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Trial Transcript, Vol. 72, Afternoon Session

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IN THE DISTRICT COURT FOR THE FIFTH JUDICIAL DISTRICT

WASHAKIE COUNTY, STATE OF WYOMING

IN RE:

THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING.

Civil No. 4993

FILED 6/23 1981

Margaret V. Hampton CLERK

DEPUTY

VOLUME 72

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Tuesday, June 2, 1981

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ORIGINAL

THE SPECIAL MASTER: Come to order, please.

MR. MEMBRINO: Thank you, Your Honor.

DIRECT EXAMINATION (RESUMED)

BY MR. MEMBRINO:

Q Mr. Vogel, since the lunch break, maybe it would be a good idea for you to recapitulate where we've gotten to end the presentation of your work.

A. Certainly. As you recall, we had gone through step one. I have selected the stream reach. We have gone out to that stream reach, and we selected the study site where we are actually going to go out and do our physical measurements. Right now we are on step three where we are actually going out and doing these measurements, hydraulic measurements and fish characteristics present in the study site.

Q. Okay. Now, we left off discussing around Exhibit 283, and I refer you now on that exhibit which is a cross-sectional profile of the hypothetical transect to the three horizontal lines across that exhibit. Could you explain what they are?

A. Yes, For five of our study sites on the stream on the Wind River Indian Reservation we were going to apply IFG-4 hydraulic simulation model developed by the Instream Flow Group in Fort Collins. This put in the computer model -- the computer simulation model requires that two or three or possibly more separate flows be measured, possibly a low

flow, a medium flow, and a high flow. Now these are the actual flows where we went out and did our measurements, and what we did was we went out, and our low flow represented here by the lowest horizontal line in the cross-section, and we did our measurements of velocity, depth, and substrate at each one of these points represented by the vertical hash marks. Now going back at a medium flow, we took the measurements at the identical locations. Here we have the two head stakes as reference so we were able to determine exactly how many feet out from the head stakes to take those measurements.

Q. So you left the head stakes in place after your first measure ment?

A. That's correct.

Q. And at a subsequent time when you would establish that a lower flow -- or a higher flow was occurring, you went out and took your next measurement?

A. That's correct. And for the high flow, we did the same thing. We went back out to the same location in the stream and took our velocity, depth, and substrate readings.

Q. Could you tell the Court about over how much time your field work occurred?

A. The total field work encompassed the summer and fall of 1979 and the summer of 1980. For the five IFG-4 sites that we

selected, the lowest -- excuse me, the highest flow was taken probably around July of 1979; the lowest flow was taken probably around somewhere later that summer or early fall.

Q. I see.

A. And the medium flow sometime in between that. It was on a receding level of flow in the river.

Q. Okay. Could you describe briefly how you go about taking those depth and velocity measurements there?

A. Okay. We would actually go to the head stake and put up what we call a tag line. It is a thin wire that we stretch clear across the stream from one bank to the other that is marked in gradiations in feet. This is what we are going to use as our reference each time we go back to the same study site, so we go out and we try to establish these vertical hash marks such that not more than -- usually not more than five to ten percent of the total volume of water coming down the stream would not pass through the area between the two hash marks. I'll refer to these in the future as subsections. Again, these vertical hash marks represent the point where you actually take a point measurement. We actually measure the velocity present, the substrate present on the bottom, and the depth of the stream at that particular flow.

vogel - direct - membrino

END

Q. (By Mr. Membrino) Are you making a conclusion when you take those measurements that that data stands for flow at that point or that flow for the space between the hash marks?

A. What that represents, our actual field measurements represent the information for that particular point in the stream. We go over -- Say, for example, in this case, we might go over one or two feet, take another measurement. Then we run this through the computer, the computer will average those two measurements, and it will come up with a mean velocity for this entire subsection. It will also come up with a mean depth. We have a depth recorded here and depth recorded here on the stream. The computer will average those, and give us its mean depth.

Q. I see. Now, what do you do -- What do you do with the information that you get for what you described as each subsection?

A. Okay. Now, I'm going to use both exhibits here to show you what a subsection really represents. Again, on Exhibit C-283, the subsection is the total area between the two different hash marks represented as the vertical dotted line. That is a, that's a cross-section of a subsection, and each subsection is extended upstream and downstream. And I use -- Is it okay if I mark on the exhibit?

Q. Sure. Before you do that, I would like to ask you, though, is there a topographical view of that shown, of a subsection shown at Page 4 of your report?

A. Yes, there is.

THE SPECIAL MASTER: What page did you say?

MR. MEMBRINO: Page 4, Your Honor.

Q. (By Mr. Membrino) Could you describe what that is?

A. I'm referring to Exhibit 1 on Page 4 on the instream flow report. The subsection that's denoted as diagonal hash marks through there are represented, I'm drawing an example on this Exhibit C-282 to give you an idea of what we are talking about, a subsection.

(Brief pause.

A. Okay. Referring both to Figure 1 on Page 4 of the report, which is Exhibit 280, and referring to Exhibit 282, which is the top view schematic of an example study site, the rectangle that's denoted with the diagonal hash marks are one and the same, they represent one and the same. This is what I refer to as a subsection.

Now, remember, these are three-dimensional, three-dimensional images. This is a top view of it, and this is a cross-sectional view of it.

Now, the velocity that we've measured for each one of these points, a point located here on the lefthand side of

the subsection and one on the righthand side of the subsection will be averaged by the computer, as will the depth. Now, we are extrapolating this forward up the stream and downwards in the stream, so we have a mean velocity for the entire subsection, and we have a mean depth for that, as well. The substrate that we recorded is intended to represent the substrate in this entire subsection.

THE SPECIAL MASTER: What is meant by "substrate"?

THE WITNESS: Substrate is the streambed material itself. It's referring to sand, gravel, cobble, boulders, things like this.

Q. (By Mr. Membrino) And that's to be distinguished from the confirmation, the streambed, which is what?

A. I beg your pardon?

Q. How would you distinguish that from the confirmation?

A. The confirmation, the streambed morphology is referring to the actual shape of the channel. The substrate would be the actual material in the bed of the channel. There is an important point I should bring out here too, and that's when we are in the field, we can weight this transect upstream or downstream. If we do nothing with it, the computer will just assume that we are weighting this halfway up to the next transect and halfway down to the next transect. If I want, if I feel that this transect has a lot of

characteristics that should be extended further upstream, such as, say ninety percent way up to the upstream transect, I can extend it up there.

In other words, I would have a dotted line drawn across here, right below Transect 4+70.

Q. And that is because the transect is more representative of the stream than the upstream transect?

A. That's correct.

Q. Now, you have -- You've described how you get, you take the measurements and collect data for each subsection. What -- What do you do with that? Are there subsections exact measured throughout that whole study site?

A. That's correct. Each one of these transects has subsections. When we start from the downstream transects, it has subsections that only go upstream. Say, if we don't put a weighting factor halfway to the next transect, so the subsections for each one of those would extend halfway up.

The next transect would have weighting downstream and weighting upstream. There would be subsections associated with that transect. Of course, finally, as we work upstream, there would be subsections associated with this transect continuing all the way up to the uppermost transect where the subsections are only weighted downstream. This is the termination of the study site.

Q. So the schematic on Page 4 of your report, that is Exhibit 280, really described what a whole grid of subsections would look like on a study site?

A. That's correct.

Q. Having acquired -- Now, you have all this, all this information you've collected, is acquired by the direct measurements taken in the field?

A. That's correct.

Q. None of this information so far is extrapolated from other sources?

A. We have -- We're still on step three, we're only talking about the actual measurements. We went into the field, and we actually measured what was present at that given flow.

We haven't gotten into the computer simulation portion of it yet.

Q. And in the case of the IFG-4, where you have to take more than one measured flow, you repeated the process for each of these subsections, one, two or three times?

A. That's right. I should mention too, since we have mentioned IFG-4, also bring out the IFG-2 computer program. That is also a hydraulic simulation model that's used by the IFG, Instream Flow Group in Fort Collins, but it requires field measurements at one measured flow. For example, if we went

out to the field and the particular level of the stream was at the lowest vertical bar going across this cross-section in Exhibit C-283, and this is the flow we measured, and we only go out and take measurements after this particular flow. We do everything in the same manner as far as the data collection, except we don't take it at a,you know, like a high, medium or low flow, it's only one flow.

Q. Does that make the IFG-4 method more reliable than the IFG-2?

A. No, it doesn't. The results are intended to be the same as far as reliability. The IFG-4 method relies more on empirical data and less on theoretical data or formulas, whereas IFG-2 models rely more on theoretical formulas, hydraulic formulas and less on actual measured field data.

Q. But --

A. But the results would be equally reliable.

Q. Thank you. Now that we've got all this information you've completed, or all your measurements for velocity, depth and substrate, as you described in step three of your outline, what do we do next?

A. The next step on this outline would be step four, the actual computer simulation of stream reach?

Q. Now, is it -- At this point now, we are leaving the field measurements and we're going back to the office to do

computer work?

A. That's correct. Now, the objective here is to predict what the stream reach is going to be like at different flows that we have now actually seen. We've gone out and we've seen what the stream looks like at a given flow. IFG-4 has three flows, and IFG-2 has one flow, so we know what all these measurements were at these given flows, but now we have to know what the stream looks like at flows that we have not measured, high flows or lesser flows. So now we have to use the computer program to simulate, to actually model this entire stream reach.

* * * * *

Q Okay, would you explain how that's done?

A The first important step in the computer simulation is to actually calibrate our field data. What I mean by calibrate is actually run our field data through the field computer program, either IFG-2 or IFG-4 to make sure that they conform with what we actually measured in the field. For example, IFG-2 -- we went -- part of our field measurement is we took water surface elevations on both sides of the stream, averaged them to come up with one elevation to represent that elevation of this particular transect. We did the same for subsequent transects upstream. Now, when we run this field data through the computer module, the computer is going to give us an output. Now, we have to make sure the output is correct as far as what we measured in the field. In other words, if we run it through and the computer is saying that my elevation here is actually a foot higher than what I actually observed in the field, I have to calibrate the computer or I have to change some numbers to get it to calibrate the actuals, what is the true actual value, what it should be.

Q Could you explain how the computer would state something other than what the actual measurement is?

A Okay, there is one control I have over it. The control is the roughness of the stream for IFG-2 model. It is

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basically an energy balance model. It talks about the energy losses going downstream from one transect to the other. Now, when the data is run through,the only control I have over this,as far as increase or decreasing the level of water in the stream, is to make the channel basically rougher or less rough. When it is rougher, in general, the water level would be raised, if it's a smoother bottom, less rough, the water level would be lower. I have control over that specifically at the hydraulic controls. As you remember, I said that these had stage discharge relationships. There are physical features in the stream that would actually dam up the water upstream. So if I can make these hydraulic controls rougher, it would have a damming influence upstream. Consequently, if I made them smoother, less rough, the water would be -- would have less damming influence and the water surface elevations would be lower. So this is the one control I have over this, calibrating the model.

As far as the IFG-4 model, there is very little involved in calibration. They build a stage discharge relationship for each transect and each subsection that I measured. It's giving me a water surface elevation for each measured flow and it's given me a velocity for each measured flow. And this, I had Robert Milhaus he is the

fellow that actually wrote the computer programming through the five IFG4 programs, I did run through with my different flows, and here verified that they were calibrated according to his standards.

MR. WHITE: I would move to strike the last answer, Your Honor, that is the rankest form of hearsay. If Robert Milhaus,were made available to testify and could be cross-examined with respect to his verification works then it would be appropriate but he has not been made available. There is no foundation. It is pure hearsay.

MR. MEMBRINO: Well, Your Honor, Mr. Vogel is simply showing what he went through in calibrating what he did. The fact is he's not relying on Mr. Milhaus' work,he's reporting that Mr. Milhaus confirmed that it is not essential to us -- his testimony does not stand or fall on Mr. Milhaus' vouching for his work.

THE SPECIAL MASTER: Let me hear the last two or three sentences of the response of the witness.

(The above answer was read back
(by the reporter, to-wit: "That
(actually wrote the computer
(programming through the five
(IFG4 programs, I did run through
(with my different flows, and
(here verified that they were
(calibrated according to his
(standards."

THE SPECIAL MASTER: I thought I heard his name

name mentioned.

(More of the answer was read back
(by the reporter as follows:
("A. And it's given me a velocity
(for each measured flow Andthis
(I had Robert Milhaus, he's the
(fellow that actually wrote the
(computer programming, through
(the 5IFG4 programs, I did run
(through with my different flows,
(and here verified that they were
(calibrated according to his
(standards."

THE SPECIAL MASTER: I'll overrule the objection --

MR. WHITE: I'm sorry.

THE SPECIAL MASTER: I'll overrule the objection. I believe what I heard read from the reporter shows that he verified these with him and was convinced that they complied with his standards. It wasn't Mr. Milhaus testifying, it was he checking his own work along Mr. Milhaus' criteria.

Go ahead,Mr. Membrino.

MR. MEMBRINO: Thank you, Your Honor.

Q. (By Mr. Membrino) Mr. Vogel, we were in the midst of your computer analysis. Would you continue with that?

A. Okay. There is the first stage we are at in this step No. 4, computer simulation stream reach is to actually calibrate what we measured in the stream with what the computer output will be. Once we have done that as I

described earlier, once we have done that and we are satisfied that the computer output does conform with what we actually measured in the field now we can extrapolate, we can go into the areas measured. This is the first time we are trying to simulate conditions that we haven't actually seen in the field. Now, with the IFG4 program we can actually go up to two and a half times what we actually measured in the highest flow. For example, referring again to Exhibit C-283, this was the flow that we actuallly went out and measured using the IFG4 program. The IFG has determined that we can go up as high as two and a half times the flow. If this flow happens to be 100 c.f.s,, we can take it up to 250 c.f.s. and simulate those conditions in the stream.

