

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

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

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

18 Q Uh-huh.

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

22 Q Uh-huh.

23 A Which is mainly in need of food.

24 Q Food?

25 mesghinna . - direct - clear



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

5 Q Uh-huh.

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

10 Q Uh-huh.

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

14 Q Uh-huh.

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

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

20 THE WITNESS: The town is called Logan, Utah.

21 THE SPECIAL MASTER: Oh, Utah State?

22 THE WITNESS: Yes.

23 THE SPECIAL MASTER: Of course.

24 THE WITNESS: Yeah.

25 mesghinna - direct - clear

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

3 A. Yeah, I started in 1976, September, 1976, and  
4 finished at the end of 1978 with a Ph.D. in irriga-  
5 tion and drainage.

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

9 A. Yes, I wrote a dissertation; the title of my disser-  
10 tation was "Crop Yield Prediction under Limited  
11 Climatic Datas".

12 Q Uh-huh.

13 A. This relates mainly to the irrigation in such a way  
14 that by optimizing water, how much yield can we re-  
15 ceive for a certain crop. Say, for example, if  
16 someone wants to invest a certain amount of irriga-  
17 tion in a certain area, you would like to determine  
18 first what kind of crop yield would you expect under  
19 different kinds of irrigation programs. So you  
20 optimize the irrigation program and you find out  
21 the yield prediction. The yield prediction technique  
22 that is developed there is not a statistical yield  
23 prediction, but it is more of a scientific that  
24 relates with the physical conditions of the soil

25 mesghinna - direct - clear

1 and climate.

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

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

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

11 A Well, I worked on Salt River Indian Reservation,  
12 which is the determination of crop water require-  
13 ment efficiencies and so on, almost related to  
14 this.

15 Q Uh-huh.

16 A I worked in the Northern Cheyenne Indian Reserva-  
17 tion. I worked on Warm Springs Indian Reservation;  
18 that was in actual design and specification work in  
19 irrigation systems design. I also worked on reser-  
20 voir system operations.

21 Q Pardon?

22 A Reservoir system operation.

23 Q Reservoir system operation?

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

25 mesghinna - direct - clear

1 allocate the water from different reservoirs --

2 Q. Okay.

3 A. -- in northern California.

4 Q. Uh-huh.

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

7 Q. Are you a licensed engineer?

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

10 Q. What professional societies do you belong to?

11 A. I belong to ASCE, American Society of Civil Engi-  
12 neers, although it was disconnected when I was in  
13 school. I reapplied and I haven't gotten the reply  
14 yet.

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1 O Have you ever ever testified in court before as an  
2 expert witness?

3 A Not except at depositions.

4 O What?

5 A Only at depositions.

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

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

10 MR. WHITE: We were very gentle.

11 THE SPECIAL MASTER: All right.

12 O (By Mr. Clear) Prior to this assignment of this  
13 case, have you done any work with respect to irri-  
14 gation or hydrology problems for the Wind River  
15 Reservation?

16 A No.

17 MR. CLEAR: As I indicated, Your Honor, Dr.  
18 Mesghinna is going to give a series of opinions  
19 basically representing the water and irrigation  
20 requirements of the arable base developed by HKM  
21 and the cost of construction, consent of use and  
22 the engineering concepts involved and the practi-  
23 cability from the engineering standpoint of the  
24 irrigation system which he has designed and which  
25 we will go into, and I would like to offer him at  
mesghinna--direct-clear

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

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

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

8 VOIR DIRE EXAMINATION

9 BY MR. WHITE:

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

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

13 Q Are any of the irrigation projects which you des-  
14 cribed that you have worked on or designed actually  
15 in operation today?

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

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

22 A Well, I did work when I was in school. I did  
23 what's called experiment in the field for about  
24 1 1/2 years.

25 mesghinna -voir dire-white

1 Q Did you ever move a sprinkler with a tractor?

2 A No, by hand.

3 Q Hand moved as opposed to side roll or center pivot?

4 A Yes.

5 MR. WHITE: We have no objection to his ad-  
6 mission as an expert, Your Honor.

7 THE SPECIAL MASTER: All right. You are ad-  
8 mitted, Dr. Mesghianna, as an expert witness in  
9 this case.

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

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

17 THE SPECIAL MASTER: You did. You did. He  
18 thought he would add a little footnote on the ex-  
19 perience, practical experience.

