Attachment 2

Initial Study Report Meeting Transcript

March 23, 2016

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Initial Study Report Meetings
March 23, 2016
Transcripts

Cook Inlet Region Inc.
725 E. Fireweed Ln.
Anchorage, AK 99503

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

SUSITNA-WATANA HYDRO

Agenda and Schedule

Initial Study Report (ISR) Meetings

Glacial (Study 7.7), Geomorphology (Studies 6.5 + 6.6),

Water Quality (Studies 5.5-5.7), Groundwater (Study 7.5)

Cook Inlet Region, Inc.

725 East Fireweed Lane

Anchorage, Alaska

March 23, 2016

ATTENDEES

Emily Anderson, Wild Salmon Center
Julie Anderson, DMS
William Ashton, Department of Environmental Conservation
Greg Auble (phone), United States Geological Survey
Matthew Burak, Louis Berger
Bryan Carey, Alaska Energy Authority
Dawn Chapel, Pacific Groundwater Group
Monir Chowdhury (phone), FERC
Douglass Cooper, United States Fish & Wildlife Service
Matt Cutlip, Federal Energy Regulatory Commission
Jeff Davis, Aquatic Restoration and Research Institute
Kathy Dube (phone), Watershed GeoDynamics
Paul Dworian, AECOM
Wayne Dyok, H2O EcoPower
Sean Eagan, National Marine Fishery Service
Peter Foote (phone), Louis Berger
Bill Fullerton, Tetra Tech
Solomon Gbondo-Tugbawa (phone), Louis Berger
Hal Geiger, St. Hubert Research Group

ATTENDEES CONTINUED

Sydney Hamilton, Accu-Type Depositions
Mike Harvey (phone), Tetra Tech
Melissa Hill, Department of Natural Resources
Ken Hogan, Federal Energy Regulatory Commission
Phil Hilgert, R2 Resource Consultants
Chris Holmquist-Johnson, United States Geological Survey
George Kalli
Jan Konigsberg (phone), Alaska Hydro Project
Joe Klein, Alaska Department of Fish & Game
Felix Kristanovich, Ramboll Environ
Mathew LaCroix, Environmental Protection Agency
Michael Lilly (phone), Geo-Watersheds Scientific
Heide Lingenfelter (phone), Ahtna, Inc.
Ellen Lockyer, Ak Public Media
Becky Long, Susitna River Coalition
Matthew Love, Van Ness Feldman
Jon Ludwig (phone), Tetra Tech
Dave Mclean (phone), Northwest Hydraulics
Betsy McCracken, United States Fish & Wildlife Service
Betsy McGregor, Alaska Energy Authority
Sunny Morrison, Accu-Type Depositions
Jason Mouw, Floodplain Resources
Jim Munter, JA Munter Consulting, Inc.
Doug Ott, Alaska Energy Authority
Dirk Pedersen, Stillwater Sciences
Steve Padula, McMillen Jacobs Associates
Kathryn Peltier, McMillen Jacobs Associates
Meg Pinza (phone), Ramboll Environ
Rob Plotnikoff, Tetra Tech
Andrea Ray (phone), National Oceanic and Atmospheric Administration
Dudley Reiser, R2 Resource Consultants
Tim Ruga, AKRF
Greg Ruggerone (phone), National Resources Consultants

ATTENDEES CONTINUED
Tyler Rychener, Louis Berger
Sen Bai (phone), Tetra Tech
Harry Gibbons (phone), Tetra Tech
Dan Smith, Alaska Energy Authority
Jay Stallman, Stillwater Sciences
Marie Steele, Alaska Department of Natural Resources
Steve Swope, Pacific Groundwater Group
David Turner, Federal Energy Regulatory Commission
Cassie Thomas, National Park Service
Rui Zou Rui Zou(phone), Tetra Tech
Paul Makowski (phone), Federal Energy Regulatory Commission
Woohee Choi (phone), Federal Energy Regulatory Commission
Jose (Pepe) Vasquez, NHC
Sue Walker, National Marine Fishery Service
Fred Winchell, Louis Berger
Whitney Wolff (phone), Talkeetna Community Council
Mike Wood, Susitna River Coalition
WobusCameron Wobus (phone), Stratus Consulting
Lyle Zevenbergen, Tetra Tech
Jon Zufelt, HDR

INTRODUCTION

MR. PADULA: Welcome to day two of three meetings this week on the Susitna-Watana Hydro Project ILP process and we're at the stage in the process where we're holding the formal initial study report meetings three days this week and two days next week.

I'm going to go through opening slides that I did yesterday. I apologize for those who heard all this yesterday, but I know there's some new faces in the room today. Let's start with introductions in the room and then we'll go to the phone.

Attendees present introduced themselves.

Attendees on the phone introduced themselves.

GEOMORPHOLOGY STUDY (Study 6.5)

MR. PADULA: Okay, thank you very much. We're going to get started. Can the folks on the phone see the screen okay, see the first slide?

UNIDENTIFIED SPEAKER: Yes.

MR. PADULA: Great. We're going to get ourselves started here. So again, a reminder for folks on the phone, we'd really appreciate it if you could mute your phones, unless you are intending to make a comment or a statement, and also, a reminder, please do not put us on hold, because the rest of us will hear music and we prefer not to, at least during the course of the meeting.

In terms of logistics in the room here for anybody new today, if there's any sort of safety issues in the building, exit right here and congregate over by the restaurant. Hopefully, we won't have any issues, but just in case. Restrooms are out the back door to the left.

We'll have a lunch break at noon today and we will try to stay on the agenda like we did yesterday. So if we finish something early, we may have to wait for folks to join us on the phone. So we're going to try and be pretty rigorous about sticking to the agenda.

We do have a court reporter in the room today. So again, when you speak, at least your first time, please again state your full name and affiliation and they'll get a sense for who you are and then after that, we can shorten that up a little bit, but always please identify yourself. It will be very helpful.

Silence your cell phones, if you would. Watch the sidebar conversations again, because there are mics and speakers throughout the room and everything will get captured on the record, and there was a sign-in sheet at the back door. If you haven't signed on the sheet today, please do so at some point over the course of the day.

We have the agenda for -- I think it's back up here, the agenda for today's meeting. The first half of the agenda is showing there up through noon. Again, our objectives today, this morning is going to focus on geomorphology, fluvial geomorphology and glacier and runoff study, and then this afternoon, we'll move into water quality and end the day with groundwater and again, we will stick to that order today.

So this slide is just a reminder of where we are in the ILP process for this project. Again, lots of -- lots of work and interaction has led up to today over the last several years, in terms of study planning and reporting and interactions.