MR. WHITE: Go ahead.

A. And we can also go down to .4 times our lowest measured flow. If this happened to be, say, ten c.f.s., we can run it through the computer program and it would be four times ten, it would be four c.f.s. So we can simulate. That is the range of flows we can simulate. Those are our constraints in the model.

MR. WHITE: Your Honor, I would object to the further -- or going farther in this line of questioning and I also move to strike the last answer on the grounds of foundation.

Mr. Vogel didn't write the programs. Mr. Vogel simply used the programs. Mr. Vogel has no personal knowledge of how the programs work or what limitations or assumptions are contained within the programs. Bob Milhaus who lives in Fort Collins forty or fifty miles to the south is the fellow that wrote the programs, developed the assumptions and was able to explain this. Having this witness explain it is -- and Mr. Milhaus isn't, for example, a fisheries biologist, he is a hydraulic engineer. If someone needs to explain this program, someone needs to explain the assumptions and the accuracy and how far the predictions can be made from the measured flow, that is Mr. Milhaus, not this witness. This witness has no personal knowledge and he's established no competency with respect to the programs as they were developed for the assumptions that are included therein.

THE SPECIAL MASTER: You may be right and in some subject matters with which I would be a little more familiar and more comfortable I would sustain you. We are dealing in this ephemeral field so new within the last four or five years of devising a system to try to arrive at a conclusion as to what is a flow recommendation that I think I'll let him go ahead with what he's saying. What I don't understand is if you had this latitude of two and ½

times more on the top side or down to four-tenths or much less on the down side, what difference does that make with what you did in coming to your next step in your calculations?

THE WITNESS: Okay. The important thing to remember is we want to find out what the optimum habitat conditions will be in these stream reaches and different flows. The only way we can do that is to have the computer run it through and tell us what the conditions will be like at a whole range of flows, at high flows, medium flows and low flows. If we just go out with three flows we are very limited. We could go through --

THE SPECIAL MASTER: How can three flows be limited, one representing the all-time highest measured flow, the other representing the all-time lowest measured flow and the other one is the intermediate measured flow; what more is there to work with than anything but the alpha and the omega of it?

THE WITNESS: Okay. When I refer to measured flow, I was speaking of relative terms to what had actually been measured in the field. This high level flow doesn't necessarily have to mean the all-time flow, it was higher than these other two flows.

THE SPECIAL MASTER: And what I hear you saying is

this for one season, one year in one --

THE WITNESS: Right.

THE SPECIAL MASTER: I've got some questions about this whole process. If it's not the state of the art for this hundred years or a given system or from any years there may be records having been kept on this particular stream, then what does the water service at the highest measured flow stand for on these exhibits that you're referring to?

THE WITNESS: Okay.

THE SPECIAL MASTER: I thought it stood for just exactly what it says.

THE WITNESS: Okay. It is -- it's the highest measured flow when we went out there. If the stream just happened to be a hundred cfs and that's what we measured at the one flow. You see, when it happened to be 40 cfs, that was our lowest measured flow. Now another flow might naturally occur during the spring --

THE SPECIAL MASTER: So this applies to what you did the day you worked there?

THE WITNESS: Exactly. Exactly.

THE SPECIAL MASTER: It has nothing to do with the historical records of that particular stretch of river?

THE WITNESS: That's right.

THE SPECIAL MASTER: Where in it is the science to your science if this is what you work with? It's just what you're doing during the time you're out there putting up your transects?

THE WITNESS: Understand what we're talking about is hydraulic measurement. We're not talking about the hydrology, we're not talking about how much water is available in that system. We haven't gotten to that point yet. We're just talking about the hydraulics of what the stream looks like with these flows coming down it. You see, as of yet we haven't plugged in the information and what is available, truly available in the system.

THE SPECIAL MASTER: No. Well, we are not only talking about availability, we're talking about historic records and what is in fact the highest measured flow in that particular stream.

MR. MEMBRINO: I can --

THE SPECIAL MASTER: I'm not getting the message, I'm afraid.

MR. WHITE: Your Honor, could I have a continuing objection and the motion to strike which I made just a few moments ago so I don't have to keep standing up; and those are that no foundation has been established here, no competency of this witness to talk about hydraulics or the

development of these computer models. The foundation would be established by someone like Mr. Milhaus from Fort Collins coming up and explaining to the Court.

THE SPECIAL MASTER: You may have those continuing objections, Mr. White.

MR. MEMBRINO: I think to complete the record on that the witness has been qualified as an expert in fisheries management biology and he's been asked if IFG, the IFG incremental methodology is used by people in his profession and by himself and he said, yes, it is, and what he's -- what he's doing is explaining the tools that people in his profession rely on. He is not explaining the theory behind it. He's saying this is all I'm permitted to do with this methodology. I'm not permitted to do something more than estimate two and a half times the highest measured flow or to guess at what the -- what four-tenths of my lowest measured flow may be. It is necessary for the Court to understand the limits of Mr. Vogel's testimony so that the Court doesn't get misled and the methodology does have limitations and he's speaking to them. He's not apologizing for them or explaining them, he's just stating that they are there.

MR. WHITE: Mr. Membrino has put his finger on the precise point, Your Honor. The point is that this is a fledgling methodology, it's a new methodology. It's a methodology that's not generally accepted outside the government. The witness has only been able to testify as to Federal government use of this, and primarily the Fish and Wildlife Service use of it. It's never been accepted by any court of record. It was suggested it might be used in Montana, they didn't use it in Montana, they went to a percentage flow type arrangement. And to try to avoid the necessity for establishing a foundation through the person that actually wrote the program, developed the assumptions and might be said later to develop some of the data that was used, I think is inappropriate. It's not in compliance with the Rules of Evidence and we ought to have a foundation laid by the person that actually developed this methodology, which as of yet is completely untested in judicial proceedings.

MR. MEMBRINO: Your Honor, I should point out it's being used elsewhere, it's being used by the State of Wyoming in --

THE SPECIAL MASTER: Let him finish, please, Mr. White.

MR. MEMBRINO: Being used by the State of Wyoming under contract with the Bureau of Land Management to

determine instream flows for this very case.

MR. WHITE: I would like to suggest that the contract be produced. I think the Court could then see why it's being used.

THE SPECIAL MASTER: Let the man finish.

MR. WHITE: I'm sorry, Your Honor, I thought he was done.

MR. MEMBRINO: Your Honor, the witness has testified that in his professional opinion the different methods available for calculating instream flows, which is a new science, leaves him -- leads him to believe that the best method, most responsible way to present something like this matter to the Court is the IFG Incremental Methodology. And he is -- he is explaining that that is the basis, the basis for his work.

If the State believes that it is, it should be discounted, then it's up to the State to put on a case to say that is not a reliable method and we will gladly produce rebuttal testimony. But the rules clearly state that the -- that the experts can rely on this kind of information.

THE SPECIAL MASTER: I have no quarrel with that, it's just that I don't understand the significance of Exhibit C-283. And I thought for quite a long time they were talking about a measure made within a river, within

a portion or a strip within a segment of a stream that would identify between two states what the high-level water mark was of that mark and low-level mark of that stream, and that's not so.

THE WITNESS: Right.

MR. MEMBRINO: Let me clarify that with some questioning.

THE SPECIAL MASTER: We need to clear out a few misconcepions in my head and we can proceed with the case.

What then is the literal significance and reflection of the three lines on C-283?

THE WITNESS: Okay. These three lines refer only to what I actually measured, not what historically has occurred, but the day I went out there and made my measurements. This is what the particular flow level was.

THE SPECIAL MASTER: Is that subject to all sorts of vagueries depending on whether it's been raining or not before, depending on whether it is April or October, depending whether it's sometime 10 in the morning or 10 at night?

THE WITNESS: That's correct.

THE SPECIAL MASTER: Then what value is this type of information?

THE WITNESS: Okay. At this particular level of flow, each one of these subsections has a particular

characteristic about it. It's got a particular velocity, it's got a particular depth and it's got a particular substrate that's unindated along the side of the channel. If we go back at another flow and see what's present, for example, the lowest measured flow here that I actually observed, then this substrate is no longer unindated, it's exposed.

THE SPECIAL MASTER: What's the difference between the first line and the third line in the middle of the stream, in your middle subsection? What are you talking about, following the hatch mark down your middle subsection? That's it. Now, what is the distance between the first and second line?

THE WITNESS: It may be two feet.

THE SPECIAL MASTER: No. Vertically, up and down.

THE WITNESS: Oh, this distance?

THE SPECIAL MASTER: Only between the first and second line.

THE WITNESS: Oh, I see what you mean. It depends on the nature of the stream. It may have an inch or two, or it may have been six or seven inches or maybe a foot.

THE SPECIAL MASTER: How long do you stay in each place where you set up a transeit?

THE WITNESS: Just for that particular day.

THE SPECIAL MASTER: The river varies a foot from the

time you're there one day, from its high-level to its low-level?

MR. MEMBRINO: May I ask a question?

THE SPECIAL MASTER: It will vary two, three feet in one day?

THE WITNESS: No. We are talking about different times of the year it's varying. This flow represents that particular flow right at the day I went out there, at that time of the year. Later in the year I may come back in the fall and the river's flowing less and that's what I actually measured then, and that's where the level of the river is at.

THE SPECIAL MASTER: So C-283 does not give you the results of one visit to one place period? It gives you the results of many visits to one place where a transeit over a period of what, within a year?

THE WITNESS: That's correct. Actually we had, the highest flow was early in the summer, low-flow was late summer or early fall.

THE SPECIAL MASTER: Go ahead. Mr. Rogers.

MR. ROGERS: And to remind Your Honor, I believe the witness testified his work spanned over summer and fall of 1979 and summer again of 1980.

THE SPECIAL MASTER: Okay, go ahead.

Q (By Mr. Membrino) So you were in the field three times in

using IFG-4 and made three measurements at the same place --

A That's correct.

Q -- of the elevation of the stream?

You did not use, for example, United States Geological Survey Hydrology Records to mark what the highest measured flow was?

A No.

Q These were your imperical observations?

A That's correct.

Q Okay. Now, I'd like to --

A Excuse me. I want to make sure that -- okay. When you're referring to that, you're talking about historic flow?

Q Right.

A Okay, that's correct.

Q What I would like to do now, to understand a little better of what the computer can know, would you discuss what information the computer will have about the streambed, the morphology of the stream?

A Okay. When I made my transect I made measurements of the distance away from the headstake, and what the elevation of the streambed was. I've done that for each of the vertical hash marks clear across the stream, so that is a static situation, that's going to remain that way, that's an assumption, that's going to remain that way for

all three of our flows. So that is in the computer and the computer now has that information. It now has this measurement of what the streambed morphology looks like.

Q All the way between the headstakes?

A That's correct.

Q Even where there's no water flowing?

A That's correct. I even made measurements of the streambed where I don't have hash marks here, but actually above the water level just in case I wanted to try and have the computer raise the level of water in the stream to see what all the different characteristics will look like. It has that information, what the stream channel looks like between here and the headstake in the right-hand corner of C-283.

Q Now, let me ask you this: If, for example, the water supply, the water in the stream was at the -- at the intermediate measured flow, what would that -- what would you know then about the streambed itself?

A Versus the higher flow?

MR. WHITE: Excuse me, could you reread that question, I didn't understand it.

(Whereupon the following question was read back as follows: Q: "Now, let me ask you this: If, for example, the water supply, the water in the stream was at the -- at the

(intermediate measured flow, what
(would that -- what would you know
(then about the streambed itself?"

THE WITNESS: Okay. The streambed itself would remain the same. There would be portions of the streambed, however, that do not have water in it. This area here would not be covered with water, this area here would not be covered with water (indicating).

Q (By Mr. Membrino) And what would that -- what would, what use would that information be in your ultimate effort, which is to determine habitat?

A That's correct. Our ultimate goal --

THE SPECIAL MASTER: He said what would your conclusions be.

Q (By Mr. Membrino) How would that help you?

THE SPECIAL MASTER: What would they be?

THE WITNESS: Okay. For example, here we may have habitat available for say young fish on this little shelf on the right-hand corner of the exhibit that I'm referring to. That habitat may be lost with a lower flow, it is no longer available to the fish, so habitat may be lost in this particular case.

Q (By Mr. Membrino) And why would you pay particular attention to that little shelf?

THE SPECIAL MASTER: He just answered that, I think, because it's a habitat portion that will be lost and it wouldn't have any water for little fish.

Q (By Mr. Membrino) Now, when you use your computer, you said you can take your highest measured flow, you went out in the field and made a measurement of stream flow. You testified then that the computer is able to estimate, if I'm correct, how much of the streambed would be covered between the headstakes up to two and a half, if up to two and a half times the highest measured flow occurred in the stream.

A That's correct.

Q Now, could you explain what -- what use that would be?

MR. WHITE: I am going to object, Your Honor. It calls for the rankest form of speculation. There's no foundation established.

THE SPECIAL MASTER: Well, it's sure hypothetical. I don't see, you know, you can punch in 15 times higher flow and you're going to get a nice big flood down in Ethete someplace. What does it tell us?

MR. MEMBRINO: We are discussing what we can learn from the computer. We are not punching in 15 times, we are punching -- we can only punch in a maximum of two and a half times of measured flow. If Mr. Vogel goes out to

the field and on a given day discovers what the highest measured flow is --

THE SPECIAL MASTER: Well, is Mr. Vogel going to tell us that you can learn more from the computer than the sum and totals and answers to the problems that you punch into it? If he is, then we better make a special record of this because it's of great news to the world.