20 MR. WHITE: That's all right.

21 DIRECT EXAMINATION (CONTINUED)

22 BY MR. CLEAR:

23 Q Dr. Mesghianna, I am sure you are aware, although  
24 you have not been here, of the distinction that has  
25 mesghinna -voir dire-direct-white-clear

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

5           A       Yes, I am aware of those distinctions.

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

9           A       I am going to testify about the future projects.

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

14          A       Yes, I know what it shows.

15          Q       Just briefly state what it shows for us.

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

25          mesghinna--direct-clear



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

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

10 THE WITNESS: Yes.

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1 A Yes.

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

6 THE SPECIAL MASTER: All right.

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

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

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

23 THE SPECIAL MASTER: Final conclusion is  
24 what?

25 mesghinna --direct-clear

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

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

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

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

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

19 (A brief recess was  
20 taken.)

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mesghinna -direct-clear

1 THE SPECIAL MASTER: Are we ready to resume?

2 Okay.

3 MR. CLEAR: I think so.

4 THE SPECIAL MASTER: Mr. Clear.

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

10 A. Okay.

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

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

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

22 A. Okay. Evapotranspiration is nothing but the evapora-  
23 tion from the soil plus the transpiration from the  
24 plants.

25 mesghinna: - direct - clear

- 1 Q Uh-huh.
- 2 A So that is the amount of water that is evapotrans-  
3 pirated from an irrigated land.
- 4 Q Transpiration is the water the plant uses in grow-  
5 ing, that it consumes?
- 6 A Yes, though the plant gets its water through photo-  
7 synthesis and then it transpires it.
- 8 Q Okay.
- 9 A So that's what I mean when I say transpiration.
- 10 Q Okay.
- 11 A Okay. And evaporation really means evaporation  
12 from the soil.
- 13 Q From the soil?
- 14 A That is something you cannot avoid whenever you  
15 apply water to the ground.
- 16 Q Okay.
- 17 A Okay. The fourth item that we studied was, after  
18 determining what the climate is, what the cropping  
19 pattern is, what the evapotranspiration is, is the  
20 on-farm systems design.
- 21 Okay, in one sentence, about on-farm systems  
22 design: It is the facilities and the interaction  
23 of the crop, water and soil at the farm level, just  
24 at the farm. At the farm plot. We haven't gone  
25 mesghinna - direct - clear

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

3 Q All right.

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

8 Q Okay.

9 A. The sixth part is pumps and pumping plants.

10 Okay, we have the farm, we have the pipes,  
11 and then the next logical thing is we need pumps  
12 to supply water to the pipe and the pipes supply  
13 water to on-farm systems. The next logical thing  
14 is canals and related structures. Okay, then we  
15 have to supply water to the pumps through the  
16 canals and related structures. The related struc-  
17 tures, like diversion structures from the rivers  
18 or streams or some syphons or drop structures and  
19 so on. And the canal is the canal that conveys  
20 water from the source to the pump stations.

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

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

25 meaghanna - direct - clear

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

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

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

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

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

25 mesghinna - direct - clear

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

3 The final item is the total cost. We'll go  
4 on. As we go along with on-farm systems, pipe net-  
5 work and so on, we'll determine the costs. But as  
6 a final thing, including the operation and mainten-  
7 ance, then we'll come up with a total cost.

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

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

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

14 A. Okay. In order to come up with water requirements,  
15 one has to first study what is the climate in the  
16 area. When we say climate, we are specifically  
17 talking about the climate that affects the crop  
18 evapotranspiration. The reason why we need climate  
19 and cropping pattern is actually in order to deter-  
20 mine evapotranspiration.

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

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

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1 in the area, the precipitation, the solar radiation.