So today is this -- is the opportunity to discuss study results that occurred to date and for AEA to present its thoughts regarding any modifications or continuing work to complete the study upwards to fulfill the currently approved study plan. It's also, then, the opportunity for other participants of this process to engage and share their thoughts with regard to the work that's been done to date, their thoughts about work that is required, again, from their perspective to complete the study plan, thoughts about modifications. I thought that went really yesterday. I thought some really positive interaction and -- and hopefully, we can continue that today and tomorrow.

If someone believes there, ultimately in their mind, is a need for a modification to the approved study plan or possibly the need for a new study, FERC has specific criteria laid out in the ILP regulations. We have those up on poster boards here in the room. Again, those are just verbatim out of FERC's regs. We didn't really need to refer to those yesterday, but they're there in case we need to today.

So to date, the work that's been done has been captured and compiled in a series of major filings with FERC, four parts, essentially, to the ISR to date. Parts A, B, and C were filed last -- in June of 2014, and then there have been subsequent technical memoranda since that point and then a major update in November of last year, which was ISR Part D, in response to an interest from FERC.

An effort was put into trying to develop a roadmap to assist all of the participants with following through the series of documents and technical memoranda that we produced (indiscernible - speaking simultaneously), as well as to be explicit with regard to variances that have occurred during the conduct of the study plan to date and proposed modifications.

In addition, there were some changes in the proposal, in terms of the transmission and access route corridors and information in that regard was also presented in Part D, and lastly, and again, this will be covered today, AEA's thoughts with regard to steps required to complete the study plan.

All this information has been online on AEA's website, filed with FERC, and again, the last series of documents, either study implementation reports where AEA believes there is additional work that needs to be conducted to complete the approved study plan or in some instances, a study completion report where they believe the study plan requirements have been met.

Just a very quick overview of significant dates in 2016, we've got three meetings this week and two next week. To meet the requirement of the ISR meetings, AEA will then have to file meeting summaries by April 24th for all five days of meetings.

The next deadline is June 23rd, and this is the opportunity for any participants to file comments, disagreements, recommendations for, again, modifications to studies or new studies, and to file all that in writing with the Commission. There is then an opportunity up through August 22nd of this year, again, for anyone participating in the process to respond to the meeting summaries and the disagreements, if any, and recommendations, if any, and make those thoughts available to FERC on the record.

That all leads up to, currently it's an October 21 deadline in FERC's schedule for the Office Director to actually make a determination on all of that material filed, essentially from this point forward through August 22nd, and to make a final determination as to FERC's sense of what is required from their perspective to ultimately complete the study program.

Again, five days of meetings, we're on day two here, March 23rd. We've got the agenda showing what we're going to cover today and then tomorrow is more in the instream flow, riparian and ice arena, and then next week are more the terrestrial-related issues.

So the basic approach, for those who were here yesterday, you saw how this went. I think it went really well. Again, we, the AEA team, technical team, we're not going to try to summarize everything that's happened over the last several years. It would obviously take too long to do that. Again, hopefully folks with interest in specific areas have had an opportunity to review the material that's on the record.

So we -- there's a lot of slides you'll see. Again, they're in the record. We won't -- we won't belabor every one of those, but we will be clear, in terms of basically study highlights to date and AEA's plans for completing the study, if there's still remaining work to do and if there are any proposed modifications related to completing the work.

If variances have occurred along the way, we will also touch on those and again, please, it worked really well yesterday, really ask everyone to be interactive. It's your opportunity to ask questions of the AEA technical leads and also to let us know what your thoughts may be currently with regard to the status of the study program and what it might require to successfully complete the study plan and I believe that's it. Unless anyone has any opening questions or comments, we'll jump right into our first presenter, Bill Fullerton (indiscernible - speaking simultaneously).

MR. FULLERTON: (Indiscernible - speaking simultaneously) thanks, Steve. We're getting the presentation pulled up here. Thanks, Dan.

UNIDENTIFIED SPEAKER: Yeah (affirmative).

MR. FULLERTON: So the geomorphology studies that is in two parts, there's the geomorphology study and then there's the fluvial geomorphology study below Watana Dam and so those are Studies 6.5 and 6.6. I'll be presenting 6.5 and Lyle Zevenbergen will be presenting 6.6.

Also, I think you heard Kathy Dube is on the phone. She was the task leader for the large woody debris studies, reservoir erosion and the stream corridor crossings. Also, we should have Mike Harvey on the phone, who is the lead geomorphologist for our effort and he's calling in all the way from New Zealand. Mike, are you on now?

MR. HARVEY: I'm here now.

MR. FULLERTON: Great. Wow, no delay or anything, that's great. I'll get used to the whole set-up here. To go over the status of those studies, associated with the ISR documents, there's been a tremendous amount of work put into Study 6.5. We've developed a total of 16 technical memorandums.

Most of our results are presented in those technical memorandums. Several of them are updated a couple of times. For example, the reach delineation and geomorphic characterization was updated -- updated twice. So nine documents were filed prior to the June 3rd, 2014 ISR filings and then another seven documents were filed with or before the Study Implementation Report that was recently filed here in November, and then of course, there's the roadmap to all of these documents, which is Part D.

So in terms of what's been done in the actual work, in terms of the various study components, which there were 11 of them, there's four study components that have been completed. There's the sediment transport data collection. This was actually work that was performed by the USGS from 2012 through 2014, where they collect sediment transport data throughout the Susitna River in the major tribs.

Then there was the assessment of geomorphic change in the Middle and Lower rivers, the riverine habitat versus flow in the Middle River and then the same for the Lower River.

Then there's four study components that the majority of the work has been completed that includes the Study Component 1, the reach delineation and geomorphic characterization, the Study Component 3, which is the sediment supply and transport in the Middle and Lower Rivers. The Study 6 was the recon-level assessment of project effects and then nine, the large woody debris.

Now there's three other studies where the majority of the work still remains to be done. One is the reservoir geomorphology study, the component eight. The next one is the geomorphology of the stream crossings. That's Study Component 10. That's kind of linked with one that Mary Lou mentioned yesterday, 9.13, the habitat and the corridor crossings, and then there's the last study component, which is kind of the integration of fluvial geomorphology study or modeling study and the geomorphology study to get context to the model results.

In terms of our field data collection, we've completed all the data collection in the Middle River and the Lower River. This included the (indiscernible) mapping of geomorphic surfaces in the focus areas, which the work was actually just described in the other -- with the other data collection in the Middle River for the modeling, but the results are described under Study Component 1 in this study, and then data remaining to be collected is in the reservoir area.