I believe all that computers can do is solve some of the problems you ask it to, and his input is what is important.

MR. MEMBRINO: That's right.

THE SPECIAL MASTER: He's putting into the computer the fact that there can be a methodology which says that you can have flows as high as two and a half times more than your high flow?

THE WITNESS: Right.

THE SPECIAL MASTER: All right. What does that tell us?

MR. MEMBRINO: He is also putting something else in.

THE SPECIAL MASTER: May I ask him that? What does that tell you?

THE WITNESS: It may tell us at a higher level there is completely different habitat conditions then. There

may be more streambed material.

THE SPECIAL MASTER: What purpose is it when your job is to give us evidence to make a legal or reasonable conclusion of what flow requirements are, to sustain the fish life that was in that stream?

THE WITNESS: Okay. Fish selects optimum conditions in its environment. Fish in a stream have particular preferences for, say velocity. They much more -- some species prefer velocity of two feet versus ten feet per second. That might be adverse conditions. In other words, high levels of flow might actually be detrimental to fish, they don't prefer those conditions, in other words, flood conditions, flows less than [illegible] may be preferable. A computer's going to let us know what those conditions look like at different flows.

THE SPECIAL MASTER: I must confess to all of you that this has left me less certain in what I am doing than anything else so far, and we have been over some pretty difficult ground.

MR. MEMBRINO: Your Honor, we certainly hope we can clear that up. I think -- I think there is a method to the method and as the examination continues we will draw that out.

THE SPECIAL MASTER: Okay.

MR. MEMBRINO: We have been going rather heavily for

a bit. I was wondering if we could take a break.

THE SPECIAL MASTER: Surely. Let's take a ten-minute break.

(Thereupon a ten-minute recess
(was taken.

* * * * *

THE SPECIAL MASTER: All right. You may proceed.

MR. MEMBRINO: Thank you, Your Honor.

Q. Mr. Vogel, to make clear exactly what this methodology is all about for the Court, I would like you to recapitulate the objectives of the study, that is what we're trying to do.

A. The entire objective of the study is to establish what habitat would be preferable for the streams on the reservation. We want to try a range of flows.

THE SPECIAL MASTER: What habitat would be preferable for what?

THE WITNESS: For the fish in the streams on the reservation. We want to know what flows would be the best flows to have going through these streams.

Using this methodology, I believe it's capable of telling us in the final product what this optimum flow should be.

Q. (By Mr. Membrino) Okay, now explain again how --

THE SPECIAL MASTER: Well, is the optimum stream flow really all that important in this lawsuit, or is the minimum stream flow what we ought to be talking about?

Now, I throw that out, Mr. Membrino, and you may take exception to that.

MR. MEMBRINO: Well, maybe the question should be --

THE SPECIAL MASTER: Or you, Mr. Rogers,

MR. MEMBRINO: I think the issue here is what the incremental methodology tries to establish is the optimum habitat. Now the optimum habitat, as Mr. Vogel is going to explain, is not necessarily equivalent to the maximum flow. In fact, the maximum historic flow could create conditions in the habitat that are damaging --

THE SPECIAL MASTER: It is not synonymous either with the minimum stream flow because you may destroy and lose much habitat for fish, the smaller ones up on the edges where the water won't get.

MR. MEMBRINO: That's right.

THE SPECIAL MASTER: But isn't the purpose of the hearing to establish a minimum stream flow on where there should not be a draw of water to protect fish and fish habitat, rather than what you say now, to find an optimum?

MR. MEMBRINO: Yes, Your Honor. Well, our recommendations are made in terms of mean monthly instantaneous flows. We have determined that the optimum habitat will be in the month of January, a flow of 100 CFS, and in the month of June, it may be 150 CFS, and in the month of September, it may be 75 CFS, but that does not -- it is determined in the context of habitat availability, so we are looking not, for example, at stream flow records that USGS historically keeps, because all they tell us is how much water was there.

They don't tell us -- If we know that it was 200 CFS, we could not go out to a stream and know how that stream behaved without seeing that much water in the stream. So what Mr. Vogel had to do is set aside that kind of information, and using this methodology, go to the stream and actually see what this stream behaved like on the day he was there, at a given flow. And if it's -- if his first measured flow happens to be the lowest he encountered, he could describe exactly what the stream behaved like in terms of its depth, velocity and substrate with that much water in it. When he went back a month or two later, he would look at the stream again, and from the precise same place, see a greater flow in the stream, precisely measure that, and how the stream was behaving at that point; what kind of habitat it provided. Then go back a month later or two months later and his maximum measured flow, when he's using the IFG-4 methodology. Now, he got a lot of information and I know there was some question as to methodology, but I think he's testified that so far he will have acquired exactly a picture for the computer of what the streambed looks like between the head stakes, so the actual streambed is in the computer. He is also able to tell the computer --

THE SPECIAL MASTER: The streambed is not -- is of little relevance to what we are talking about, isn't it?

MR. MEMBRINO: It is of great relevance.

THE SPECIAL MASTER: I thought the morphology of the streambed had little to do with the levels. And I don't see this relationship, but I guess that's because I'm not grasping the subject matter, and I apologize probably for that.

Mr. Rogers, you had something you wanted to address?

MR. ROGERS: Your Honor, I was just trying to address your inquiry about optimum versus minimum, and I think you have to ask minimum for what purpose, or to what result. And the answers that Mr. Vogel will give are going to relate to what we are putting forth, the government is putting forth, as to optimum to maintain different species of fish, which are for us, minimum.

MR. MEMBRINO: For example, we'll know -- well, I don't want to anticipate Mr. Vogel's testimony, but in his outline, you can see that he is going to talk about fish preferences.

THE SPECIAL MASTER: Yes.

MR. MEMBRINO: That means fish prefering what kind of conditions in terms of what he's already testified to: velocity, depth and substrate. Now, it may turn out that the lowest measured flow on that graph -- on that hypothetical example, provides the optimum habitat for the species of fish that he will be discussing, and it could be that the maximum measured flow provides the worst habitat because of what is

there in the stream, what streambed material is uncovered, what material is covered, where there is shelter for the small fish to escape predators, where there's all sorts of information, the temperature on the stream, and that's what he's -- we mean to elicit.

THE SPECIAL MASTER: All right. I'll do my best to abstain from questioning. You proceed with your case.

MR. MEMBRINO: No, please advise us where we are not making ourselves clear.

Q. (By Mr. Membrino) Please continue then, Mr. Vogel, and again tell us what information you're attempting to provide to the computer, and what that information is able to do for us in terms of the ultimate objective.

A. Okay. As we said earlier, we have the two head stakes there, that we have a reference point, so using those head stakes, we have given the computer an outline of what this streambed looks like. So, as you said it earlier, the computer actually has a picture of what that cross-section looks like.

Now, we are not trying to predict flows. We are telling the computer, we are plugging in, saying for example, a thousand CFS. We are pushing that in the computer at a thousand CFS. What's the stream channel going to look like, how high or low is the water going to be, what is the velocity going to be like, what's the amount of substrate going to be covered,

how deep is the water going to be in each one of these sections? That's the information we want to know, and we are going to use that and apply it to what the fish prefer.

Q. But before you ask the computer that question, what have you given -- you have told the computer what?

A. We have given it the information at flows. We actually went out and measured. We actually went out there at several levels of flow and told the computer at these conditions, at these flows, we know these conditions exist. So the computer has that to build on, and it can use that. The computer has built -- the IFG has built this into the computer programs, so that computer is capable of predicting how high or how low the flows would be above this flow here, or in between these different flows, or even lower than that. And then the computer can tell us the velocities would be this, the substrates would be this, the depth would be this, and then we tie it in with what the fish prefer.

THE SPECIAL MASTER: How do you tie that in with what the fish prefer?

THE WITNESS: That will be step five, right here.

Q. (By Mr. Membrino) Can you introduce that briefly to the Master at this point.

A. Yes. I think at this point it would be valuable to refer to a figure in my report and in Exhibit 280 on Page 7, that's

Figure 2. These are preference curves for adult Rainbow Trout for velocity, depth and substrate. We are dealing now with only three physical factors: velocity, depth and substrate. Now, fish species select certain conditions in its environment that are optimum. In other words, if you put a fish in a certain stream, we believe the fish will actually go to the conditions that it likes the best. But it will also use conditions less than optimum, but the likelihood that it will use those conditions will be decreasing. For example, if we refer to this figure in the upper lefthand corner, the probabilities on the lefthand side of the graph, and velocities across the bottom, what that tells me is that the velocity of approximately 1.2 feet per second is the optimum flow that an adult Rainbow Trout prefers. That is, a velocity that the Rainbow Trout really likes. Now, if you have higher velocities from that, it prefers those velocities less until we get up to a point of three feet per second. It's highly unlikely that adult Rainbow Trout would prefer those flows. If it had its druthers, to make it simple, it would want a flow that was going -- or it would want a velocity of 1.2 feet per second. That's the optimum conditions it would like.

Likewise, for depth, you can see for obviously zero depth, they are not going to prefer that, because it is just

not preferable habitat, but for a depth of two feet and above, it is highly likely that Rainbow Trout will prefer that environment. If it's only one foot deep, there is a very little likelihood, there is a relative probability of only .2 that it would use that particular depth. In other words, if it had its druthers, in this case it would prefer depth higher than two feet per second -- deeper than two feet per second --

Q. Two feet deep?

A. Excuse me, two feet deep.

The same thing for substrate. I'll point out here the substrate scale we are using. It goes from zero to ten. That's a scale that's made relative to particle size, substrate size. For example, substrate value of six refers to cobble, a substrate value of five refers to gravel, a substrate size of four refers to sand. Increasing above that, a substrate size of seven would be boulders, and eight would be bedrock. So, in this particular graph, our substrate tells me that the particular substrate that Rainbow Trout, adult Rainbow Trout prefer, is cobble. Now, we have three physical variables that we know that Rainbow Trout adults prefer. Now, we can tie that in, back into this computer simulation model and tie it together now. This is our objective. We have

generated -- using the simulation, we have generated the hydraulics. We can simulate how deep the water will be at a certain flow, how fast the water will be moving. Now, we've got to match it up -- excuse me. Now we have to match it up with what we know the fish prefer. If at this particular flow it might be good conditions as far as depth, it is over two feet, or three feet deep, but these velocities might be way higher than what they prefer. So each one of these variables has a tremendous bearing on the habitat of the fish, and the assumption we are using that each one of them controls their habitat. These are physical factors that control the fish habitat.

Q. Could you tell the Court what fish you are actually dealing with?

A. As far as our study on the reservation, we dealt with four species of trout. They were: Rainbow Trout, Brown Trout, Cutthroat Trout and Brook Trout. In most of the studied reaches, we concerned --

THE SPECIAL MASTER: What did you do with the German Brown? I suppose -- I meant that to be halfway serious. Did you have a German Brown problem for a while, or do you know?

THE WITNESS: No, we used German Brown Trout as far as a fish species.

THE SPECIAL MASTER: So the four you have there are --

THE WITNESS: Rainbow Trout, Brown Trout, Cutthroat Trout and Brook Trout. In most of the cases, most of the stream reaches, we tried to model it for Brown Trout and Rainbow Trout. We considered them to be the most numerous species that we are concerned with.

Q. (By Mr. Membrino) How did you go about considering them?

A. First of all, I consulted with Dick Bauldis, the man I mentioned earlier. He is a fisheries biologist, he was my boss in Lander. He's been working there about eight or nine years. I believe he is very familiar with the reservation, and I understand that he was raised in that area too. He is an enrolled member of the Shoshone Tribe. I consulted with him, and I looked through our files in the Fish and Wildlife Service Office. We did have some information that was -- fish sampling information such as electrofishing, or seining, things such as this to see what fish were present where. And I have a little bit of personal knowledge myself on which species were present in different portions of the streams on the reservation.

THE SPECIAL MASTER: So now we have chosen which fish we want?

THE WITNESS: I have just stated them, the trout --

MR. WHITE: Excuse me, Dave.

Your Honor, I would like to object to further continuance

of this line of questioning and this answer with respect to those species of trout which are not native to the reservation. The claims being made here are presumably for an 1868 date. For instream flows for species of trout, with the exception of Cutthroat, which I think by anybody's reckoning, were not native at the time the reservation was created. As the witness has carefully explained, the particular preference of each species has a lot to do with the flows that are required for that species, and to proceed with facts and data based on non-native species, Rainbows, Brookies and Browns, would appear to be the basis of evidence which is not relevant to 1868, which I expect is the priority date which the United States would like to have these instream flows granted.

* * * * *

THE SPECIAL MASTER: Theoretically, I would imagine that that objection ought to be sustained. As a practical matter I cannot sustain it, Mr. White, and these aresome of the reasons why: Over the decades Indian and non-Indian alike has helped to deplete the numbers of all kinds of fish from Indian waters downstream from Boysen. And their replenishment, I think, was in the interest of both Indian and non-Indian; which kind of fish to replenish it with, what's the optimum condition for plentiful fish was of interest to both Indian and non-Indian in that area.

Now, that's not the reservation, however. Part of it is, part of it isn't.

I'd like to get on the record, give me some distinctions between what the native habitat fish would be and that of the introduced fish, but I'm going to overrule the objection for now with a flag in my mind there is something there that might --

MR. MEMBRINO: Your Honor, while that issue is before the Court, I'd like Mr. Vogel to address that question.

THE SPECIAL MASTER: All right, fine.