2 Q Solar radiation?

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

9 Q What do you mean by weather station now?

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

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

18 A. Yes.

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

21 MR. CLEAR: National Oceanic --

22 THE SPECIAL MASTER: Will you give it to him?

23 MR. CLEAR: National Oceanic and Atmospheric  
24 Administration --

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THE WITNESS: Uh-huh.

THE SPECIAL MASTER: Formerly known as the  
Weather Bureau.

THE WITNESS: Yes.

\* \* \* \* \*

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

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

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

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

25 mesghinna -direct-clear

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

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

9 THE SPECIAL MASTER: The word after solar  
10 is irradiation?

11 THE WITNESS: Yes, radiation.

12 THE SPECIAL MASTER: Irradiation?

13 MR. CLEAR: Radiation.

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

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

25 mesghinna -direct-clear

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

5 A Yes.

6 Q You do, or just by nonbeneficial crops?

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

9 THE SPECIAL MASTER: All right.

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

20 THE WITNESS: No.

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

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

25 mesghinna -direct-clear

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

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

6 A Yeah.

7 MR. CLEAR: Can you see it, Sandy?

8 MR. WHITE: Yeah, thank you.

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

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

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

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

25 mesghinna --direct-clear

1 climatic station.

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

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

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

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

20 A Yeah. What we are saying is the evapotranspiration  
21 in these blue areas is similar in all the areas  
22 in here. The evapotranspiration in Pavillion  
23 is quite different, which is not much, but a  
24 little different from Riverton, so these areas  
25 mesghinna -direct-clear

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

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

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

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

25 mesghinna -direct-clear



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

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

25 mesghinna -direct-clear

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

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

25 mesghinna -direct-clear

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

5 Q What kind of soils?

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

8 THE SPECIAL MASTER: Versus frigid soils?

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

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

17 THE WITNESS: Annually.

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

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

25 mesghinnas-direct-clear

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

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

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

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

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

24 THE SPECIAL MASTER: Do you want to move

25 mesghinna: -direct-clear

1 ahead?

2 THE WITNESS: Let me finish this.

3 THE SPECIAL MASTER: All right.

4 MR. CLEAR: Okay.

5 A So if we can see in here, the elevation criteria  
6 indoctrinates in here and the elevation between  
7 Pavillion and Riverton, which is the boundary  
8 between those two climatic zones, is about  
9 5270; 5,270.

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

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

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

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

25 mesghinna -direct-clear

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

3 Q Thermopolis?

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

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

25 mesghinna -direct-clear

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

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

25 mesghinna -direct-clear

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

5 Q Is --

6 A A prerequisite of evapotranspiration.

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1 Q (By Mr. Clear) Prerequisite.  
2 A So, if we have to go a little bit farther into it,  
3 one unit, as an example, if we take the North Crow-  
4 heart Unit that I mentioned before, the North Crow-  
5 heart Unit encompasses three different climatic  
6 zones. There is Burris, some of it in Burris cli-  
7 matic zone, some of it in Diversion Dam, some of  
8 it in Pavillion. So when we determine the crop  
9 water requirements, we proportion the different  
10 acreages in the different climatic zones and we  
11 separately determine the crop water requirements  
12 for each one of them and then we weighted them out.  
13 We weighted them together to come up with one unit  
14 requirement at the end. Although we see it later  
15 on, it would become clearer and clear as we go along  
16 with this.

17 Q Okay, Dr. Mesghinna, you are obviously familiar  
18 with that map. Is that map made under your direc-  
19 tion and control or did you make that map yourself  
20 or what?

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

22 Q Uh-huh.

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

25 mesghinna - direct - clear

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

13 MR. CLEAR: Your Honor, I would move the ad-  
14 mission of Exhibit WRIR C-244.

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

17 MR. WHITE: Yes, sir.

18 THE SPECIAL MASTER: All right.

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

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

23 MR. WHITE: Thank you.

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25 mesghinna: - direct - clear

VOIR DIRE EXAMINATION1  
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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

mesghinna - voir dire - white

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

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

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

11 (Whereupon the instrument iden-  
12 (tified as Exhibit U.S. WRIR  
13 (C-244 was received into evi-  
14 (dence.