This relates to the tributary studies, the reservoir erosion study and collection of the large woody debris data in the Upper River and also the data on the transmission line corridor access crossings.

So I won't go over in -- the study objectives, but there is -- each of the study components was developed to address one of the 11 objectives, which have been described and presented in both the RSP and the ISR and then repeated in the Study Implementation Report.

Where's the other (indiscernible) and again, this is just a single list of all the study components that I talked about the status on already.

Okay, so in terms of variances, I won't go over all of these. There's a number of them that are actually where we collected additional information. I'll skip through those, so we can get to the presentation. So some of the variances where we performed something different, first was the bed-material sampling that USGS collected. They didn't collect samples in 2012 due to river conditions.

They also suspended the bed load. That's kind of ironic, suspending the bed load, but -- a little sediment transport humor.

UNIDENTIFIED SPEAKER: (Indiscernible - too far from microphone).

MR. FULLERTON: Yeah (affirmative), very dry. It's dry, right? So they terminated those due to safety concerns up at Susitna River at Tsusena Creek near the dam site. For the determination of effective discharge below Tsusena Creek, that wasn't -- wasn't performed, but we added additional location, Susitna Station, Chulitna River, Talkeetna River and the Yentna River. It's basically because we didn't have the data there.

Let's see, that was an opportunistic. So Study Component 5 goes to the aerial photography that we were originally in the RSP going to collect at three different flow discharges and develop area versus flow relationships. We only collected at a single -- at a single discharge. We didn't collect the two others and the last one was -- is just, again, some additional data that we're able to collect for the LWD Study because of having the couple of sets of aerial photos and that bracketed a high-flow event, kind of cool.

So in terms of results, as I said earlier, a lot of the results are presented in these 16 technical memorandums we've prepared and have been filed. This next few slides kind of summarizes some of those, as well, or lists some of those, as well as there's other information that was contained in the ISR and SIRs.

So there's the geomorphic reach delineation and classification for the Upper, Middle, and Lower Susitna Rivers. That's a technical memo. There is the geologic, surficial geologic mapping and the geomorphic surface mapping in the 10 focus areas. Those results were presented in the ISR and a little bit of it in the SIR. The last three focus areas above Devil's Canyon are represented in the SIR, and one of the accomplishments with that study in putting together a lot of information from this study and the modeling was Mike Harvey's development of a geomorphic succession model for the Middle River and he's also developed a channel evolution model.

The USGS completed their sediment transport data collection and that information, the entire three years' of data are reported in the study implementation report. The sediment supply and transport developed a technical memo that showed the relationships and also performed a sediment balance in that study. We actually had a technical memo in 2013, and then updated it in 2014.

The -- in terms of geomorphic feature mapping that was part of Study Component 4, in the Middle and the Lower Rivers, we developed an initial (indiscernible) in 2013, and then updated it in 2014, wherein we added the 1950s aerials, which doubled our period of analysis, and also added the turnover analysis, which looked at the rate at which the floodplain was converted to channel and the channel converted to floodplain.

In terms of the riverine habitat versus flow in the Middle River, that was documented in a tech memo that looked at just the 1980s and current aerial photography, similar -- that same memo contained information from the study for the Lower River also.

Study Component 6 is a reconnaissance-level assessment of project effects in the Middle and Lower Rivers. We did -- performed in conjunction with the Riparian Instream Flow Study 8.6, Kevin Featherston, Mike and Kevin primarily worked on literature review for dam effects and then -- and it was concentrating on northern rivers.

We also did a refinement of a sediment transport assessment when we updated some of the sediment transport relationships and information in that effort played a role in the decision back in 2013 to extend the modeling from Sunshine down to Susitna Station.

Then the Study Component 7, there was the, again, the macro-habitat mapping and there was also synthesis of the 1980s Lower Susitna River segment aquatic habitat information. This was primarily to get a handle on information from the '80s that would help develop -- that details the plans for -- to be conducted in 2013/14 and future study years.

The stream flow assessment was also conducted in this study component and that's where we looked at the existing conditions hydrology and then compared it to one of the operation scenarios.

So reservoir geomorphology, we worked on initial estimates of trap efficiency of the reservoir and completed that, performed an analysis of potential changes to sediment delivery from the Susitna watershed from glacial surge. That's tied to the glacial study that will be presented just before lunch and then we did an aerial reconnaissance of the tributaries to help us detail out data collection and efforts for the future.

Large woody debris, all the log jams and large wood have been digitized from the aerial photos from the present and 1980s, and all the mapping of that -- the field mapping has actually been performed in the Middle and Lower Rivers.

Not much yet has progressed on the stream crossings, but what we did do, Kathy did an aerial reconnaissance, again to kind of further define the field data collection effort and in the last study component, the main thing we worked on was development of a framework to identify and anticipate trends and levels of project effects on the channel and floodplain system. That's, again, something Mike worked on and part of that was kind of results of the literature review that we did with the dam effects.

So the next several slides just list specifically the titles of the various tech memos and a number of decision points were made or executed in the study over the last several years. The -- we supported the -- 6.5 supported the decision point about extension of the 1-D model below 29.9. The RSP had indicated there would -- make a decision about whether we would collect additional historical aerial photos in the Middle and Lower Rivers.

We did -- we added, after the PSP, for the 1950s. After we worked on the study, we decided that we had good aerial coverage, not to add any, but also from a practical standpoint, there was no large database for the whole river that we could find for any other dates than were substantially different than what we already had found.

There was also a decision on whether to get additional flows -- of aerials of additional flows in the Lower River and based on the results at the target flow where we did the mapping, the decision was made not to collect the additional aerials and in the reservoir or delta or tributary study, we selected six tributaries for study. That was done in conjunction with the stakeholders.

One of the other decision points was a result of the FERC study plan determination and it related to the glacial -- glacier runoff changes study and it said to analyze the potential changes to sediment delivery from the Upper Susitna watershed into the reservoir from glacial surges to see if that was something significant we should look at, in terms of reservoir loading and based on the work that we did, we made the decision that it wasn't significant and we were not -- and we decided not to add a glacial surge scenario to the sediment loading.

These are some of the proposed modifications. We decided not to do the effective discharge in the Middle River, since it's supply limited. So the effective discharge calculation would be fairly meaningless and then we changed the method to perform the effective discharge in the Lower River and then we're also replacing the grant methodology for the -- to analyzing downstream impacts with the geomorphic/geologic context with this first and second order framework for dam effects that might develop and we're proposing not to do the determination of the Modified Braiding Index in both the Middle and the Lower Rivers.