MR. WHITE: Well, I think the question ought to be asked so I would have a question to hear; the question, if it's based on his personal knowledge, if it's based on particular sources, then those sources ought to be

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stated or personal knowledge stated.

THE SPECIAL MASTER: He ended up, and some of my personal knowledge, he added to that which he had from the authorities.

MR. WHITE: So if Mr. Membrino would make a question, I'd just like to have a question.

THE SPECIAL MASTER: All right.

Q. (By Mr. Membrino) Mr. Vogel, have you made any investigation to the presence of native trout on the reservation?

A. Yeah. I consulted with a fellow by the name of Dr. Robert Behnkeat Colorado State in Fort Collins. He is,as I understand it, is an expert in the distribution of the fish species, in the genus salamo. Salamo, refers to the actual genus, like salamo garanarity is rainbow trout, salamo carki is cutthroat trout. So he's an expert as far as the distribution of these species of salamonics as far as the western United States. He's probably the foremost authority in that area. He's done extensive research on it and he's recently published a manuscript entitled something to the effect of -- I'd better not guess at the title of it, but it deals with the distribution of taxinomic characteristics of the fish of the genus salamo.

THE SPECIAL MASTER: Monograph?

THE WITNESS: It's a monograph. It was funded through the U.S. Fish and Wildlife Service.

In his opinion he said that what Mr. White said is correct, that cutthroat trout are the only true native species in the genus salamoi, the true native trout during 1868. The other fish species I mentioned, rainbows, browns and brookies were introduced at a later date. I further asked him, as far as what he believed the habitat characteristics would be like for the fish species present at that time. What, in other words, if cutthroat trout were present back then, what would be their preferences and in his opinion it would be very similar to what rainbow trout preferences would be. His rational for that, when these exotic species were introduced, they basically pushed the cutthroat trout, pushed them out of the water shed. A cutthroat trout is in simplistic terms, is a weaker species than rainbow trout.

They're capable of out competing cutthroat trout. Cutthroat trout have a higher tolerance of colder water so usually what happened, in his opinion, they distributed themselves to various portions out of the water shed. In most cases it was higher up in the elevations where colder water occurred. The rainbow trout and brownie

trout and brook trout don't have, if they were put in the same situation, in these higher elevations, colder water, at those locations, cutthroat trout are more able to compete with the other species. But at the lower elevations where we establish claims as shown on Exhibit 281, we're talking about the lower elevation streams on the reservation. Here the summer or the water temperatures during certain times of the year arehigher than what they would be in the higher elevations, so in those areas the exotic species that were introduced were capable of out competing cutthroat trout. But if -- I put a hypothetical question to him. If cutthroat trout were present now, in the entire absence of these new species, had been introduced, they would have very similar preferences to what rainbow trout exhibit. They have a similar preference for velocity, similar for depth, similar for substraight.

THE SPECIAL MASTER: What did he say to that?

THE WITNESS:. He believes they would.

MR. WHITE: I'm constrained to make my typical motion to strike on the basis of hearsay, Your Honor.

THE SPECIAL MASTER: I appreciate that, and if the roles were reversed I would be making the same motion, but I'm going to overrule it.

MR. MEMBRINO: However, Your Honor, it doesn't warrant

being sustained because he consulted with an expert who is a recognized authority in the field and as an expert he's entitled to rely on the opinion of an expert.

MR. WHITE: That's an interesting theory. We have our differences. I think we've got a brief on that particular issue and we stand on our brief.

THE SPECIAL MASTER: Go ahead with your question, Mr. Membrino.

Q. (By Mr. Membrino) Now, you said that you had the, you looked at fish preferences and you used an example of rainbow trout. Would you explain how you, how you relate the preference to the computer simulation of the stream reach and what happened from that relationship?

MR. WHITE: I object, Your Honor; lack of foundation. We do not have a description of a computer simulation of the stream reach.

THE SPECIAL MASTER: Will you give me the question again, please.

(Thereupon the following question
(was read back as follows:
("Q. Now, you said that you had
(the, you looked at fish preferences
(and you used an example of rain-
(bow trout. Would you explain how
(you, how you relate the preference
(to the computer simulation of the
(stream reach and what happened
(from that relationship?"

MR. WHITE: My point is, Your Honor, there is nothing before us that describes either the in: conceptual terms or specific terms, the computer programs to which he's referring. The programs, as the Court's painfully aware by now, obviously have listings. They're -- those listings are readily available, they should be presented as part of the foundation of this witness' testimony. It's an issue that simply can't be addressed by saying that the listings are available to everyone or the State should have the listings. There are roughly 103 programs or subprograms, sub routines in the IFG library that are updated virtually continually, and to know which particular listing or which particular program the witness used is virtually impossible unless he identifies it by way of program listing. On that basis I object to the foundation.

THE SPECIAL MASTER: Did you cross this material in the deposition and discuss this in the deposition?

MR. WHITE: We didn't discuss the program, Your Honor.

THE SPECIAL MASTER: Are you familiar with what specific program you applied this information to?

THE WITNESS: The ones we've already referred to.

Q. (By Mr. Membrino) Would you reiterate them.

A. The hydraulic simulation or IFG2 and IFG4.

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Q. Did you give testimony about that in your deposition?

A. Yes, I believe I did.

Q. Thank you.

MR. WHITE: Your Honor, the point is IFG2 and IFG4 programs are updated, I wouldn't say daily, but very frequently. And if you were to use, if you were to seek the program for IFG2 and IFG4 today, with a hundred percent certainty they're going to be different than those Mr. Vogel used. It seems to me to be a very fundamental question. We're entitled -- the Court's entitled to have the answer to see whether or not there is adequate foundation for the answer which is sought by the question, and foundation objection again is where -- what programs specifically were used, not just IFG2 or LFG4. They changed frequently, but the program listing for the particular programs which were used as part of this witness' own personal specific analysis.

THE SPECIAL MASTER: I'm going to overrule the objection knowing that you will bring out any differences in the program listings, should there be some, from the time he applied it and the time as it now exists in the computer software.

You may answer.

Q. (By Mr. Membrino) Would you tell the Court what you did

use and how you used it. We want to get, get before the Court just exactly what you did use of the IFG incremental methodology.

A. Okay. Now, we're tying steps 4 and 5 together, we're actuallytying what the fish prefer with what the computer is telling us, what IFG2 and IFG4 are telling us.

What we do is we use these fish preference curves that I refer to on page 7 of Exhibit 280. Now, the IFG has -- is maintaining these, they call them, for short they call them fish files or FISHFILS, I'll just call them fish files. Within these --

THE SPECIAL MASTER: And that deals with the term habtat, when you use it in your report, h-a-b-t-a-t?

THE WITNESS: That is a portion of habtat. The fish files are contained within habtat. Now, this brings us into the third computer program. This is where we're actually going to tie these two together here. We use IFG2 and IFG4 and we're going to tie in habtat. We're going to use the two to generate the habitat information.

Q. Could you, to make sure everyone understands the relationship of those differentterms and the programs, maybe if you could pull out one of those, one of those blank tables and draw a little organization chart showing what is a function, what in terms of habtat, fish file and the others.

A. At step 4 the hydraulic simulation portion, we used either IFG4 or IFG2. As we stated earlier, either one of these programs gives equal reliable information about the hydraulics of the stream, simulated hydralics. Now, we want to tie in fish preferences. That's where the third program comes in, habtat.

And as a part of this program are these fish files, these curves that I refer to in figure 7 of my report.

IFG simply refers to it as FISHFIL, all capital letters. Now, these aren't interchangeable. FISHFIL is similar; it's a portion of habtat. So we use the hydraulic information that's generated in computer simulation from either one of these models and feed it into the third program, habtat.

Q. Just to make this clear, IFG4 and IFG2 are what you use at step 4 of your outline; is that right?

A. That's correct. Now, we're tying in step 5, the fish preferences, to generate what the actual habitat is going to be.

A. So there's two things of concern here: the fish preferences. And knowing the fish preferences, tying it in with the hydraulic information, we can generate fish habitat or as the IFG refers to it, as weighted usable area.

And I'll just carry it one step further just to complete the outline. Going through again, okay, we have simulated the hydraulics. We have run it through what we know the fish prefer, and we have plugged it in, a bunch of flows, just to see what they were like. Okay, we tie the fish curves in with what these different flows are, and we generate habitat conditions at each one of these flows. Then that gives us a chart to go by. We'll have a chart of what's called in IFG Methodology, weighted usable area versus flow.

I'll just use an example out of my report to show you what I'm talking about here. On Page 23, this is that graph I just referred to as weighted usable area versus flow. Okay, so at this point we have what the habitat looks like at different flows that we have asked the computer to run through. Okay, this graph here on Page 23 is a product of that.

Q. We have a larger exhibit over here, maybe that would be helpful to use and find the corresponding one in the report.

MR. MEMBRINO: I'm now referring, Your Honor, to United States Exhibit WRIR-C-284.

Q. Mr. Vogel, would you please identify that?

A. That's a graph of weighted usable area versus flow for one of my particular study sites. This study site happens to be the reach of stream in the Big Wind River below Bull Lake Creek down to Diversion Dam.

THE SPECIAL MASTER: It really isn't really Page 23 in the exhibit, however?

THE WITNESS: No.

Q. (By Mr. Membrino) Could you find that in your report?

THE SPECIAL MASTER: It isn't 24 either.

THE WITNESS: Let's see. It would be Page 32.

THE SPECIAL MASTER: Thank you.

Q. (By Mr. Membrino) So Exhibit 284 is reproduced in your report at Page 32?

A. That's correct.

Okay, now at this point, the computer is now giving this graph, and it's telling us what the fish habitat in that particular reach of the stream looks like, and all of the entire range of flows.

Now we'll refer to U. S. Exhibit C-284 and call your attention to the curve on the very top of the graph. You can also refer to Page 32 in the report. That curve

represents the habitat that's available to adult Rainbow Trout in the reach of stream on the Big Wind River, from the confluence of Bull Lake Creek down to Diversion Dam. This is telling us the habitat availability per thousand linear feet of stream at these ranges of flows I've plugged into the computer. And as you can see, there is an increase in habitat with an increase of flow up to approximately six hundred CFS. Higher flows beyond this result in a decline of habitat for adult Rainbow Trout.

I have carried this all the way through to the end quickly just to kind of give you a broad overview of what we are trying to get to.

Now, using this graph here, I am able to come up with my final flow recommendations.

THE SPECIAL MASTER: For that portion of the river only?

THE WITNESS: For that portion of the river only.

THE SPECIAL MASTER: Which were three hundred to five hundred CFS.

MR. MEMBRINO: On Page 30, Your Honor, it is set out in tabular form, the recommended mean monthly instantaneous flows for that portion of the stream.

THE WITNESS: Okay, understand now that we are only talking about one particular species of fish, adult Rainbow

Trout. In that particular reach of stream that we are referring to, we also looked at the habitat for Brown Trout, which would be the page immediately in front of the one we are talking about, on Page 31. If you look at that page, follow the curve for the line that's connected by the triangles pointed upwards, and you can see that the peak habitat occurs at approximately four hundred CFS. So here we have a condition where Brown Trout would prefer a flow of four hundred CFS, and Rainbow Trout would prefer a flow of six hundred CFS. So to come up with a flow that would be good for both of them, I recommended five hundred CFS. So I have carried it all the way through to the end.

If I can find my marker here, I'll finish the flow diagram.

THE SPECIAL MASTER: What if there were testimony that there should not be the same habitat for Brown and Rainbow in the same stream, what would your testimony be to that?

THE WITNESS: What if other testimony --

THE SPECIAL MASTER: What if other testimony were to come before us that there ought not be an optimum condition created for Brown and Rainbows in the same stream, because there's some basic antagonism between the two fish, what would you say about that?

THE WITNESS: I guess I don't understand your question.

THE SPECIAL MASTER: Let's see if I can make it a little more simple: What if an expert were to try to say you shouldn't try to make optimum stream conditions in a stream, or the same stream, for Brown and Rainbow Trout, because there is a basic antagonism between the two breeds for optimum conditions?

THE WITNESS: You might be saying we should prefer one species over the other?

THE SPECIAL MASTER: Sure.

THE WITNESS: My experience is that Brown Trout and Rainbow Trout can coexist with no problem, so there wouldn't be a reason to prefer one over the other. We could, however, -- We gave equal weighting to both of them. We could, however, say okay, we're going to take just Rainbow Trout and forget the Brown Trout, and go with the six hundred CFS or vice versa. Just take only the Brown Trout and have a recommendation of four hundred CFS.

THE SPECIAL MASTER: Why did you do it the way you did?

THE WITNESS: We just give equal weights to Brown Trout and Rainbow Trout, since they are both species that are present. We didn't have any particular reason to prefer one species over the other.

THE SPECIAL MASTER: Go ahead, Mr. Membrino.

Q (By Mr. Membrino) While we are on Exhibit 284, Mr. Vogel,

I noticed that there are a number of other curves on that graph. Would you explain what they represent?

A. Yes. These curves show all the life history stages of Rainbow Trout. The one I just referred to was the adult life history stage. The curve immediately below that refers to the life history, the life cycle. This is the incubation of the eggs after they have been spawned. The one immediately below that, that's basically a line connected between the circles, is the life history stage known as juveniles. These are your fish that are smaller than the adults. The one immediately below that, the line connected between the squares, is the fry life history stage --

THE SPECIAL MASTER: Is the what?