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

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

18 THE SPECIAL MASTER: All right, shall we resume?

19 MR. CLEAR: Yes, Your Honor.

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

23 MR. WHITE: Do we have a reporter?

24 THE SPECIAL MASTER: Yes.

25 MR. WHITE: Oh, there you are.

THE SPECIAL MASTER: Mr. Clear.

1 MR. CLEAR: Your Honor, with respect to Exhibit  
2 244, there was only one copy of that, a black and  
3 white copy, was given to Mr. White in a deposition  
4 in January, but he doesn't have a color copy. He  
5 has asked if he can remove that from the courtroom  
6 so his experts can, you know, magic marker the  
7 boundary paths.

8 MR. WHITE: Thank you.

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

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

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

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

18 DIRECT EXAMINATION (RESUMED)

19 BY MR. CLEAR:

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

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

25 mesghinna - direct - clear

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

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

7 A Okay.

8 Q Are you ready to do that?

9 A Sure. No problem.

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

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

23 Let's say we go, for example, to South Crow-  
24 heart Unit. There are two South Crowheart Units,  
25 mesghinna - direct - clear

1 it has two climatic zones, Riverton East -- I mean,  
2 Riverton climatic zone and the Pavillion climatic  
3 zone. So part of the acreage is in the Riverton  
4 climatic zone and part of it is in the Pavillion  
5 climatic zone, and we determined the crop consump-  
6 tive use and other necessary things based on those  
7 climatic zones and so on.

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

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

15 Q Uh-huh.

16 A So, now, from the climatic study, we know where each  
17 unit is located and now let's see what kind of crops  
18 can we grow in these areas? Okay, we have the cli-  
19 mate, we've classified the climate, we have differ-  
20 ent climatic zones. So what kind of crops do you  
21 expect to grow in here? Because without the crops,  
22 you don't have a project.

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

25 mesghinna - direct - clear

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

3 Q Why is that?

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

12 Q With respect to water requirements?

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

21 Q Peak consumptive use of water?

22 A Peak consumptive use of water. Yeah, peak consump-  
23 tive use and also in gross water requirement. When  
24 I say "gross water requirement", it is almost

25 mesghinna - direct - clear



1 related to --

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

3 THE WITNESS: Yes.

4 THE SPECIAL MASTER: Gross water requirements?

5 THE WITNESS: Yes, gross water requirements.

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

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

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

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

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

16 Q Uh-huh.

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

24 Q Heat units?

25 mesghinna - direct - clear

1 A. Heat units. The heat units are the temperature  
2 maximum. It is a function of maximum and minimum  
3 temperatures, so it requires certain amounts of  
4 heat units during its growth, for example. At 86  
5 degrees Fahrenheit it can grow very vigorously;  
6 above it, it doesn't grow. And when you come to  
7 50 degrees Fahrenheit; below it, it doesn't grow  
8 very vigorously. It doesn't die, but it doesn't  
9 grow very vigorously. So it needs this tempera-  
10 ture between 50 and 86, the better if it's higher.

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

13 THE WITNESS: Ambient temperature.

14 THE SPECIAL MASTER: Ambient temperature?

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

20 Okay. So now, what we are saying is we'll do,  
21 we have this kind of temperatures that range some-  
22 how between 50 and 86 degrees in all over the Reser-  
23 vation. Do we have that? Okay, the answer is no,  
24 we don't have everywhere. If we go to the Burris

25 mesghinna - direct - clear

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

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

23 So in those areas, coupled with the tempera-  
24 ture deficiency in the upper areas, if you don't

25 mesghinna - direct - clear

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

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

8 A Okay. Now --

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

14 MR. CLEAR: Well, Your Honor, like he was giv-  
15 ing corn as an example.

16 THE SPECIAL MASTER: All right.

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

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

25 mesghinna - direct - clear

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

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

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

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

12 THE SPECIAL MASTER: The what?

13 THE WITNESS: Wyoming Agricultural Statistics.

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

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

25 mesghinna-direct-clear

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

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

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

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1 we used published information or published data  
2 by the Soil Conservation Service, which I think  
3 all of you are aware of the famous technical lease  
4 number 21, discussing the range of temperatures  
5 needed for the crops and the number of days of a  
6 certain crop to mature, and we used also that to  
7 relate that and to see whether that is really true,  
8 although we know the crops they are growing.