Then one of the results of the last time this group got together at the ISR meetings was that we did make the decision to do the 1-D bed evolution modeling at the upstream end of the reservoir. So in the fluctuation zone, we'll be routing the gravel, cobbles, and sand with the 1-D model to look at how the sediment, the bed material will be deposited.

So in terms of steps to complete the study, the reach delineation and geomorphic characterization, the main thing we'll be doing there is a comprehensive technical memorandum that's going to be kind of integrating, from the geomorphic standpoint, the work that Mike's been doing on developing the channel evolution model, his geomorphic surfaces, and also ice processes, just trying to bring all of these different technical memorandums and the work that they're doing and coordination with the riparian study and ice processes, kind of all into, just basically the roadmap to why the Susitna River behaves the way it does.

So also, just a little bit more to do -- update and look at different scenarios with the sediment supply and transport studies. Again, similar thing, looking at each scenario with the assessment of project effects and reservoir geomorphology, still have to do the 1-D modeling and the reservoir erosion pass.

Large woody debris, you have to collect the data in the Upper River and then work with the other studies to integrate the large woody debris component into modeling, and then the geomorphology stream crossings, most of that work still remains and then integration with the fluvial geomorphology modeling study. Each time scenarios are executed, we'll be looking at that to provide some more geomorphic interpretation and context. Now we're ready for questions.

MR. PADULA: Thank you, Bill, (indiscernible) a tremendous amount of information shared. So we appreciate your (indiscernible). Any questions or comments for Bill? Back of the room, okay.

MR. MCLEAN: Dave Mclean here from (indiscernible - interference with speaker-phone). I have a couple of questions.

MR. PADULA: Dave, if you could wait until...

MR. MCLEAN: Can you hear me?

MR. PADULA: Yeah (affirmative), you'll be next in line, Dave, hold on just a sec.

MR. MCLEAN: Sorry.

MS. LONG: I'm sorry, I think we should probably let the experts go first, but that's okay. I just have a few brief things. This is Becky Long from SRC. Number one, I wanted to say that the literature review on dam effects on downstream channel and floodplain geomorphology and riparian communities, et cetera, that was a really good literature review.

I have used that on other issues in our area and I really, really appreciate that and especially the reference to other studies, et cetera.

MR. FULLERTON: Thank you.

MS. LONG: The -- number two, I just wanted -- you can answer this afterwards, why you guys decided to extend the modeling down to the Susitna Station and I guess that goes along with -- you extended the bed evolution model below river mile 29. If you could just, you know, afterwords remind me, explain really quickly why you did that and I know I should know that, but I don't, and then, I just wanted to ask you, you did aerial surveys of the Denali East option. I don't know, I wanted to ask you if the aerial surveys included the new Denali East option, and then finally, talking about the one where you guys looked at the glacial surge and how that's going to affect the reservoir sedimentation.

I was really interested in that and I think at the October 14th meeting, you know, really -- FERC really pushed it -- you guys to look at that based on, you know, what Harrison said, et cetera, and you put out a technical memorandum and then there was a meeting in the beginning of December, I believe.

I wish there had been notes from that meeting. I mean, I took notes, but you know, this stuff goes really fast. I wish that there had been notes on record and it just seems like that the experts have decided based on (indiscernible) Creek historical gauges in 1952 to 1953, and 1987 to 1988, and -- which was during two glacial, historical glacial surges, you know, and also the gauge data from the Talkeetna River, based on that, and the fact that there's approximately 90 miles of extensive braided headwaters that any sort of sediment transport from the glacial surges is not going to be significant.

If you took a really radical look at, you know, how much the sediment that's going to come down, the experts say it would only affect the life of the reservoir for approximately 50 years, you know, it would be less and that's not considered significant.

I get it. I get why the experts agree with this, but -- I mean are saying this, but I'm not sure I agree with it. There's things happening so much, so fast in the climate change scientific world. There are studies coming out all the time about glaciers and then climate change modeling is getting better so fast that what was predicted in 2014, based on some historical data might not be applicable to feature glacial conditions and their effects on the future.

MR. FULLERTON: Well, that was a list, Becky. Thank you. I don't know, you may have to remind me, I think you had about four points there. There was a glacial surge, the decision on the extensive modeling, and what (indiscernible - speaking simultaneously)...

UNIDENTIFIED SPEAKER: What did you (indiscernible - speaking simultaneously)...

UNIDENTIFIED SPEAKER: Denali East option aerial.

MR. FULLERTON: Denali East option aerial survey, what it really was, was what we did for the -- Kathy did for the stream crossings was a reconnaissance. It was a helicopter...

UNIDENTIFIED SPEAKER: (Indiscernible - too far from microphone).

MR. FULLERTON: Betsy, did you want to...

MS. MCGREGOR: I -- this is Betsy with AEA. I can answer a couple of those questions for you, Bill. We did collect aerial imagery of the Denali East option and it was included in the mapping that will be coming out.

Again, that's with Study 11.5 and 11.7, and with respect to the meeting notes, Becky, I just checked our website and we do have meeting notes from the December 4, 2014 meeting.

MS. LONG: Okay, sorry, I missed it.

MS. MCGREGOR: No problem. I just wanted to check we had them available.

MS. LONG: Thanks.

MR. FULLERTON: And Kathy's on the phone. We also have the aerial recons for the crossings. Kathy, did you do the East Corridor?

MS. DUBE: Let me check on that. I did aerial reconnaissance of the newly -- the one that was newly proposed that we did not have much information on is what I did.

MR. FULLERTON: Becky's shaking her head back there, so...

MS. LONG: Yeah (affirmative), that answers the question.

MR. FULLERTON: Okay, good, good, and then in terms of the decision to first extend the modeling downstream to -- from about river mile 79 down to Susitna Station at 29.9, that was largely based on our stream flow assessment and looking at the level of changes in peak discharge, and then the decision to not extend the modeling downstream of river mile 29.9 was based on four criteria that we had proposed that characterized the potential changes in channel width, changes in the volume or mass of sediment being transported, changes in the flow duration and frequency, and then changes in potential velocities and depth, and then Lyle's going to, I think -- because that was mainly done in the fluvial geomorphology modeling study and I think I already set Lyle up yesterday to talk more about that to answer some other questions. I think he'll get into more details on the modeling and if people do want, he can go into the technical memo.