THE WITNESS: The fry. These are fish that are smaller than juveniles, yet they have already hatched from the eggs. And the one immediately at the very bottom is the life history stage that deals with spawning habitat. In this particular study, we eliminated spawning and incubation as far as our analysis. I do not believe that on the reservation spawning habitat is uniformly distributed among the streams on the reservation, so I did not want to bias my selection process by going out and actually picking spawning habitat. My rationale was to chose only the adult life history stage. We did look at the fry and juvenile history stages, however,

to make sure that we we weren't doing something that would be detrimental to those life history stages. I believe if we could make the habitat satisfactory for the adults, that the optimum -- or the habitat for the frys and juveniles would also be adequate.

Q (By Mr. Membrino) Now, in using three life history stages, how many trips do you make to the fish-fowl library to determine the fish preferences?

You have on Page 7 of your report the preference curves for the adult Rainbow Trout. Did you limit yourself to the adult Rainbow Trout curves, or did you look at other curves as well in coming up with your flow recommendations for each species of fish?

A. No, as I said earlier, we also looked at the -- we were concerned also with the fry and the juvenile life history stages, so that each one -- this figure you're referring to on Page 7 is only for the adult life history stage. There's three physical factors we are looking at: depth, velocity and substrate.

Now, juveniles have a particular preference of depth, velocity and substrate, as do fry. They may prefer less velocities in the stream, they may want to have less depth in the stream than the adult would, so we also did examine those life history stages.

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Q. Now, if you could return to Exhibit, I believe it is 283, could you briefly recapitulate how the information that you got for each subsection relates to your determination of fish preferences and ultimately, habitat?

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A Okay. We are back up here again, we're right in between the steps four and five. We have simulated the hydraulics, the stream through use of the computer models. It's telling us what the hydraulics and what the fish or -- excuse me, what the hydraulics and what the flows would be like. We know what the depths would be like and we know what the substrate would be like and a range of flows.

Now, I'll, refer I'll refer back to Exhibit C-282. Now, what we are doing, remember we are simulating the entire stream, the entire study site here, and the study site I believe is to be representative of the entire stream reach. So, we are working from the small and we are going all the way to the large.

We run a flow, we'll have a computer run a flow through the entire computer study site. When it does that for each of the subsections, it's telling us, say for example, the hundred cfs, the mean velocity in that subsection is maybe going to be two feet per second, the average depth is going to be three feet and substrate on the bottom is going to be cobbled. Okay. If I run another flow through it, say twice the amount of flow, that means velocity is going to increase, the depth is also going to increase. However, the substrate will remain the same.

So, we will run a range of flows through the study

site, through the use of the computer models and the step is to tie in with what the fish prefer, and this is done in habtat; we are going to use the fish curves here, the fish preferences and tie it into these sub-sections.

Now, we are going to bring a new term in here. It's called composite probability of use. What that is is tying all three, velocity, depth and substrate together. Up to now when we talk about the probability of use or likelihood of use, we're talking about only a particular variable, be it the velocity, depth or substrate. Now, we're going to tie all three together and we're going to come up with a composite probability or relative likelihood of use that a fish may use in certain combination of each one of those perameters. For example, we'll stick right with the ones we have for Rainbow Trout. I refer you to both that figure and on page 7 of Exhibit 280 and page 6 immediately before that. And I'll call your attention to the last paragraph of page 6, the second sentence. I'll read from the report. "In a subsection of a transect, see figure one, the measured velocity is two feet per second with a depth of 1.3 feet, has a substrate of 6.0. The CPUF" -- which I said earlier is --

THE SPECIAL MASTER: Flow. What's the F?

THE WITNESS: Excuse me, I'm sorry, I didn't mention --

THE SPECIAL MASTER: You said composite possibility use of flow.

THE WITNESS: I'm sorry, that would be factor.

THE SPECIAL MASTER: Thank you.

THE WITNESS: "The composite of use factor in this example for adult Rainbow Trout is", and then it's got a range of numbers, multiplied with a product and I'll show you by referring back to page 7 how I arrived at those numbers.

Now, for the sake of example, we'll use this particular subsection here to make it more graphic for you. We have one, one particular flow through the study site through the use of the computer programs. Now, remember, there's an entire, there's a tremendous quantity of subsections through this entire study site as referred to earlier on page 4 of the report.

Remember, there's many subsections here. Each one of them has a unique combination of velocity, depth and substrate. Each one might be a little bit different.

Just now, for this example we'll just use this one particular subsection. And we'll say that that particular subsection, at a particular flow we run through the computer, has a measured velocity of two feet per second, has an average depth of 1.3 feet and has a substrate value

of 6.0 or its cobble on the bottom there.

Now, we want to know how that relates to the fish. So we refer back again to the figures on page 7. Okay. We said the depth in that subsection, or excuse me, the velocity in that subsection was two feet per second. What does that mean in terms of Rainbow Trout and what they prefer? So you look at the graph for velocity versus the probability of use for adult Rainbow Trout and follow it up to where the line, the graph connects to two feet per second. Read over to the left and you see that it's .62 -- excuse me, .61. That's the relative -- .61 is the relative likelihood that adult Rainbow Trout would prefer two feet per second.

Q In another way, does that mean there's a 61 percent chance that the fish would turn up there?

A No, that's dealing in terms of true probability. We are dealing in terms of relative probability in comparison of other flows.

Okay. That's our first number that we've come up with is .61.

Now, we said that that particular subsection here on the exhibit is 1.3 feet deep. Now, we look at the graph or depth versus probability for use of adult Rainbow Trout on page 7 and we read the coresponding figure

off of that. We said 1.3 feet. Following that up we find out that's the relative probability of .4. If I'm losing somebody, please let me know.

So that's our second figure. Now, our last figure for the substrate value, we said that it's got a substrate value of 6.0 or as I said earlier, it represents cobble in this particular subsection. We refer to, again, page 7 in the figure and we find that that happens to be the optimum substrate that Rainbow Trout prefer. In other words, they have a relative likelihood of use of 1.0. So that's our three figures, that's our three probability of uses. We multiply them together and we get a composite probability factor of .24. Now, remember this is referring only to this particular subsection. We haven't gotten to the other subsections yet.

Now, habtat, the computer, the computer program referred to here that has these fish files which was extracting this information, remember, fish file here comprises these graphs such as the one I showed on page 7 of the report.

These are the actual preference curves for adult Rainbow Trout. Remember, there's other preference curves that we'll get to, but right now we are dealing with adult Rainbow Trout.

Okay. We've determined now what the different relative probability of uses are going to be at this given range of these different substrates for velocity, substrate and depth. We got a composite probability use factor of .24.

Now, in our study site, since we've fed all this information in terms of distance, depth, everything like that, the computer knows how large of an area it is, it knows that in square feet. It knows that because we measured the distance between the transect and the difference between the headstakes on each transect, and it knows the distance between each corresponding boundary on the subsection. So the computer knows how big of an area that is in square feet.

Now, I'll refer you back to page 4 of the report. This is Exhibit C-280. The harvest area shown here is simply one subsection, but we want to know what all these subsections look like. Each one of these subsections has a particular combination of depth, velocity and substrate. It's got a unique value assigned to each one.

Now, using habtat, it's capable of going in there and for each one of these subsections, it's telling us what the velocity is going to look like, what depth's going to look like, what the substrate available to the

fish is. And has all the ones that have similar characteristics. In other words using this example we've stated previously with the velocity of two feet per second, a depth of 1.3 feet, a substrate value of two, the computer looks through the entire study site and it finds how many of those subsections have that identical combination of those parameters. And it just simply adds them all together as shown in figure 1.

There must have been, oh, more than a hundred subsections there. Say out of five of them, five of these subsections had that particular combination of depth, velocity and substrate. It would simply add them together and come up with the total square feet within our study site that would have those combinations.

Okay. Now, --

Q Is that process repeated for all different combinations of velocity, depth and substrate?

A That's right. It sums up the, those combinations for each one of those variables.

Okay. Now, we want to know what the total area of optimum habitat is going to be. Now, remember we come up with a composite probability of use factor, the CPUF of .24. Now, the computer adds each that have that particular combination of variables and finds out, for

example, there's a thousand square feet within the study site that has that particular combination of variables. We just simply multiply the .24 times the thousand and come up with 240 square feet of optimum habitat for adult Rainbow Trout for that particular combination of depth, velocity and substrate.

Now, we do that again for each other subsection that has a little bit different combination of variables. We carry it right on through, we assemble them all, multiple it times a particular composite probability factor. It might be different, it might be .8. If it's got a thousand square feet of land, it would be .8 times a thousand square feet or it would be 800 square feet of habitat.

Now, we are almost to the end here. What we do, we sum all those optimum habitats, we sum the 240 square feet we had for this one and all the others, we summed the 800 square feet, we sum all of them and come up with a final value of optimum habitat within the study site.

It may be 40,000 square feet of weighted usable area. This is the optimum habitat.

Now, the IFG makes this relative to a thousand linear feet of stream. That's for comparison purposes. If we want to compare one stream with another stream or if we want

to compare one species with another. Remember, in this example we only used adult Rainbow Trout. If we wanted to know what it looks like compared to Brown Trout, we have a relative comparison.

We can refer to it as a weighted usable area or habitat per thousand linear feet of stream. I'll go back again to Exhibit C-284 and show you what the results of all this work gives.

THE SPECIAL MASTER: The page on that again for our drawing is page what?

MR. MEMBRINO: 32.

THE SPECIAL MASTER: 32, thank you.

THE WITNESS: Okay. Looking at only adult Rainbow Trout now, for example, the computer's telling us, I've plugged in the computer a range of flows. It goes from 200 cfs up to 1300 cfs. In other words, I'm asking the computer to run this water down our stream and tell us what the habitat's going to look like for adult Rainbow Trout. And this is the result of that work.

As you can see where 200 cfs, excuse me, you can see from 200 cfs up to 600 cfs. There's a substantial increase in habitat for weighted usable area in square feet.

* * * * *

A. Now, these figures here are habitat per thousand feet of linear stream. Now, we compared that also with the other life history stages. Once we plugged them through this entire process, this is why, right here, why we need a computer --

THE SPECIAL MASTER: You were going a little too fast. The weighted usable area in square feet on the left of the diagram is per -- it is the weighted usable area in square feet for per one thousand what?

THE WITNESS: Linear feet of stream.

Yeah, please slow me down if I go too fast.

THE SPECIAL MASTER: That's all right, I appreciate your answer.

By using the various transects set along your study areas in between your study areas where you have conditions so much different than that which you have analyzed with this concept, you can't find every good attractive deep hole in a 40-mile stretch, for example, between Diversion Dam and Crowheart --

THE WITNESS: That's correct.

THE SPECIAL MASTER: What is the study site intended to represent? To extrapolate --

THE WITNESS: To extrapolate. It is intended to represent what the general conditions, what the entire

stream reach looks like.

THE SPECIAL MASTER: Would you move that map down for me, please, for my next question?

THE WITNESS: Sure.

THE SPECIAL MASTER: How many study areas did you have in that forty-mile stretch of the Wind River, for example, between the two large hashed Xs on --

THE WITNESS: These? Exhibit C-281?

THE SPECIAL MASTER: On Exhibit C-281.

THE WITNESS: This particular reach referred to as 2 we had one denoted by the yellow dot.

THE SPECIAL MASTER: You had one study area on that 45-miles?

THE WITNESS: Right. This particular study area happened to be, I'll give you a relative idea of distances involved, I believe, if my memory serves me correctly, it happened to be, I think, about a third to almost a half a mile long from the downstream transect to the upstream transect.

MR. MEMBRINO: That is the study site.

THE SPECIAL MASTER: And was it one you looked at on C-282, the one that actually went into this stretch on C-281 that you just referred to? That is held -- Is the transect exhibit of C-282 actually the one that is spotted

with a yellow cirle in between the figure 2 -- or is it the one near South Crowheart Butte?

THE WITNESS: Oh, no, this is just an example transect.

THE SPECIAL MASTER: I see. Thank you.

Q (By Mr. Membrino) Would you please recapitulate how you feel you can extrapolotate from that study site?

A Okay. Again, we broke the rivers and streams on the reservation into what I believe were relatively homogenous segments. In other words, in my opinion, from this area, in the upper left-hand corner of Dinwoody Creek on Exhibit C-281 down to Bull Lake Creek, I believe there was no significant change in the fish habitat. There was no significant amount of water coming into the stream or there was no significant amount of water coming out of the stream. The general channel shape throughout there was basically the same. The basic substrate, the type of cobble or sand, whatever it may be, is basically the same in that entire stretch. The general fish habitat as far as the pools and riffles, things like that. Theoretically, if I would compare this, put another study site up here, (indicating), I would eventually come up with the same recommendations as I did at this study site. These study sites are simply to represent what the stream may look

like in this entire homogenous segment.

Q. So the study site you selected there, which you described as being about a third of a mile long, you considered to contain the characteristics that were -- could be found on a random basis anywhere else in that homogenous stream reach?

A. That's correct. Whatever characteristics were present at the study site, I believe, were also representative of the other portions within the stream.

Q. Now --

THE SPECIAL MASTER: Would you say that's true down on the study area between 11 and 12 on the Popo Agie? The North Fork of the Popo Agie? Is that what that is? -- Oh, that's on the Wind, the Little Wind, rather.

THE WITNESS: Right. This is on the Little Wind.

THE SPECIAL MASTER: You would say that was true also of that one between 11 and 12?

THE WITNESS: Are you referring from this hash mark --

THE SPECIAL MASTER: Yes.

THE WITNESS: Yes, sir. The study segment shown there, I felt, was representative of the reach of the stream from here to there.

THE SPECIAL MASTER: Which is a distance of how long?

THE WITNESS: I believe that was roughly, just going

off the top of my head, was about 40 miles. I can't remember entirely, but it was something about like that.

THE SPECIAL MASTER: Uh-huh, thank you.