9 We have to relate it in a more scientific way.

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

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

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

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

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

9 THE WITNESS: Yes.

10 THE SPECIAL MASTER: All right.

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

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

18 THE WITNESS: There is some, yes.

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

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

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

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

3 MR. CLEAR: Your Honor, again, we're as he  
4 has testified already, he has taken the arable  
5 land base developed within HKM and used that and  
6 he has also taken in consultation with Mr. Dornbusch  
7 developed a cropping pattern. He testified he went  
8 out on the ground to see what grows there. He  
9 studied the literature to come up with the crops  
10 that grow, and he has consulted with Mr. Dornbusch  
11 to come up with a cropping pattern. It's kind of  
12 a chicken and egg situation. Who do we put on  
13 first? We could put on Mr. Dornbusch and he'd  
14 say that he got the figures from Dr. Mesghinna  
15 and Mr. White would object, "Wait a minute."  
16 So I think we have to go through this. The crop-  
17 ping pattern is important because it determines  
18 the percentage of crops that grow in a certain  
19 area. Dr. Mesghinna testified that the evapo-  
20 transpiration and eventually the water duty will  
21 depend on a mix of crops. He could say, "I didn't  
22 consult with Mr. Dornbusch at all," so we assumed  
23 that it's economically feasible to grow corn  
24 all over the reservation and the water duty for  
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1 corn is 12 billion gallons." But there has been  
2 consultation back and forth. They have a cropping  
3 pattern; Mr. Dornbusch will testify how that was  
4 arrived at from an economic standpoint. Dr.  
5 Mesghinna testified to his input from the factual  
6 standpoint, and it is vitally important to his  
7 testimony to determine the water duty for the  
8 irrigable ranges on the reservation, which is the  
9 point of the government's case.

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

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

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

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

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

11 MR. CLEAR: I forgot the question now.

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

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

16 MR. WHITE: Let me make sure I understand the  
17 question. Are these the cropping patterns the  
18 economist gave to Dr. Mesghinna or the crop adapt-  
19 ability patterns that Dr. Mesghinna --

20 MR. CLEAR: These are the cropping patterns --

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

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

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1 THE SPECIAL MASTER: That's all right.

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

4 THE SPECIAL MASTER: Yeah, I appreciate that.

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

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

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

21 MR. CLEAR: All right.

22 Q (By Mr. Clear) Where did the information on crop-  
23 ping pattern come from?

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

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

7 But to answer your question in exact terms  
8 after we discussed back and forth several times  
9 with Dornbusch people, they came up -- it was  
10 their decision to come up with this cropping pat-  
11 tern. It was their decision. We gave them --  
12 these are the kind of crops that are adaptable in  
13 the area and they verified it also themselves that,  
14 indeed, the crops that we told them that these are  
15 adaptable in the area. They went to the area them-  
16 selves. Dornbusch himself went over there and veri-  
17 fied it himself.

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

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

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1 towards the economist then rather than Dr. Mesghinna.

2 THE SPECIAL MASTER: Well, he said it was inter-  
3 related, however, but he accepts their conclusions.

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

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

8 MR. WHITE: Thank you.

9 THE SPECIAL MASTER: Go ahead, Mr. Clear.

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

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

14 Q What's the lower area?

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

17 Q Okay. Uh-huh.

18 A The five climatic zones, this is the lower area.  
19 And the cropping pattern there is alfalfa, 67 per-  
20 cent; corn, 12 percent; small grain, 5 percent;  
21 small grain nursing alfalfa, nursing alfalfa,  
22 small grain nursing alfalfa, 16 percent.