In terms of the glacial surge, the other part of that decision, a big part, which you did mention about, was the large braid plain where pretty much, you know, the transport of the sand is limited by the capacity of the river. So that would act as a storage area buffering the results of glacial surge. I don't know, Mike, do you want to add anything to that? You primarily authored that technical memo.

MR. HARVEY: Yeah (affirmative), two things, really, one is that the analysis we did based on data that had been collected at (indiscernible - interference with speaker-phone) glacier in the '87/'88 period. We had data that had been collected that was an order of magnitude higher concentrations than the Denali gauge in the non-surge period.

So we took that -- that (indiscernible - interference with speaker-phone) which literally, you know, 30,000 versus of -- all right, the orders of magnitude, I'm sorry, not just one order of magnitude, higher than the Denali gauge long-term readings and we applied that number for the entire proof of water season, as opposed to a couple of months, which is generally what happens when they surge, and even when we're applying those numbers, we end up with a less -- or actually, a 10% reduction in the reservoir volume and so it doesn't (indiscernible - interference with speaker-phone). That's one of the reasons.

The other thing that I would add is that the whole issue of the glacial surges was conditioned on a submission by Dr. Harrison based on some of his works and observations in the AE studies and it was sort of an interesting -- when we were talking to him later on this, he sort of changed his position a little bit.

He said, you know, given what we've got with global warning this (indiscernible - interference with speaker-phone), he thinks that it's unlikely that there will be surging on the glaciers. He goes the rivers are so -- the glaciers are able to (indiscernible - interference with speaker-phone), you know, they're (indiscernible - interference with speaker-phone) without having to surge, you know, periodically. So it's an interesting question with respect to, you know, climate change.

MR. PADULA: Thanks. Thanks, Mike. I think Dave Mclean had a couple of phone -- yeah (affirmative), David, on the phone, your question, please.

MR. MCLEAN: Sure. I have a couple of general questions and then some more specific ones. I'll just maybe start on the general, relooking at the downstream effects, going through this vast amount of material, the very comprehensive description of the existing conditions on the river, but the -- so far, the project's effects, it's a little unclear to me where we're at there.

Those are described in -- really in -- this is a reconnaissance level assessment of project effects components and to some extent in the model integration and both of those seem very preliminary at this stage to me. I just wondered if you could give a bit more information on the status of that work? I guess, to me, ultimately, the project's effect is described as the future with project minus the future without project and it's not clear that describing the existing geomorphology of the river -- is that -- are you assuming that is the future without project, because I think we know that there is climate change happening, that there is trends happening, in terms of hydrologies, sediment supply, glacier extent, so how will -- do you have a very clear description now of what the future without project will be?

MR. FULLERTON: At the...

MR. MCLEAN: Let alone what the future with project will be, because you have this -- you need to know both before you can actually determine the magnitude and direction of the changes that are going to be occurring.

MR. FULLERTON: At the current approach, we're assuming the existing conditions are representative of the future. We're not doing a separate projection of the future.

MR. MCLEAN: And you're comfortable there are no trends happening or if climate change was a (indiscernible - interference with speaker-phone) affect on the behavior of the river over the next 200 years?

MR. FULLERTON: Well, our analysis is for the next 50 years and we're, you know, it's -- we're going to look at the impacts relative and so part of that, it's the delta between the two. So yes, there are trends. We've even noticed the -- some trends or changes, you know, when we did our turnover analysis. There's some variation, some reaches where (indiscernible) in the two periods. Some reaches had more floodplain, more, you know, vegetation encroachment, others didn't or reversed in the next period, so anyway, but right now, we are not proposing to do a future projection on starting at the existing condition. I don't know, Lyle or Mike, did you want to add anything?

MR. MCLEAN: The...

MR. FULLERTON: No, okay. Sorry, Dave.

MR. MCLEAN: The other question would be -- well, so in terms of understanding what the future with project/without project conditions, I'm sort of relying on these two components that you've produced. Much of the -- when will there be potentially more information on project effects that we can actually look at and when you do characterize project effects, are you going to be trying to characterize the uncertainty in your projections? My example is the work done by (indiscernible - interference with speaker-phone) on the Peace River where they looked at the effects of regulation on the Peace downstream and they did a number of uncertainty estimates or uncertainty analyses to try to bracket what the impacts would be with the different scenarios like different methods of calculating which changes -- the primary effects on the Peace were lateral changes, which I understand probably also are going to be some of the major effects on this river. Are you going to be able to give people a range of projections and an estimate of the uncertainty in your estimates on what the effects are or are you just trying to come up with a single estimate?

MR. FULLERTON: Well, I think the plan is to incorporate uncertainty that's somewhat addressed in the modeling aspect of that and Lyle could maybe hit on that in the next portion of this session and yes, things like width change and some of our projections that we make from our geomorphic interpretation of the model results, we can also apply some -- apply uncertainty too. Now one of the things, I just want to let you...

(Feedback from speaker-phone)

MR. PADULA: (Indiscernible) on the phone. Someone on the phone, maybe you could mute your phone, if you haven't? We're getting some feedback in the room.

MR. FULLERTON: So in terms of the projection or the determination of the project effects, mostly what's shown right now in the ISR, SIR, in the other documents related to this study are very preliminary. It was used to look at, for one, like the recon, the level assessment, that was part of the basis for extending the modeling from 29 or from 79 down to 29.9. So the bulk of the project effects assessment will be done in the next year of the study and for at least one project scenario would be presented in the USR, the complete package for the geomorph.

Now, Lyle is going to talk about the modeling and in that study, we've actually, both the 1-D bed evolution model, as well as the 2-D model, we -- the bed evolution model, we've executed project scenarios with and have results. Part of the results from the very initial bed evolution model, the 1-D model, played a big role in our decision on whether to or not to extend the study below 29.9.

So you know, we're just -- we're kind of getting into that phase of the study where we've built kind of our basis of information of developing our understanding of the river and now we're starting to get to -- our models are developed and getting to the point we can start looking at project effects.

MR. MCLEAN: Just a brief (indiscernible - interference with speaker-phone), are you going to do a formal uncertainty analysis that will sort of demonstrate how uncertainties in various assumptions and inputs will then be (indiscernible - interference with speaker-phone) through your whole analysis, through your (indiscernible - interference with speaker-phone) input, through your modeling, through habitat, et cetera, so that we can see the whole -- what the ultimate effects of how these (indiscernible - interference with speaker-phone) effects change the reliability of the predictions at the end? I guess that's the ultimate purpose of an uncertainty analysis to say, well, do we really know the direction and the magnitude of change in the timeframe within certain limits, and what are those limits? Is that going to be part of your study?