Q (By Mr. Membrino) Now, I want to understand then, after you have made your calculations for all the subsections on the study site and computer weighted usable area in terms of the study site, how do you extrapolate that or do you extrapolate that to the entire stream reach?

A. Yes, I do. Remember, in this example, we used -- we'll stick to the one we have on the graph over here. On Exhibit C-284 we came up with a flow recommendation, so we compared both rainbow trout and brown trout. You remember, brown trout, the optimum flow of 400, and rainbow which is 600 c.f.s., we simply averaged them to recommend a flow of 500 c.f.s. Now, this chart right here is talking about the flow through the study site and making it relevant to 1,000 linear feet of stream. Now, I'm using that information in Site No. 3 on Exhibit 281 and extrapolotating that flow recommendation of 500 c.f.s. for this entire reach of the Big Wind River.

Q Now --

THE SPECIAL MASTER: Between where Bull Lake Stream comes in and the Diversion Dam --

THE WITNESS: Yes, that's correct.

Q (By Mr. Membrino) Now, to return to a matter that the Court raised some time ago about the extrapolation of information with your computer, I notice on Exhibit 284 that the curves on your -- that's Page 32 of your report, the curves on your graph start at the 200 c.f.s. mark and they terminate at the 1300 c.f.s. mark at the right edge of the graph. Why is that? Is there a reason for why those are the limits of the curves?

A On this particular graph?

Q Yes.

A Yes, there is. I recall that the 200 c.f.s. was our lowest limit we could extrapolate. That was .4 times our lowest measured flow in the field. Which, maybe this flow, may be a flow represented like this on Exhibit 283 (indicating).

Q That is then the lowest measured flow which is the lowest measured line on that exhibit which is the lowest horizontal line on that exhibit, which is what, 283?

A Right.

Q Was that information gleened from that measurement regarding velocities, depth and substrate, those are hard facts that you got that were plugged into the computer and the computer was able to take that and calculate what .4 of that would produce in terms of the habitat preferred by the -- well, all life history stages or the three life

history stages of the trout under consideration?

A. That's correct.

Q. Now, if you would reset that -- Maybe on the other -- maybe in front of the other exhibit.

Now, so that is the reason why those curves don't start over at the 100 c.f.s. or, in fact, at the left side of the graph?

A. That's correct. We could not, according to the IFG methodology, we could not statistically extrapolate to flows lower than 200 c.f.s. They would not be statistically sound, so we did not attempt to do it.

Q. And a further question then: The curves depicted on that graph are the product of real information that you extracted in the field and plugged into the computer and then interpolation and extrapolation of that information of that information by the computer?

A. That's right.

Q. And going to the extreme right side of the graph, I see that the lines continue right up to the edge.

A. Right, at 1300 c.f.s.

Q. Could you explain what went on there?

A. Okay, the highest calibrated flow, as best I can remember for this particular study site, was about 1800 c.f.s.

Q. And that would be the top line on -- hypothetically, that

would be the top line on Exhibit 283?

A. That's correct. That's correct. However, I only have 1300 c.f.s. represented here. 1800 c.f.s., if you extend it over further, over to the right on this exhibit, C-284, I did run it through once, and I found out that it was just a continuous habitat decline at higher flows. So, in other words, at this particular flow here of 1800 c.f.s., there was a substantial decline in habitat, so it wasn't necessary for me to show that on the graph. I simply limited it to the 1300 c.f.s.

Q. So that's an example then of a situation if more water, if it were available, would produce continually deteriorating or unpreferrable habitat?

A. That's correct.

This, for example, fish would prefer flows of a lesser nature.

THE SPECIAL MASTER: For the adult?

THE WITNESS: For the adult life history stage.

It is also true on this particular example that the same is true før the fry -- I mean, excuse me, the fry and juvenile life history stages. You can see they prefer -- as the flows increase, their habitat decreases.

THE SPECIAL MASTER: Is it fair to assume as a layman that the incubation would probably disappear after that

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fast a stream, that it was probably too fast for the fish to even --

THE WITNESS: At what flows?

THE SPECIAL MASTER: Faster than 11, 12, 13. You're practically -- you go from 200 feet down to 800 feet, and at 1,000 feet they virtually disappear.

THE WITNESS: It may be. You might eventually reach velocities that are so incredibly high --

THE SPECIAL MASTER: When you tracked that through, did you come up with a figure of incubation at which there was virtually no productivity?

THE WIENSSS: Yes, on this particular site, we did have a little habitat, spawning habitat, available. It was tied in with the substrate itself. It's tied in with the gravel. Gravel is usually what trout prefer to spawn in. It just happened, like I said earlier, we didn't go out and try to look for spawning habitat. It was there, it was okay, but we didn't really use it in our analysis.

Q. (By Mr. Membrino) Now, related to that on Page 53 of your report, Exhibit 280, I believe the graph there seems to indicate that there appears to be no spawning habitat, is that correct? It runs right along the bottom of the graph?

A. That's correct. I believe the reason for that is there didn't happen to be any gravel present within our study

site.

Q And could you explain once again why you didn't insure for a representative sampling that you investigated a site that did have spawning habitat in it?

A. In my opinion, as a fishery biologist, my experience has shown that spawning habitat for salmonoid is not uniformly distributed throughout a stream; and so if we attempted to actually sample that spawning habitat, I felt we would be biasing our sample. We would actually be going out there and choosing, okay, there is an area we want to choose. I wanted to try to eliminate as much bias as possible, so I did not specifically look at spawning habitat.

Q Okay.

THE SPECIAL MASTER: I'll go on through unless somebody wants a break.

Are you all right?

MR. MEMBRINO: I would like to take about a five-minute break.

THE SPECIAL MASTER: All right; we'll take about a five-minute recess.

(Recess, 3:29 p.m.

* * * * *

THE SPECIAL MASTER: Okay, come to order, please. Go ahead, Mr. Membrino.

MR. MEMBRINO: Thank you, Your Honor.

Q. (By Mr. Membrino) I just want to clear up one point before we continue, Mr. Vogel. We have described the various measurements you have made in your field work at the transect sites. You described -- Could you very briefly recapitulate each of the measurement techiques that you used for velocity, depth and substrate.

A. When we went out to our transects and made our particular measurements at each one of these hash marks used in Exhibit C-283, we used current meters to determine the speed of the water.

THE SPECIAL MASTER: Current meters?

THE WITNESS: Current meters. We used actually three different types of current meters which all give the same equal reliable results.

We actually lowered the meters down at the proper position in the stream to take those measurements.

Remember, I talked earlier, if the water was over two and a half feet, we take a high and low to get the average mean vertical velocity. In some of the deep water in the Wind River Canyon, in the deep pools we had to string a cable across there and attach our boat to that cable and

use a winch with a cable with a big lead weight lowering a current meter up and down so as to position it properly in the current, in the stream. We did that for each one all the way across the stream. As far as the depth --

Q. (By Mr. Membrino) Before you get to that, your readings were expressed from the current meter in terms of what?

A. Feet per second.

Q. Okay. Please continue.

A. In terms of depth recorded, those, in terms of, to the nearest tenth of a foot in depth, and those were measured directly. We had what's referred to as a weighting rod, it's the actual rod that we actually attach our current meter to position it at the proper place in the stream. It's got gradiations in tenths of feet right on the rod. We just stick it in the water and read how deep it was. In terms of the third and final measurement, substrate, we'd make an estimation of actual size of the material. In the streambed, if it was cobble, it was in between about three inches to ten inches in diameter of X material, we said that was cobble. If was a material over that, it was called a boulder, and we gave those a value. For example, cobble, as I said earlier, is 6.0. Gravel, if it was smaller, say roughly about three inches to, down to say a couple millimeters in diameter, that was a value of 5.0.

I would also like to mention something I didn't bring out earlier, that when we get that value, there were times when in one section we didn't necessarily have a hundred percent cobble, or a hundred percent gravel. We might determine there was ten percent gravel and remaining ninety percent was cobble. We did have a little mixture in the subsections, and the way we handled that in our scale, if it had that particular value, ten percent gravel or 5.0 or 94 cobble or 6.0, it would have a value of 5.1. If it was half and half, 50-50, it would have a value of 5.5. In other words, half cobble, half gravel.

THE SPECIAL MASTER: Let me ask this question: And in every instance, was it by visual examination of the substrate that you concluded whether the value was six or higher, or was it something else?

THE WITNESS: In every instance except the cases where we couldn't physically get to the bottom, like say it was nine feet deep. I made a judgment decision on that. If, say this was nine feet deep in the center portion of Exhibit C-283, I would visually observe what the substrates were on the side, on either side of the stream, and we went in the middle with our boat, I could give a rough feel for the bottom with the lead weight on our cable. I could tell whether it was soft mud, whether it was bedrock or boulders, or cobble, and

decided the value that way. I didn't necessarily see it though.

THE SPECIAL MASTER: Thank you.

Q. (By Mr. Membrino) Now, the range of values that you assigned to substrate, numerical value ranged from what to what?

A. I believe the smallest value we had was mud, which is about I believe 2.0 up to bedrock. I believe that was 8.0.

THE SPECIAL MASTER: On what scale was that value? That wasn't on your Page 7, Probability and Substrate, was it? Your values there are from zero to ten.

THE WITNESS: If I may, I'd like to refer to the actual substrate scale to answer your question.

THE SPECIAL MASTER: Okay.

(Brief pause.

THE WITNESS: I'll have to get my other briefcase.

MR. WHITE: Off the record.

(Brief pause.

* * * * *

A. I have here a scale of the substrate values that were used in the study, and the highest we used was 8.0, and that was bedrock.

Q. (By Mr. Membrino) Was the scale open-ended or has it got definite limits.

A. I considered bedrock to be the upper limit. Quite frankly, I don't know what 10.0 represents.

Q. Okay --

THE SPECIAL MASTER: Well, what does six represent on your scale that you just alluded to, the one that was your work paper. What is six?

THE WITNESS: A cobble. 6.0.

THE SPECIAL MASTER: And cobble you earlier defined as being a series of rocks from three inches in diameter to about ten?

THE WITNESS: About ten inches, right.

THE SPECIAL MASTER: And what is the lowest end of the scale that you worked on on your work paper, was that two?

THE WITNESS: Right, it was considered mud.

THE SPECIAL MASTER: Okay. Thank you.

Q. (By Mr. Membrino) What is the source of that scale?

A. I believe I got this from the Instream Flow Group in Fort Collins.

Q. Okay, now, we have talked about the flows that actually

occurred in the stream at the time you measured it, and we have also talked about the flows that the computer was able to estimate within certain limits. And having estimated those flows, tell you -- or tell us what the stream would look like, how would it perform, and what the streambed itself would look like. Can you tell us whether you did any investigation to see, in spite of what the computer said, whether naturally occuring water supply in the streams you studied might affect your conclusions?

A. I relied on the information supplied to me through HKM Associates that dealt with the natural flow study done by Michael Keene employed by HKM. He supplied me with the information on natural flows.

Q. What were you able to glean from that?

MR. WHITE: Objection, Your Honor. Based on the rankest form of hearsay.

THE SPECIAL MASTER: What were you to "believe"?

MR. MEMBRINO: Glean.

THE SPECIAL MASTER: Glean?

MR. MEMBRINO: I'll restate the question.

THE SPECIAL MASTER: I think I'll sustain -- go ahead. Reframe your question.

Q. (By Mr. Membrino) How did the -- did the information you received from Mr. Keene influence any of your flow

recommendations?

A. Yes, it did.

MR. WHITE: Objection. Your Honor, whether it did or not, it's inadmissible, isn't it, on several grounds. First of all, it assumes a fact not in evidence which, under normal conditions under the new rules, might not be a legitimate objection, but Mr. Keene is scheduled to testify in this matter on exactly that topic, so he's going to be here, and there is no reason that he can't testify to that, as opposed to Mr. Vogel. The second reason is that, again we have an opinion based upon an opinion, and the third reason is we have absolutely no idea of the facts, data and assumptions upon which Mr. Keene's work was done. Now, if Mr. Vogel is going to rely on Mr. Keene's work in some respect, I think the objection is a very good one.

THE SPECIAL MASTER: Mr. White, if I sustain you, what does that leave? In this lawsuit, obviously he is an expert witness while he worked, and he relied upon things in making his conclusions so I've got myself -- if I agree with you, I foreclose him from going ahead about his work, and whether he relied on --

MR. WHITE: I'm not suggesting that you foreclose him from testifying to his work. I'm suggesting you foreclose him from testifying about Mr. Keene's work.

THE SPECIAL MASTER: That I will do. I will foreclose you from testifying about Mr. Keene's work. But if he was aware of some of the professional papers or publications of Mr. Keene and he read them and made some reliance upon them, I believe he has a right as a witness, as an expert witness, to touch on that.

MR. WHITE: The rule is very clear, Your Honor. Only if it is the type of information reasonably relied upon by people in this area of expertise.

THE SPECIAL MASTER: In this area of expertise: It is so limited and so new and so well -- Frank Trelease himself used to have a term for it in law school, days, years ago, it was not nebulous, but filled with new directions and obfuscation, you know, and difficult to pursue with some degree of exactitude.

MR. WHITE: That's exactly the reason we have the rule of evidence, Your Honor, is to be very cautious and very conservative when we approach a new area of law or a new area of science to which the law is to be applied. This is exactly --

THE SPECIAL MASTER: I have to reconcile that with the fact that he's still an expert witness, and that latitude that carries which is a different reliance.