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

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1 THE WITNESS: Okay, when one plants alfalfa  
2 for the first time, alfalfa requires a lot of atten-  
3 tion and it has to be protected from winds and other  
4 problems, terribly hot sunshine and so on. So what  
5 they do is they plant small grain together with al-  
6 falfa, they mix them.

7 THE SPECIAL MASTER: I remember that.

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

10 THE SPECIAL MASTER: Yeah.

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

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

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

1 be discussed by the economist, there will be differ-  
2 ences -- a difference in yields in the upper areas  
3 and the lower areas. But that I will leave to the  
4 economist.

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

7 A. No.

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

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

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

21 A. Okay.

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

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1 just in a very general manner.

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

14 To start with, let's define first what really  
15 evapotranspiration is. Evapotranspiration, as I  
16 said it earlier, it is a combination of evaporation  
17 from the soil and from the plant foilage and trans-  
18 piration from the plant itself. So it is a combina-  
19 tion of both evaporation and transpiration.

20 But one may ask how do we determine evapotrans-  
21 piration. I think evapotranspiration is -- to talk  
22 about it, it looks easy, but it is one of the com-  
23 plex things. So I will start from the very begin-  
24 ning and go all the way, and you can stop me if

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

3 Q Okay.

4 A. Evapotranspiration, as defined by Penman, who is a  
5 leading fellow in evapotranspiration work, which he  
6 calls it potential evapotranspiration. Potential  
7 evapotranspiration is the amount of water transpired  
8 from a reference crop, which I will define later on  
9 what reference crop is, which is well-watered, mean-  
10 ing that there is ample water; that there is no  
11 stress in the crop, it gets water as it wishes, of  
12 about uniform height, which is usually about 25  
13 centimeters in height, and completely covering the  
14 soil. So this is what you call potential evapotrans-  
15 piration. The reference crop that I mentioned be-  
16 fore - the usual reference crops that are used in  
17 the world today in determining evapotranspiration  
18 are alfalfa and grass. It is predominately alfalfa,  
19 but there are people who use grass as a reference  
20 crop.

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

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1 equation in the world so far. Then what do we do?  
2 How do we determine the evapotranspiration of corn?  
3 How do we determine the evapotranspiration of small  
4 grain or alfalfa? We determine it indirectly. There  
5 is no direct determination except by measurement,  
6 such as a lysimeter or other instruments for measur-  
7 ing it.

8 Okay. The first thing we do is we determine  
9 potential evapotranspiration, that is, we determine  
10 an ideal condition that the crop is completely cover-  
11 ing the soil, it is of uniform height and well-  
12 watered. We determine evapotranspiration of the  
13 reference crop.

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

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

19 Q Uh-huh.

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

22 Okay. Now, there are several methods of  
23 determining crop evapo-- I mean potential evapo-  
24 transpiration. To mention a few: There is what  
25 mesghinna - direct - clear

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

6 Another method of determining potential evapo-  
7 tranpiration was by Christensen in California, and  
8 that fellow is still alive, too, together with Har-  
9 greaves. And then there was another equation that  
10 was developed later on by Mr. Hargreaves himself,  
11 who is still alive at Utah State. And there is  
12 the Lowery-Johnson, there is the Penman equation.  
13 There are many, many equations and later on came  
14 the Jensen-Haise equation.

15 Q Spell that for the reporter.

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

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

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1 Jensen-Haise equation.

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

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

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

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

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

21 THE SPECIAL MASTER: Blatant.

22 MR. CLEAR: Blatant.

23 THE SPECIAL MASTER: Is it possible Mr.

24 White might not object to its introduction at

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1 this time?

2 MR. WHITE: No chance, Your Honor.

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

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

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

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

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

16 THE SPECIAL MASTER: That's all I want.

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

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

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

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1 from there.

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

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

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

11 MR. CLEAR: I have extra copies.

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

20 (Off-the-record discussion.)

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

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

1 U.S. Attorney's office.

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

4 MR. CLEAR: They have copies already.

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

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

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

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

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

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

1 THE WITNESS: It doesn't.

2 THE SPECIAL MASTER: Stetson only.

3 THE WITNESS: Yes.

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

7 (Whereupon, a short recess  
8 was taken.)