MR. FULLERTON: Well, that would need to be integrated, not only with our study, but ice processes, riparian instream flow, and fish and aquatics instream flow, and that's a topic we're still working on the details of. It's something we -- it's complicated and we're trying to figure out the best way to approach that. So it's a work in progress.

MR. MCLEAN: All right. I know we're running out of time. Can I ask, do you have time for a couple of specific questions?

MR. FULLERTON: Sure, if -- yeah (affirmative), Steve's nodding his head.

MR. MCLEAN: So I was just curious about this use of the continuing the effective discharge in the Middle River and also using the (indiscernible - interference with speaker-phone) better than transport models estimating the effective discharge in the Lower River. What are (indiscernible - interference with speaker-phone) did you say that there's no reason to do it in the Middle River because it's supply limited?

I mean, most rivers are supply limited, but I mean, the purpose of -- I thought the purpose of continued effective discharge is usually to try to come up with some sort of channel forming discharge parameter or so I guess, if you're not doing it, what are you doing as an alternative or are you -- is that not needed? You don't need to know what the channel forming discharge is and if you can use the (indiscernible - interference with speaker-phone) model on the Lower River, would that not be possible to use it on the Middle River? I guess I don't see why. Could you just provide more insight on that?

MR. FULLERTON: Yeah (affirmative), that -- a little bit here, just that -- yeah (affirmative), you could do the calculations. In fact, we did the effective discharge calculations using (indiscernible) classic methods. I think we reported those for existing conditions in one of the TMs. It was either sediment transport supply and balance or maybe the recon level project effects and it might have also been in one of the ISRs. I could check on that and get back with the reference there, but you know, after, you know, and then the part with the modeling, it's just -- actually, it's just a more accurate determination of the actual transport rates than you get from the sediment transport relationships, but Lyle, did you want to talk a little more about that? Yeah (affirmative), you can come up here and use this mic. It's easier than chewing on that other one.

MR. ZEVENBERGEN: So on the effective discharge in the Lower River, the Lower River is very much an alluvial river, a grading braided, very dynamic, and so the change in the hydrology would be reflected in the effective discharge and we can either use the standard approach, as Bill said, or the model, the 1-D model actually gives us, you know, the exact same information from a with-project or an existing conditions. So we have a direct comparison there.

We did the effective discharge with the classic approach in the Lower River and compared it to the modeling results and they were virtual identical, indistinguishable.

In the Middle River however, the effective discharge calculation for existing conditions, where we have a large sediment supply of primarily sand, again, the modeling and the classic approach did very similar results, but it becomes kind of a meaningless exercise in the Middle River because sediment rating curves drop essentially to zero because of the, you know, the vast majority of the sediment is collected in the reservoir.

So the effective discharge calculation really loses its value in the Middle River and is better replaced by the actual modeling that's being done.

MR. FULLERTON: Thanks, Lyle.

MR. MCLEAN: The effective discharge is often used in a width-type calculation to estimation the effects of the project would be on width. How -- are you doing something as an alternative to replace that or I guess I'm just not clear.

MR. ZEVENBERGEN: Yes, because the Middle River really isn't an alluvial bed. It's very much more of a very coarse immobile bed during open-water conditions, that the width change there without a sediment supply would be primarily from vegetation encroachment and that's what we're looking at, not a geometric change in channel width, but more of an active width based on vegetation.

MR. MCLEAN: Okay, that's -- I've taken up enough time. Thank you very much.

MR. FULLERTON: Well, we appreciate the questions, Dave.

MR. EAGAN: This is Sean from Marine Fisheries.

MR. FULLERTON: Hi, Sean.

MR. EAGAN: I have three questions. The first is you said you had a study modification not to do aerial photos of 5,000 cfs and it seems to me it would be better to have those, because in the max load following scenario, I see a large period of the year where it's being ramped between 5,000 and 12,000, and if we had pictures of what it does at 5,000, we would know which side channels are dry and it would be a great truthing tool to whether an open-water flow model is really putting water where it actually is at 5,000 cfs. So it's just an encouragement that knowing what's really going on at 5,000 cfs would be great.

MR. FULLERTON: So one of the things we're doing instead of the aerial photos, we're going to in the next study season -- we would be doing between -- it would be a joint effort between the fluvial geomorphology modeling study and the riparian instream flow study and we're going to go and survey breaching elevations at all of the lateral habitats, primarily in the Middle River, so that we can link that to our hydraulic models with the estimates.

There's also lots of observations of -- in the various focus areas and that -- that are kind of done at different times and gives us ideas about the connectivity.

We've also placed a number of level loggers that give us real good information on the water level fluctuations in the focus areas and then in the focus areas themselves, we have the 2-D model to give us -- that we're calibrating and checking against those observations, those level loggers, so that we get a very good idea on the kind of activity.

The one -- one of the issues is with the aerial photos is almost -- it's just practicality. We tried for a year to get aerials at different discharges and because of the different weather conditions and flow conditions, it was -- we weren't able to and then the same thing in a second year. It was hard to even get a complete set at any discharge. I don't know how we got so lucky in the 1980s, maybe again another example of climate change that patterns are changing in the summer and that -- so we don't -- we don't think -- the other thing about aerial photos, and they relied on in 1980s, but their whole analysis was kind of geared toward those aerial photos and basically static relationships and just saying that, well, we changed the discharge, so we're going to change the area and that's our habitat analysis, but we're looking at the morphology and other potential changes. So our channels in our studies aren't static.

So the aerial photos are an, you know, an example of the existing or characterize the existing condition, but they may not characterize the with-project condition as the channel (indiscernible) in the project.

MR. EAGAN: Okay, and you would still calibrate -- validate the model as it exists today at that 5,000 cfs, but the next question is, in the Peace River over the last 49 years, they've looked at it and seen that there's a lot of change where the tributaries come in and I'm wondering if in the Middle River, you've looked at what those tributaries could deliver, in terms of sediment size that might not be moveable by these low flows that will be around in a post-dam scenario?

MR. FULLERTON: That is -- that's a good question and that's one that the fluvial geomorphology modeling study is addressing with the tributary, confluence of tributary delta studies where we selected a number of the tributaries to model both existing conditions and future conditions where we may not have as large of flows or the flow regime may be different when the tributary deposits come down and look at how those fans of deltas may change in the future. So that's something we've actually -- that we've incorporated and we actually have two levels of modeling.

There would be 2-D modeling in the focus areas of the -- it's a little less than a dozen of the three (indiscernible) deltas and then there's several others that we'd be doing a 1-D model and Lyle's going to talk more about that or can talk more about that in the next session.