MR. MEMBRINO: Your Honor, Mr. Keene will be here to testify about his virgin flow analysis and his study of

hydrology in the stream. Mr. Keene will not be here to testify as to how Mr. Vogel was able to interpret his work and make conclusions about it from instream flow recommendations. Mr. Vogel has to do that.

THE SPECIAL MASTER: This is all HKM versus Stetson Engineers, over and over again.

MR. WHITE: It is the old opinion based upon an opinion. You're absolutely right.

MR. ROGERS: Your Honor, it is exactly the same thing we are going to have when we start hearing the State's case.

THE SPECIAL MASTER: When I ruled --

MR. WHITE: No, I don't think we'll make the same mistake, your Honor.

MR. MEMBRINO: Your Honor, it is not a mistake --

THE SPECIAL MASTER: You may answer his question, but don't tell us what Mr. Keene -- what we are going to hear from the man who is the best witness to tell it to us.

Can you remember the question again, and can you ask it in such a way as to visciate or remove Mr. White's objection thereto?

MR. MEMBRINO: Well, I'm not sure we can, Your Honor, because what we are talking about is the fact that there are, as you pointed out earlier, there are historic stream flow records from which HKM Associates has determined

the virgin flows for the Wind River system. Now, remember we have some confusion with Mr. Vogel's testimony about what his measured flows represented, the historic flow --

THE SPECIAL MASTER: That wasn't confusion on his part, that was confusion on my part, and I was unable to grasp it.

MR. MEMBRINO: Well, because we only know and the computer only knows, the three measured flows, for example, that were taken, and can extrapolate from them to a certain extent. We still have to know how those flows fit into the natural cycle of the stream we are talking about and how or whether or not the predictions that are made for optimum habitat by the -- or maximum habitat by the computer are relevant. Because there may not be enough water for that.

THE SPECIAL MASTER: I appreciate that,

Mr. White.

MR. WHITE: I think we might be able to solve it, Your Honor. I would have no objection to the witness testifying about the USGS guage flows. That is something over which there can be very little dispute. That's something to which he doesn't have to base his opinion on evidence which some other witness is going to give.

THE SPECIAL MASTER: It is almost something of which I should take judicial notice, in other words..

MR. MEMBRINO: It is the same kind of information, and we are still talking about the need for computations.

THE SPECIAL MASTER: Can you do that? Can you refer and lock this into the gauge flow figures?

MR. MEMBRINO: We are not talking though, Your Honor, about stream gauge figures. We are talking about a virgin flow analysis. Stream gauge figures only give you an instantaneous record of what occurred, what water was flowing by the stream.

THE SPECIAL MASTER: Mr. Membrino, if you're talking about virgin flow analyses, you're going to get another witness' testimony from this witness, I'm afraid.

MR. MEMBRINO: No, Your Honor, I'm only trying to get what happens, what constrains another expert's opinion.

THE SPECIAL MASTER: But on Mr. Vogel's work --

MR. MEMBRINO: And Mr. Keene -- it is not like we are sending Mr. Keene off somewhere and not making him available to testify. In the ordinary course of our case within a matter of a couple of weeks, Mr. Keene will be here to testify in great detail as to how he went about garnering his conclusions. But we feel that as an expert, Mr. Vogel is entitled to rely on the work of another expert that is integral to the developing of instream flows.

MR. WHITE: Why don't we do this, Your Honor --

MR. ROGERS: May I say this before Mr. White speaks?

THE SPECIAL MASTER: Let me hear what we have over here.

MR. WHITE: I was going to make it easy.

THE SPECIAL MASTER: Hold your thought, please.

MR. ROGERS: We seem to have this, we seem to have a witness who may testify as a hypothetical, that the optimum flow for a particular species of fish or the groups of the species in this particular reach, may be a hundred CFS. But he's also been furnished information from another expert who's done an analysis of virgin flows in this same area that in fact, the virgin flows may only be 80 CFS. His claim, his testimony then, is only going to be based on the 80, not the 100. Now, it seems to me the solution to the problem is if this witness bases his opinion on -- given this particular situation -- on the analysis given him by Mr. Keene, that if Mr. Keene's testimony then does not adequately support that analysis, then obviously it calls this witness' testimony into question, and that can be resolved after Mr. Keene has testified and survived cross-examination.

MR. WHITE: It is an excellent suggestion, Your Honor, and I would ask you to reserve on my objection until that time. And to make the record easier to find altogether, the objection is that the witness is asked to testify based on hearsay, based on an opinion from another expert, which expert has not yet testified, who will testify in the future, and I would couple with my objection a Motion to Strike in

the event that the testimony of Mr. Keene in the future does not exactly line up with the values which Mr. Vogel used and which he received from Mr. Keene. And I think if you reserve on that --

THE SPECIAL MASTER: I do.

MR. WHITE: -- until Mr. Keene gets on and off, we can solve the problem.

THE SPECIAL MASTER: I'll be happy to with the understanding that you have enumerated.

MR. MEMBRINO: I should point out further that Mr. Vogel's testimony does not stand or fall on Mr. Keené's work. Mr. Vogel has gone out and made his own empirical observations of stream flows and has relied upon a computer program that permits extrapolations to be made from that period.

* * * * *

All we're talking about is, for example, and I think this might wrap it up, that if Mr. Vogel's maximum measured flow was 60 cubic feet per second and the computer using the extrapolating limits that it can, was able to extrapolate up to 80 feet per second, 80 cubic feet per second was what would provide optimum habitat. Mr. Vogel consults with and Mr. Keene reports that historically in terms of virgin flows there are only 70 cubic feet per second of water occurring in that stream -- the computer is going to be -- or Mr. Vogel, correction, rather, is going to be corrected down to what is actually occurring in the stream. So the computer starts out with a limited hydrology information and extrapolotations can be made from it. If additional data on historic stream flows acts as a constraint on that, then Mr. Vogel's recommedtation of 80 c.f.s. has to be limited back to 70 c.f.s. That's all we're talking about, so Mr. Vogel's --

THE SPECIAL MASTER: We are going to want a lot more evidence on this with some exactitude and with some accuracy, especially with your so-called virgin flow, how far back? And with his understanding, we can go ahead.

MR. WHITE: Well, Your Honor, I need to respond to one point. That is the suggestion that Mr. Vogel's testimony does not stand or fall on the virgin flow values. It seems to me that it is a --

THE SPECIAL MASTER: It is certainly going to be modified at this time.

MR. WHITE: It seems to me it is a very telling observation of the incremental flow methodology if, in fact, it is represented by Mr. Membrino to predict optimum flows at levels higher than the virgin flow.

MR. MEMBRINO: Your Honor, I don't -- I would like to respond to that, if I may. If we are again returned to Exhibits 283 and we look at the two headstakes,we notice that in that hypothetical the level of the surface of the stream is below the level of the headstakes. What the computer sees is the surface of the ground all the way up to the headstakes. If it determines that there are ledges or cobbles or gravels that sit up there and extrapolated flow is estimated to cover that area, it could very accurately say that in all probability that's good habitat, that land area will be covered with water and provide good habitat for fish. That's all the IFG methodology is calculated to produce.

MR. WHITE: Well, that's a problem with it, Your Honor. It makes predictions which are unable to be verified by what actually happens in the field.

MR. MEMBRINO: Quite the opposite. They will be verified, and they will be compared with the virgin flow analysis to see what the limits of the extrapolation are.

The one limit of extrapolation related to the capability of the computer to statistically realiably extrapolate to a higher or a lower flow. The second limit is what happens, what is the occurrence of the natural flows in the stream, and Mr. Vogel is not here testifying to water that's pie in the sky. He's going -- he's compared his conclusions with hydrology produced by an expert in hydrology,, and that is the final comparison to tie up his work in making flow recommendations.

THE SPECIAL MASTER: Well, what more expertise could there be in hydrology than thefigures of the United States Geological Service having to maintain gauging stations on this river since day one; that was 1870's or so. What is better than --

MR. MEMBRINO: There's nothing better than that. In fact, I'm sure that's what our expert witnesses have relied upon, at least in part, but that is data that has to be interpretted and calculated and so forth and so on and it takes a hydrologist to do that,not a fishery biologist, so there is an interdisciplinary effort.

MR. ROGERS: Your Honor, the problem is the USGS data is the data that shows what the flow is as affected by the various depletions made by men.

THE SPECIAL MASTER: Well, we have to be realistic in that and come out with conclusions as to --

MR. ROGERS: Not the virgin flow analysis.

THE SPECIAL MASTER: You can't have it both ways; and if you ask for historic irrigation of four or five new projects and say that now what you really want is also more water, nobody is going to ever draw an acre-foot of water for irrigation that is -- you can't have that either. That's again why I came back to the minimum stream flow. What is the minimum required for helping fish habitat on this Reservation? That's what I'm interested in arriving at, not what's the optimum. The optimum is no more achievable here than it is in the lakes of Wyoming that no longer have any fish, and that's because there have been too many fishermen --

MR. MEMBRINO: I would like to ask the witness to help clear up that point.

THE SPECIAL MASTER: All right.

Q. (By Mr. Membrino) Mr. Vogel, would you describe for the Court the two matters we have in mind and what your work is calculated to produce, and I'm talking now about the Special Master's referral to minimum stream flow and your conclusions about optimum habitat; and when I say optimum habitat, I'm distinguishing that from maximum flow. Could you elaborate on that distinction for the Master?

A. Okay, first of all, as we saw earlier in an example, just

so everybody understands that the highest flows don't necessarily mean the highest habitat.

THE SPECIAL MASTER: We have seen that. You were saying the adult habitat.

THE WITNESS: My objective in this study was to come up with flows that would maximize fish habitat. Higher flows may actually decrease the fish habitat. There is some point that at a certain flow will actually maximize the available fish habitat. Remember again, we are talking about fish habitat, we are not talking about numbers of fish or biomass or eco-system model. We just want to find out what the proper flow to have coming down a given reach of stream on the Reservation to maximize that fish habitat in that particular reach, and that's it. And we want to make sure, going back to this last thing we were talking about, we want to make sure that we are not asking for the "pie in the sky".

As it turns out, none of my flow recommendations occurred -- or none of my flow recommendations were made. I'm trying to think of the proper way to say this. The proper way, I guess, would be to actually use an example.

* * * * *

MR. WHITE: Before he answered that, Your Honor, I think this is the place where I ought to insist that a question be asked by counsel or the Court, so we know exactly what he's comparing his flow recommendations with. If these are the Keene values, then I'd like to know it so I can make a further objection. If they're not --

THE SPECIAL MASTER: Let him continue with his -- with his discussion and if he approaches the subject matter which you think is improper, then make your objection. If he starts quoting directly and you figure that not appropriate, you may move to strike.

MR. WHITE: Thank you.

THE SPECIAL MASTER: That sound right?

All right, go ahead.

THE WITNESS: Okay. So my major concern here is I had a flow recommendation, that previous example, 500 cfs, and that was the stretch of the Big Wind River from the confluence of Bull Lake Creek down to diversion dam. We used that for an illustrative example. Now that I know that flow of 500 cfs will maximize the habitat for adult Browns and Rainbows, I wanted to make sure the water's available there, and remember, my flow recommendations are based, I actually present them on mean monthly

instantaneous flows. So I have a flow recommendation for January and for each month all the way through to December.

Now, during January there may not be 500 cfs that would naturally occur in that stream reach, so I had to rely on work of a hydrologist to make certain that I'm not asking a flow that cannot be naturally occurring at that time. And in this particular case it was not. I'm recommending a flow of 500 cfs, but only a flow of 254 cfs occurs in the one and two year recurrence interval.

THE SPECIAL MASTER: Are you on page 34?

THE WITNESS: Page 30, Your Honor.

THE SPECIAL MASTER: Okay.

THE WITNESS: However, --

Q (By Mr. Membrino) Before you continue --

THE SPECIAL MASTER: Let me ask a question here. What difference would there be in the recommended mmf, on page 30, regarding the Bull Lake Creek and diversion dam stretch if you had used here the figures of the USGS gauging stations and instead of what you used?

THE WITNESS: I could probably guess at that.

THE SPECIAL MASTER: But you're not sure you can answer it accurately?

THE WITNESS: I couldn't accurately answer that myself.

THE SPECIAL MASTER: Well, I really don't want your guesses, you know.

MR. WHITE: Your Honor, I think the witness had done some work in that area, testified about that during his deposition. If you gave him enough time he might be able to figure out those values.

THE SPECIAL MASTER: We're getting along toward the end of the day. Maybe he could have a look at it and we can do something with it tomorrow. Go ahead.

MR. WHITE: I can ask him about it on cross-examination.

THE SPECIAL MASTER: Go ahead.

Q (By Mr. Membrino) Could you explain -- To continue your explanation, you talked about optimum habitat. Now, minimum flows seems to be a term of art in your field. If that's true, could you explain just to me the conceptual difference between approaching a problem in terms of minimal flows as opposed to optimum habitat which was your approach?

A Well, first of all there is a lot of -- minimum flows, as it turns out, is a relatively loose term.

THE SPECIAL MASTER: Yeah, we have to define it otherwise we're in serious trouble, and I welcome any definitions. What do you mean when you say "minimum flow',

and we'll see if that's what we've been meaning so far in this lawsuit.

THE WITNESS: Myself, I don't like to use the word "minimum flow" because it has connotations that are hard to comprehend. For example, if we say what would be a minimum flow for fisheries, we don't know, it's just enough to support the fish population. We might be able to have a fish population with just a male and a female trout. If they can spawn there's a population there, but it might be so severely limited that it's not worth having at all.

What we tried to do here was to recommend flows that would actually maximize the habitat available. Again, we are not getting back to the point of trying to recommend a minimum flow, just to support the fish population, we're talking in terms of habitat only.

