Thom Hardy Intro

THOM: Ladies and gentlemen, come in and take a seat. We would like to get started. We're running a few minutes behind. Wow, I don't get this kind of respect in the classroom. You guys all want to come to Texas State to grad school?

All right. Well, this afternoon session is about new methods and new tools, and I'm Thom Hardy. I'm a professor, endowed professor for environment flows at Texas State University at The Meadows Center for Water and the Environment. I've been doing this for quite a while, and I just have some opening remarks. We have a very distinguished set of panelists this afternoon, very wise, old, grey-beard practitioners that have been in the game as long as I have. And they bring, I'm sure, some interesting insights to where we are with our tools and assessments.

But I just want to start off quickly to remind everybody that posters and exhibits must be taken down by 5 o'clock at the hotel's request. So if you are an exhibitor or you have a poster up, please ensure that you address that. The material for posters, the exhibitors, and the material here at the conference will be on the IFC webpage very quickly, so you can chase down anything that you happened to have missed via the IFC webpage. One of the things I've really wanted to ask this panel was to sort of address as they go through and during the interactive period is that are we really doing the same thing, just in a more fancy manner? Have we really gotten new and innovative tools, or are we just doing things differently? How do new methods compare to historical methods? I think this is an interesting question. Are they better, or are they just more complicated? And I think that that's a valid question when I've been a proponent of advancing methodologies and how we do things. At the end of the day, it is like, "Am I getting a better answer or just a pretty picture?"

(SLIDE 1) Okay. I made this diagram up to make a point. As you spend more money, there is a perception that you are reducing the uncertainty in your answer. But I think in reality, given the nature of what we do, it can be anyone of these three relationships. You can spend a lot of money and not get any closer to reducing the uncertainty or shedding light on the problem, especially if you've picked the

wrong tool to answer the wrong question. And so, the IFC books talk about what you need to do. They have a variety of techniques that are in there that you can look at. The biggest thing is what you need to do to answer the question. And I thought our talk at lunch was brilliant and that if you can do the simplest thing to convey the answer in ways that is understandable by both the public and the experts, that's probably the best place to be. I love lawyers, "Dumb it down, dumb it down." It's like, "No, smarten up, smarten up."

(SLIDE 3) Okay, an orange, a wristwatch, and a stream. 1978, I was involved in my first in-stream flow study. We were standing on the side of the stream with Bubba, Bob and Elroy, and I, and we were saying, "How much water is there in the creek?" because we want to know how much water to leave. I said, "I have no idea, but Barry Commoner in my ecology class taught me how to put an orange in and time it down the length of the stream." So I walked down the stream and we measured 10 feet, and I took my orange and my watch and we calculated how long it took. So we knew the velocity, and then I kind a measured with a stick and used my one-inch figure to say how wide was the creek and then how deep, and we calculated the discharge.

And then we sat there and went, "I don't know. I think a cfs ought to be pretty good." Bubba said, "Well, I don't know. I kind a like six." And Elroy went, "I don't know.. about nine." And so we kind a compromised and we said, "Okay, we're going to make an in-stream flow recommendation, a single flow rate minimum flow of seven cfs in the creek." That was my first exposure to in-stream flows. I have never been back to that creek. I'm not sure I want to.

(SIDE 4) Let's get sophisticated. Clair Stalnaker pointed out to me, that the first publication I did in instream flow publications was in 1982. With two people out of his group, Mike Pruett—who I haven't heard from in ages—and Ken Voos. We went to a stream I had worked on in Ash Creek. Clair said he can remember the creek name but he wasn't sure, but it was in Pahranagat Valley. I laid out strings, and since it was a constant flow, I measured depth, velocity, and substrate in a 100-meter section, all these little cells, and then I did observations of different species of fish by cells.

Ken and I developed an expoential polynomial probability density function for the frequency of depth and velocity for availability, and then developed the frequency distributions with those PDFs for utilizations, and you subtracted the coefficients, and behold, you got a preference curve. And then I plotted back out on a cell by cell basis what the preference values were and then compared that with a chi-square test with my observed fish distribution, and for three of the four species I got r-squares of 0.89, and the chi-square said that it was significant. That was my first gross brute-force single flow rate validation study on suitability curves and modeling stream habitat. It all went downhill from there.

(SLIDE 5) The technological avalanche. In my lifetime, I thought it was interesting because I heard the other day, that when I got started, I used punch cards and would submit it to the mainframe. It would go to the Bureau Reclamation in Denver, and then they would send back the print-out to me, and I would make changes on the punch card and it would take a month to calibrate WSP.