MR. EAGAN: Is that a technical memorandum that I missed or is that something you're planning to do?

MR. FULLERTON: No, actually it is presented, an example in his -- it was recently filed. It was in November and it was the fluvial geomorphology modeling development technical memorandum.

MR. EAGAN: Okay. My third question was, I was really impressed with the way you figured out Manning's N in the center of the channel with the concept of flying up there, drilling the holes in the ice and taking pictures. I'm a little bit curious as to whether that is presented in a way where we could see if it's actually roughest right in the center of the channel or if it grades from a roughness on the right part of the channel to the left part of the channel?

It's just summed up into, you know, 100 points and so we get one number, which is 1,000 times better than what we had before you guys did that.

MR. FULLERTON: Yeah (affirmative), it's -- yeah (affirmative), it's been interesting that whole...

MR. EAGAN: It's really cool, but I'm wondering if that could be presented in a way to tell us what the variance was down there or whether it was consistent across those 100 meters of -- 100 feet, 100 feet or 100 meters, whatever...

MR. FULLERTON: Yeah (affirmative), I don't...

MR. EAGAN: Of the main channel.

MR. FULLERTON: You know, I'll check on that. I, you know, because I wasn't out in the field. I can't recall if all of them were perpendicular to, you know, the channel or were across the width or if some of them were linear, because a lot of -- we had to work with ice conditions and things. So it might be -- there may be some locations like that. There may be other locations where it might have been a more linear or in -- the transect was aligned with the flow. I'll have to check on that. I don't recall.

MR. EAGAN: If even half were perpendicular, it'd be interesting to see that.

MR. FULLERTON: Yeah (affirmative), it's -- that was -- and that was one case where I think the weather conditions and stuff worked out for us on this project because we had -- they flew helicopters for 10 days, every day. It was March. It was 30 degrees. It was -- it all -- it worked out well.

MR. EAGAN: Thank you.

MR. FULLERTON: Thank you.

MR. PADULA: Any other comments or questions in the room for Bill on 6.5? I think you've got a question that Lyle would be better to answer?

UNIDENTIFIED SPEAKER: I can ask it for Lyle, but maybe I can ask it now and he can answer it (indiscernible - speaking simultaneously)...

MR. RUGGERONE: Yes, I'm Greg Ruggerone with NRC. I have a question. Maybe it could be addressed by Study 6.5 or 6.6. Basically, I'm working on reviewing the fish passage, Study 9.12, which relies heavily on Study 6.5 and 6.6 to evaluate fish passage into the tributaries and my question is just simply, to what extent has 6.5 and 6.6 coordinated with the fish passage study and what type of data is being -- and information provided by 6.5 and 6.6 to the fish passage study, and I'm also just wondering of the 27 tributaries identified in the ISR for fish passage evaluation, which of those studies have been addressed by 6.5 and 6.6?

MR. FULLERTON: You mean which of the tributaries?

MR. RUGGERONE: Yes.

MR. FULLERTON: Yeah (affirmative), there's a table, I think it's in the back of the -- let's see, SIR for 6.6 and that details them. I think rather than go over those, I could follow up and send you the link to that, and we have collected all of our data on the Middle River tributaries and the Lower River tribs, which was primarily cross-section surveys, bed material sampling, so we could do hydraulic modeling and get an idea of the bed load transport capacity because that's really going to form the deltas and we have to check to see if the main channel can move as -- so and that data's being shared with the barriers study, the 9.12, and again, Lyle...

MR. RUGGERONE: (Indiscernible - speaking simultaneously) is that an appendix table to 6.6 or...

MR. FULLERTON: It's -- I think it's in the part -- I'll have to just get -- I'll have to get back. We have so many documents, I'll have to get back to you on that one. I can do that...

MR. PADULA: While Lyle is up?

MR. FULLERTON: Yeah (affirmative).

MR. PADULA: You can do that then.

MR. FULLERTON: Yeah (affirmative), I'll check on it.

MR. RUGGERONE: All right, thanks.

MR. PADULA: Jeff, can we make the -- can we swap heads here and have Lyle up and you can still get your question and we can go back up if we need to?

MR. DAVIS: You're the boss.

MR. PADULA: I'd like to do that. Lyle.

MR. ZEVENBERGEN: Yes.

MR. PADULA: We're going to make the transition from 6.5 to 6.6. Lyle was complaining last night that we gave him way too much time on the agenda. So I think we've just taken care of that issue and Bill is still here. So we're not losing Bill and his knowledge, and Jeff, would you like to let Lyle get through some of his material or do you have something that you really wanted to get out there first?

MR. DAVIS: I can ask it right now while he's setting up, if you want to.

MR. PADULA: That would be great.

MR. DAVIS: So this is a question, not as an aquatic (indiscernible), but as a property owner in the city of Talkeetna and I and my insurance agent, as well, want to know how confident you are about your bed elevation model and the confluence immediately downstream.

I guess I want to get Bill and you both to tell me that you're sure there's not going to be any bed aggregation there.

MR. FULLERTON: You're getting FEMA to adopt a new standard for their Flint studies.

MR. DAVIS: Plus we do have a court reporter here, as well, and your attorney just left the room, so (indiscernible).

MR. FULLERTON: That's was -- that was (indiscernible).

MR. DAVIS: That is a serious question.

MR. ZEVENBERGEN: Yeah (affirmative), yeah (affirmative), I was just trying to figure out how to best answer that. First of all, the modeling shows, and I think it's in agreement with what we see out in the Lower River. The Lower River braided, very active, dynamic channel, aggrading, and so -- in its existing condition. That's, you just look at this river, you say, this is an aggrading river.

Under project conditions, we're changing the hydrology and the sediment input and we don't think the character of the river will change. We think it will continue to aggrade and I think that, you know, there's a very small change in the sediment, even with all of that's being collected in the reservoir, but we think it will be aggrading slightly slower than it is under existing conditions.

So I think that from a bed evolution standpoint that your property is fine and also, the project will reduce your peak flows...

MR. FULLERTON: (Indiscernible - speaking simultaneously)...

MR. ZEVENBERGEN: And the project will reduce peak flows, as well, and so from a 100-year flood standpoint, you would expect to have slightly lower peak flows and that's just -- not entirely due to storage, but just also (indiscernible).

MR. DAVIS: I would wish that you'd say something a little bit more confident than I think, and also I'm concerned that, you know, if we get into a fall situation with a full reservoir, your ability to really store those full peak flows may be limited. So if we have bed aggradation and we have, you know, some peak flows that can't be stored in the reservoir, it's something for us to be concerned about.