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

11 MR. ECHOHAWK: Yes, Your Honor.

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

14 MR. WHITE: Yes, Your Honor.

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

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

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

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

24 A Yes, I do.

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

5 A It is on Page 3 of the summary report.

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

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

14 Q Solar radiation data?

15 A Solar radiation data. And to a lesser extent  
16 you need also the mean maximum temperature  
17 and mean minimum temperature of the warmest  
18 months, which is usually is July the warmest  
19 month. So by getting the mean maximum  
20 temperature and mean minimum temperature one  
21 can determine the maximum saturation and the  
22 minimum saturation. The other things that are  
23 necessary in there are other coefficients or  
24 constants such as, for example, in the formula  
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1 where  $C_T$  is a reciprocal of  $C_1 + C_2$  times  $C_H$ .

2 Q Is what?

3 A Reciprocal.

4 Q Reciprocal?

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

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

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

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

20 One thing that we know about solar radiation  
21 is the extraterrestrial radiation. The extra-  
22 terrestrial solar radiation is the radiation  
23 on top of the atmosphere before it hits the  
24 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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1 A Now, how can we relate it to the solar  
2 radiation on the surface? We are really looking  
3 at the solar radiation at the surface when it  
4 hits the plants itself, which helps the  
5 photosynthesis of the plants, transpiration of  
6 the plants and so on. In order to come up with  
7 that, we need another parameter.

8 Q Pardon?

9 A Another parameter.

10 Q Okay.

11 A And this parameter is the ratio of actual to  
12 possible sunshine. This data is available from  
13 1931 -- from about the 1930's to about 1975, and  
14 so on. In fact, up to date, in the Dubois  
15 Airport -- not Dubois, sorry, Lander Airport.

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

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1 can be related to the percent sunshine and  
2 determine solar radiation out of this. So  
3 what we did is in order to find out the solar  
4 radiation or determine the solar radiation,  
5 we determined it in several methods. We used  
6 four different methods to determine it, and  
7 we made an average of all those different  
8 methods and came up with a solar radiation,  
9 and they are all related to the extraterrestrial  
10 radiation and possible sunshine or to the  
11 cloudless day solar radiation vis-a-vis the  
12 percent sunshine. So we determined all --  
13 using this we determined the solar radiation  
14 from months of April to September, which plants  
15 start to grow in April up to and harvested  
16 sometime in September.

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

20 Q What?

21 A NOAA.

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

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

1 example, you determine all the things which  
2 are there, the  $T_x$ , the test of which is the  
3 temperature intercept which is  $27.5 - 0.25$   
4  $(E_2 - E_1) - \text{elevation}/1000$ .

5 THE SPECIAL MASTER: Do you write that  
6 °F./mb? Is your formula given from the top  
7 of Page 4?

8 A Yes.

9 So using this formula, now, what we  
10 determined is really not our actual evapo-  
11 transpiration. We are still in the determination  
12 of the reference crop potential evapo-  
13 transpiration.

14 Q (By Mr. Clear) Right.

15 A Right.

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

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

22 Q Okay. Now what do you do?

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

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1 that are of interest to us.

2 Q Those are the crops in your cropping pattern?

3 A Yes.

4 Q Okay. Now, how do we do that?

5 A Okay. We have to define certain terms before  
6 and that is we have to define what crop co-  
7 efficient is first. The crop coefficients are  
8 different for different crops and different  
9 during the growth season. The crop coefficient  
10 is mainly a function of the crop itself, the  
11 makeup of the crop and also season or climate.  
12 But mainly, the function of the crop itself.  
13 Crop coefficient is nothing but the ratio of  
14 crop evapotranspiration to potential evapo-  
15 transpiration.

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

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

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1 the crop coefficient. In a sense, what I am  
2 trying to say is we know the potential evapo-  
3 transpiration of a reference crop. If you  
4 multiply it by a crop coefficient of corn, we  
5 get the actual corn evapotranspiration.