With the advent of technology, with the computing power we have on our desk, the ability to collect highly accurate spatial data, whether it's utilizing ADCP, high resolution low elevation aerial photography, then we've got all of these analytical tools once we got the computers, PHABSAM and RHABSAM, River 2D, the multidimensional surface water modeling system, CASiMir, on and on. We have been making more and more spatially explicit models, but the question is, are we doing any better than simple cross-sections or oranges and a stopwatch?

(SLIDE 6/7) This is a classic picture of a two-dimensional hydrodynamic model being solved with the Navier-Stokes equations, just over topping a gravel bar and showing the velocity vectors to calibrate and validate the hydraulic model. Classic suitability curves. Probably the biggest thing we have not yet advanced in our science is the biology of our systems. Most of my research now is aimed at trying to estimate numbers of fish, sizes of the fish, and their biomass rather than only physical habitat, which goes into the model. It is necessary, but it is not sufficient.

(SLIDE 8) You hear talk about validation. This is a classic example of my work in the Klamath River with steelhead one plus. Blue is suitable, highly suitable. If you

can see the river, it is not. And the red dots are GPS locations of where we snorkeled and found those fish. This was to convince me that I had the right combination of calibrated hydraulics, suitability curve relationships, and I was able to predict the actual utilization at a flow rate, different flow rates, and different occasions. This gave me confidence in using the results, which I thought was cool.

(SLIDE 9) So, oranges to multidimensional integrated modeling. New techniques, I want to stress, do not invalidate historical methodologies. There is some kind of undercurrent that the new stuff means the old techniques, such as Tennant, wetted perimeter, and others, that they're not valid. They're just different tools under different circumstances of data availability. If I had no typography, I have no hydraulics, I have no suitability curve, I am not dead in the water. I still have hydrology-based methods available to me.

And I want to make it clear, from my humble opinion, the new tools and methodologies are not invalidating all of the historical work that's been done or those methods. I want to make sure that's clear. Emerging techniques tend to be more, I don't know, spatially accurate, if I can say that, typically more temporally accurate. But where we use multi-integration of water quality, sediment transport, inundation, where we're really still falling behind is the biological response functions that can be validated. That's where I believe the work really needs to occur.

The newer techniques come at a cost. Most of these mean it takes longer, it takes more money, and -- okay, so costs more and more money. Do you always have that? Not always. And then we're still faced with situations where they need an answer tomorrow, or in two weeks, and they don't have the money at the agency to spend. You're not going to use some of the higher-end techniques, you are going to be forced back into things such as hydrology techniques and other things.

(SLIDE 10) So just remember, you have a library of tools from "high-end to low-end", simple things. You're going to have to pick and choose given the context of the questions. Are we really doing better or just making pretty pictures with more complicated methods? I like this little cartoon about consultants—no offense,

Dudley—"I am under you're consulting spell." "Really?" "Yes, your overly complicated matrices and diagrams have convinced me of your intellectual superiority"—in this case, Dudley is intellectually superior. I am afraid to act without your approval. "Hey, did I give you permission to raise your arms like that?" I mean, I am amazed that when you walk in with these sophisticated techniques -- and I thought the talk at lunch today was interesting because people go, "Oh my gosh, it must be correct because it's a computer. It's got these backward twos and you've got all this stuff, so the answer must be right."

(SLIDE 11) I'm not sure that's true. And I think our speakers today will shed some light on that. And with that, I would like to introduce our panel, Holistic Methods for Integration of Multiple Components in Flow Modeling by Tom Payne, Normandeau and Associates. Historically it was Thomas R. Payne and Associates, I have known Tom for maybe 30 years now, at least. He brings a lot of experience to the table, so I'm excited about that.

Bill Miller and I were talking, and I just think his work on the San Juan River with a population model is going the right direction in predicting numbers and looking at the impact of alterations. And what that means, it's going to be an excellent talk for this group. Dealing with uncertainty, statistical analysis, and risk assessment tools for establishing robust instream flows, Dorian Turner, you guys are going to love this. This is going to be brilliant. You're going to get it. And then Bayesian probability modeling, Jim Peterson, Oregon Cooperative Fish and Research Unit at Oregon State University. I love Bayesian belief networks. They're totally cool because I can do them without any data at all. And that means expert witness. And it's like, "I'm not so sure that at 75 or 65 percent probability, you can game these things and gain a tremendous amount of insight to your system." So I think you're going to have a really fun time this afternoon. With that, Tom, I'd ask you to come up and take it away, sir.