THE SPECIAL MASTER: Well, how about a minimum flow that would, if not maximize the habitat, certainly not do it damage and continue a healthy abundance of fish in that stretch allowing for annual harvest?

THE WITNESS: To the best of my knowledge there is no methodology that's been developed that would enable us to predict --

THE SPECIAL MASTER: Doesn't the Game and Fish Commission of various states have figures dealing with this, that result in what their spring requirements are for

dumping the bucket -- what am I saying?

MR. WHITE: Stocking.

THE SPECIAL MASTER: Stocking, for spring stocking, for nursery stocking in their respective areas.

THE WITNESS: I'm sorry, I didn't understand the question.

THE SPECIAL MASTER: Well, doesn't -- Don't the respective State Game and Fish Commissions deal with this subject matter and from this receive statistics which give their stocking work each year?

THE WITNESS: As I understand it, they will make flow recommendations that will not be detrimental to the fish population. But what I meant to say is that there's no methodology to date that will predict a true minimum flow to actually support a certain biomass of fish. That, to the best of my knowledge, that has not been developed yet. That's what we are getting from a population modeling of eco-system modeling. We're not really trying to do that here. All we are dealing with is just a term of habitat.

THE SPECIAL MASTER: What do you say a maximum [illegible] habitat -- What do you mean maximize the habitat, what does that mean?

THE WITNESS: That's again referring back to --

THE SPECIAL MASTER: That gets the most favorable

conditions?

THE WITNESS: Right, that's correct.

THE SPECIAL MASTER: For continued healthy fish population?

THE WITNESS: Yes. We are assuming that if we can offer the most favorable conditions, that the population will have a favorable response.

* * * * *

THE SPECIAL MASTER: You're not concerned with trying to keep levels to that maximum condition by a healthy, vigorous harvesting annually, which would allow room to live and let live on the fish that remain and still have a maximum condition?

THE WITNESS: We are concerned with that, of course, because that is part of my job as a fisheries biologist. In this particular study, we did not address that fact.

THE SPECIAL MASTER: Why don't you address that fact in the study?

THE WITNESS: I didn't believe it was necessary because all we wanted to do was just develop flows that would maximize fish habitat and as I said before, if we maximize the fish habitat, I'm assuming that the fish population will respond favorably. So then we provided conditions in the stream that are, that are favorable for the fish, so that they may be able to be harvested. This would be added to these recommendations, which it could be much less or much greater. I'm assuming the population would suffer at either end of those scales.

THE SPECIAL MASTER: Thank you. Thank you, Mr. Vogel.

Q. (By Mr. Membrino) To put it another way, are you really angling in after these same objectives from another perspective as The Special Master is talking about?

MR. WHITE: I object; it's a misleading question, Your

Honor. The objective the Master was talking about had to do with fish populations.

THE SPECIAL MASTER: That's a difficult question; philosophical one.

MR. WHITE: This witness' testimony has to do with the optimum habitat based on flow. They're completely different things, and I think the question's misleading.

MR. MEMBRINO: But the optimum habitat has the same meaning. We're not having habitat for the sake of habitat, we're interested in having habitat for the sake of having fish. So we are all coming to the same point.

THE SPECIAL MASTER: I may be hurrying this with my questions. Maybe I just ought to have the patience to hear it through and let you complete your case with your witness, and I think I am going to try to do that again.

MR. MEMBRINO: Well, anything we can do to help the Court understand, we would be more than pleased to do so. Please interrupt us as necessary.

Is it the Court's wish to take a break at this time?

THE SPECIAL MASTER: No. I don't want to take a break unless you want to go till five or six o'clock today. I'm assuming we'll go another fifteen minutes and call it a day.

MR. WHITE: That's fine with us.

MR. MEMBRINO: Fine, Your Honor.

Q. (By Mr. Membrino) I think, before we got into this discussion, we were talking about the limits of natural flows, naturally occurring flows on your conclusions.

A. Right.

Q. And with the Master's ruling in mind, would you tell us whether and how your conclusions were influenced?

MR. WHITE: I have another objection, Your Honor. What natural flows? I assume these are the Keene natural flows. The question I have is are these natural flows for the 1868 time period, some subsequent time period or what? And I think the objection then is that the question is ambiguous, and we are entitled to know the natural flows during what particular period, because as most of us know, the reservation was created during a period of relative drought.

MR. MEMBRINO: Your Honor --

THE SPECIAL MASTER: I will overrule the objection.

MR. MEMBRINO: Thank you.

THE SPECIAL MASTER: You may proceed.

THE WITNESS: To answer your question, I'll again refer to Page 30 of Exhibit C-280. As I started before, for the month of January, there was only naturally occurring once in every two-year period a flow of 254 cfs. Now, I'm basing this information on Mr. Keene's hydrology. If you

look at this table, just so everybody understands what it represents, the single column of flows that are offset on the lefthand portion of this table are my flow recommendations. The three columns to the right of that are Mr. Keene's information. He supplied that information to me.

They're listed on a month by month basis, and they're listed by a one in two-year recurrence, one in five and one in ten years, simply for comparison purposes.

For this study, I used an average flow or a one in two-year recurrence interval. Now, if we, as you remember in this particular stream of stretch -- excuse me, stream reach, my flow recommendation was 500 cfs. The first month where that may naturally occur is the month of May. Mr. Keene told me through his work that once in every two years a flow of 2,005 cfs may naturally occur.

THE SPECIAL MASTER: Well, if it does, what does that do to your habitat optimum condition of wanting not more than 500 cfs? Because if you get up to four times that much, you've described the conditions which you say are optimum.

THE WITNESS: That's correct. In my opinion, if such a flow was going down the stream, there would be less habitat available for the fish than if it were 500 cfs. This is a good example.

THE SPECIAL MASTER: What are you going to do? Is it

your testimony that therefore, something ought to be done to limit the flow of 2,005 second feet of water in May in the main stem of this river?

THE WITNESS: No. I'm simply stating that 500 cfs offers greater habitat than 2,005 cfs.

THE SPECIAL MASTER: Yes, but we got a river which has to serve some needs for mankind, as well as for fish, and if you can't irrigate in May, when in the name of God, are you going to irrigate?

THE WITNESS: That's true. That's a clear example. For example, this is a clear case where the fish don't need every drop of water in the stream, they only need 500 cfs to maximize their fish habitat. The rest, as far as the fish is concerned, are excess water.

THE SPECIAL MASTER: What conditions can be -- What conditions can exist or prevail here in January that could damage your 254 recommendation when the state of nature itself brings your 220, your 203, nothing can be done to guarantee more than these minimums you're saying now. So your point is merely making a record of the fact that nature itself is harsh to the maximum, it's a fear for fish once every two years and sometimes once every five years in other cases, and certainly it isn't our duty in this lawsuit to try to improve or make more optimistic those conditions in January when the state of nature themselves

render them less than what the figure is.

* * * * *

THE WITNESS: This might get back to it, I'm not sure. If I understood your earlier question, this is the minimum flow we are asking for to set aside as a claim for fisheries. We are not asking for --

THE SPECIAL MASTER: How can we settle for 254 feet in January when nature only gives you 203 feet every ten years? Does that in itself make your claim look rather extravagant? That's my comment.

THE WITNESS: No, Your Honor. In my report, I state that those recommended flows would be adjusted downward. In drier years such as a one in ten-year recurrence interval, so my recommended flow in January is 203 CFS. Naturally occurring, there would only be 203 CFS.

THE SPECIAL MASTER: And Mr. Membrino said you're not making that here. You're not asking for more than nature provides. My question is if nature provides lower amounts than are made on some of your claims that you make when it is even more than that -- I'm sorry to see that sort of thing. It brings to my mind the fact that maybe we ought not ask more than that which we know is naturally provided, and yet, here you have a study that's concluded -- but since you say there's going to be less water than that, we are going to take less than -- what is the value of your study if the state of nature puts things so that fish can live and have survived these centuries in that river, with low

flows, as set forth in the three tables on the right? Doesn't that detract from the totals you put on the first column as to what you feel should be the recommended? Why make a recommendation that can't be abided in or that nature hasn't sustained?

THE WITNESS: Is your question -- let me make sure I understand that. In these flows where they may be much higher flows occurring, why am I recommending lower flows?

THE SPECIAL MASTER: No. I appreciate your showing that fish can abide and live in a situation although they may not in a large amount, but at least they can survive. But you're saying in January, and again in December, and again in October and November, that you have a recommendation made, and you have a condition where nature has provided less water than you have recommended.

THE WITNESS: Okay. To answer that question, maybe to help out here, I'll refer back to this graph here for that particular study reach period. If in the month of January we have 254 CFS, we would have approximately this amount of habitat for adult Rainbow Trout. So there still is habitat there, and it is the maximum habitat that's available at that particular flow period. That's all we are really trying to say here.

MR. MEMBRINO: Let me ask a question related to this.

Q. (By Mr. Membrino) The two columns, or the three columns on the right side of your table on Page 30 in Exhibit 280 describes a one in twelve-year, a one in five-year, and a one in ten-year recurrence interval. Now, could you explain what that means; is that every year fish should expect to subsist in 203 cubic feet per second of water in January?

A. Are you referring to the one in ten-year recurrence interval? No.

Q. Yes.

A. No.

Q. What are the recurrence interval values about?

A. The recurrence intervals show that a given hydrological event of a certain magnitude, less may occur within that time interval. For example, one in two-year recurrence intervals, we have 250 CFS or lesser may occur, may naturally occur, however, one out of every ten years, flow of 203 CFS or less may naturally occur.

Q. But the probability is -- the greater probability is that 50 percent of the time --

A. That's correct. The one in two years would be I consider an average water year 50 percent of the time.

Q. And only 10 percent of the time will there be as little as 203 --

A. That's correct.

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Q. -- cubic feet per second?

So we are not talking about a chronic condition of 203 CFS in which that fish habitat would be defined?

A. Right.

I might point out also, Your Honor, just to make things a little clearer, this thing isn't meant to spit out the perfect answers just like that. It is up to the biologists to use this simply as a tool. The computer is telling us what the habitat looks like with these certain flows. That is just a tool just to get us to the point. Now it is up to myself, as a biologist, to make those recommendations. For example, in my opinion, during January, even though there is a flow of 254 CFS and there may be less physical habitat that's available than you may have at 500 CFS, that doesn't concern me because that's during the winter. That's the time when fish have verylow metabolic functions. They have low demands on the environment. They don't have the food intake, things such as this. So I'm not too concerned about that. However, during May, there is warmer water temperatures. It begins their growing season, they have more demands on their environment. They need higher flow to produce more food for the fish.

THE SPECIAL MASTER: And nature gives it to them. In fact, it gives them almost too much.

THE WITNESS: Correct. I also would like to mention that this methodology does not address what was known as flushing flows. These are flows that actually flushed out a system in basic terms. It actually is sediment transport flows. It is high flows that actually move the fine material in the substrates further downstream. We do not address flushing flows. We are in that respect conservative. It may be that during the month of June, which is the high run-off period in Wyoming on the reservation, we should have flushing flows because over a period of time, it's possible that there could be habitat degradation. These may be flows that are lower than what's required to transport sediment further downstream. It may eventually have an effect upon spawning habitat, even though I didn't address it. You may have mud deposits on the gravel interstices that would suffocate the eggs and kill them, and in that respect, I feel it is also conservative. During the month of June, we may actually want to have higher flows just for the flushing out the substrate material, making it a better habitat for the fish. But in this study, we did not address that.

THE SPECIAL MASTER: All right. Go ahead, Mr. Membrino.

MR. MEMBRINO: Your Honor, I think this might be a good point at which to break for the day.

THE SPECIAL MASTER: For the day. All right. Let me

ask a question before we do though:

These are the recurrence interval low flows?

THE WITNESS: That's correct.

THE SPECIAL MASTER: Do we have a record that will be in this case soon in evidence -- I would ask counsel as well as the witness -- that will give us some reflection of what the high flows are in these particular months over a given number of years?

MR. WHITE: Well, we will have that sort of information as part of our case, but I would expect it would be September or October before that came along.

MR. MEMBRINO: Your Honor, for the purposes of this analysis, we were only concerned with the impact of lower flows on habitat. Certainly the more water available --

THE SPECIAL MASTER: The less --

MR. MEMBRINO: -- the greater management flexibility you have in controlling it.

THE SPECIAL MASTER: All right. That explains why -- what is here is here, and not what I had in mind.

All right. I'm pleased to call it a day, and we can stand in recess until 9:15 tomorrow morning.

MR. MEMBRINO: Thank you, Your Honor.

(Proceedings recessed at 4:32 p.m.

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INDEX TO EXAMINATION

WITNESS: DAVID VOGEL

INDEX TO EXHIBITS

REPORTERS' CERTIFICATE

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County of Laramie)

We, Merissa Racine and Lamont Miller, Registered Professional Reporters and Notaries Public, hereby certify that the facts as stated in the caption hereof are true; that we did at the time, date and place, as set forth, report the proceedings had before the Honorable Teno Roncalio, Special Master Presiding, in stenotype; that the foregoing pages, numbered 6289-6508, inclusive, constitute a true, correct and complete transcript of our stenographic notes as reduced to typewritten form under our direction.

We further certify that we are not agents, attorneys or counsel for any of the parties hereto, nor are we interested in the outcome thereof.

Dated this 2nd day of June, 1981.

LAMONT MILLER
Registered Professional
Reporter

Merissa Racine
Merissa Racine
Registered Professional
Reporter

MERISSA RACINE - NOTARY PUBLIC
COUNTY OF LARAMIE STATE OF WYOMING
My Commission Expires Mar. 10, 1984