6 THE SPECIAL MASTER: I think I understand.

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

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

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

14 Q (By Mr. Clear) Okay.

15 A Okay.

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

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

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

23 MR. SACHSE: I wonder whether we need all  
24 the formulas and working out all these formulas,  
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1 whether we could get a little more quickly to  
2 the end results.

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

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

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

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

24 THE SPECIAL MASTER: We'll skip writing it  
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1 down on the blackboard. Go on to the next  
2 point, Mr. Clear.

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

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

22 So Jensen has provided certain methodology  
23 in determining these crop coefficients and in  
24 doing so, the Midvale Irrigation District has  
25 mesghinna-direct-clear

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

3 Q Could you speak up a little, please?

4 A Okay.

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1 THE SPECIAL MASTER: He said the Midvale Irri-  
2 gation District developed the crop.

3 MR. CLEAR: Yes. All right.

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

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

12 A. Each crop in the cropping pattern.

13 THE SPECIAL MASTER: Regardless of climatic  
14 zone?

15 THE WITNESS: Each climatic zone we have a  
16 different potential evapotranspiration. We deter-  
17 mined the evapotranspiration of corn, small grain  
18 and alfalfa in the Riverton --

19 THE SPECIAL MASTER: Okay.

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

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

6 A. And then we get by multiplying the potential evapo-  
7 transpiration of a reference crop by crop coeffi-  
8 cients during the whole season for a given crop for  
9 a given climatic zone.

10 Q Uh-huh.

11 A. We determine ETC.

12 Q Uh-huh.

13 A. What I'm referring when I say "ETC" is evapotrans-  
14 piration of a crop.

15 Q Okay.

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

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

20 A. Each climatic zone.

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

23 A. Yes.

24 Q Now, what do we need?

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

4 Q. So you have an evapotranspiration for every month?

5 A. Yes.

6 Q. For every climatic zone for every crop?

7 A. Yes.

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

10 A. That's what I have, yes.

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

15 Q. Uh-huh.

16 A. That is through precipitation.

17 Q. Rainfall?

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

21 Q. From the evapotranspiration of the crop?

22 A. Of the crop --

23 THE SPECIAL MASTER: When you say "crop consump-  
24 tive use", is that synonymous with evapotranspiration

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1 of the crop?

2 THE WITNESS: Yes, evapotranspiration of crop?

3 THE SPECIAL MASTER: Of the crop.

4 THE WITNESS: Of the crop.

5 THE SPECIAL MASTER: Is synonymous with crop  
6 consumptive use?

7 THE WITNESS: Yes.

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

10 THE WITNESS: An inch. Inches of water.

11 THE SPECIAL MASTER: In inches of water?

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

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

17 Go ahead, Mr. Clear.

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

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

24 Q Uh-huh.

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1 A All of it to determine the net irrigation require-  
2 ment.

3 Q Why is that?

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

9 Q Deep percolation?

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

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

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

18 Q Uh-huh.

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

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1 experience and also based on, you know, really  
2 climatic facts. The effective rainfall is a func-  
3 tion of two things. It is a function of evapo-  
4 transpiration of the crop that we just determined --

5 Q Uh-huh.

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

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

12 A Yes.

13 Q From who? Who put that out?

14 A The Soil Conservation Service.

15 Q Soil Conservation Service?

16 A So we used that equation or that methodology to  
17 determine the effective rainfall. After determin-  
18 ing the effective rainfall, then we subtracted it  
19 from the crop consumptive use or crop evapotrans-  
20 piration and we determined the net irrigation re-  
21 quirement.

22 Q Net irrigation requirement?

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

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

3 A Yes.

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

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

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

10 THE SPECIAL MASTER: He's had a tough long morn-  
11 ing.

12 MR. CLEAR: Should we take a --

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

14 MR. CLEAR: Would you like a lunch break?

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

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

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

21 MR. CLEAR: That's fine.

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

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1 should be enough for everyone.

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

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

7 (Recess, 11:25 a.m.)

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