MR. ZEVENBERGEN: Okay.

UNIDENTIFIED SPEAKER: (Indiscernible - too far from microphone).

MS. MCCRACKEN: Betsy McCracken with the Fish & Wildlife Service, and I'm just wondering if someone can summarize for us the significant findings of the literature search from the downstream effects of dams?

MR. ZEVENBERGEN: Okay, yeah (affirmative), that was the Study 6.5, so Mike...

UNIDENTIFIED SPEAKER: Mike's still on the phone.

MR. ZEVENBERGEN: Yeah (affirmative), Mike, would you like to give that summary? I think we're in transition from 6.5 to 6.6 here.

MR. HARVEY: I can give it a try. I think the most significant finding from -- and so, you know, bear in mind that this is a review of literature of (indiscernible - interference with speaker-phone) responses of rivers to dams and I think the most significant factor that comes out of that is that in many cases, the response of any given river is singular.

In other words, yeah (affirmative), we know some general things. They're sort of general responses under, you know, average conditions, but the problem is, is that after looking at the impacts of dams worldwide for, you know, close to 100 years, we're unable to -- there is no actual predictive capability based on the literature that you can say with any specificity that if you put a dam in here, you will get this response, and so the thing that comes out of the review is that you need to look at the specific condition and I think that's one of the reasons why we've spent as much effort as we have on Susitna, trying to establish existing conditions, because with sort of a thorough understanding of that, then puts us in a better position and that's what we're trying to do, at least on a recon level, with the tables we put together looking at it in a certain kind of order, order assessment, for the different reaches of the Susitna and likely (indiscernible - interference with speaker-phone) in fact.

So I guess, you know, in summary is this, is that the physical geomorphic basis, you know, there are no universal sorts of -- and we need to look at it as a (indiscernible - interference with speaker-phone) specific analysis.

MS. MCCRACKEN: Okay, thank you. So could the project use that information? Can the project use that information to (indiscernible - too far from microphone).

UNIDENTIFIED SPEAKER: Can people hear me? It's...

MS. MCCRACKEN: My question was, so can the project use that information from the literature and the significant findings to apply to get the specific conditions of the Lower River below project river mile 29.9? Has that been fairly looked at?

MR. ZEVENBERGEN: You know, I think that I can go into that, but perhaps we'll hold that until we get just through the -- this first step here, but I'd be happy to talk to you about the decision about below 29.9.

MR. EAGAN: This is Sean. I have a quick follow-up on Betsy's question to whoever on the phone answered that. Mike, what about the time...

MR. HARVEY: That's fine.

MR. EAGAN: As we looked at -- as you looked at rivers around the world after they built a dam, do you see most of the changes in the first 20 years? Do you see half of it in the first 50? Are there any out there that seem to have come to a (indiscernible) or do we get to expect change for 200 years? How -- is there any rule of thumb about how long it takes a river to adapt to one of these dams?

MR. HARVEY: Yeah (affirmative), I think there is a, you know, I mean sort of a (indiscernible - interference with speaker-phone) I think, again, it's site specific. What you see is depending on the situation, you know, and a lot of it is a function of sediment supply and any interruption to that, transport capacity and then any sort of (indiscernible - interference with speaker-phone) like alluvial constraints and then also downstream, where the tributaries are, and how (indiscernible - interference with speaker-phone) et cetera, but the sort of the -- the short answer to your question is that there are some occasions where things have happened very fast and then -- and they have been within very short distances downstream of the dam.

There are other conditions where there are changes occurring still, you know, 100-odd-plus years downstream. So I think, again, it's -- this is where, you know, there is no sort of universal -- the response of the river system downstream of the dam is a function of the preexisting condition and that sort of geologic, geomorphic, hydrologic and how the system affects that, and so I don't think there are any sort of, you know, rules that we can apply. I think we have to look at it on a case-specific basis.

MR. EAGAN: Okay.

MR. ZEVENBERGEN: Well, I've been informed that I've just been fired. I've gone over my time, but so -- I'll see you guys. So I would like to just go through the presentation. It's not heavy on content. It's just a living progress report and then we'll -- I think we're aiming for a break around 10:30, Steve?

MR. PADULA: Yeah (affirmative).

FLUVIAL GEOMORPHOLOGY MODELING BELOW WATANA

DAM STUDY (Section 6.6)

MR. ZEVENBERGEN: Okay. So 6.6, Fluvial Geomorphology Modeling Below Watana Dam, the ISR documents, as you can see here from the status that we've done, a number of technical memorandums, which I can discuss, you know, if there are any questions of any of them, I know there will be.

Data collection was conducted in 2013 and completed in 2014 that specifically relates to the modeling. The three study components, each were advanced. None of them are completed, but each one was advanced significantly through this time.

Our objectives, to develop calibrated models, to apply those models to existing and with-project conditions, coordinate with the geomorphology study and with other studies to provide information that's useful for the habitat analysis.

The three study components parallel those objectives. So you can just see we're developing models. We're collecting the data, calibrating the models, modeling all of the different scenarios and then coordinating and interpreting the results.

Study variances, we had originally intended to use Wilcock Crowe as our transport function. That was used in the 2-D model. In the 1-D model, that wasn't going to work. So we looked at other functions and found the Ackers White to be a very suitable function for this river.

We then, through the proof of concept exercise, we determined that we really did need to include groundwater sources in the focus area of 2-D modeling. So that was an addition. So it's a variance in the fact that it was not planned.

The third variance was to not consider PDO in selecting the hydrology and there's a technical memorandum on that selection of why PDO was not a major effect.

This just lists all of the data sources that we have and the studies where that data came from. So we did not do cross-section surveying and bathymetry surveying within our study, but we definitely used that data at length. So this is all of the data, which all of it was collected in both 2013 and 2014, except for the very last bullet, the discharge measurements in the focus areas, and those were done specifically to address that issue of characterizing groundwater inputs into some of the upland sloughs, side sloughs, and various habitats so that we could have a better informed 2-D model in our high -- in the focus areas.

So in terms of our progress and our results, the first study component, the model existing conditions with -- this would be the second study component, sorry, model existing and with-project conditions, we've run the 2-D hydraulic model for focus area 128 and that was part of the proof of concept and that information was made available and used by the aquatic habitat study.

We have done the initial 1-D modeling of the entire reach from Watana Dam down to 29.9, Susitna Station, and that has been done for existing conditions and the max load following OS-1b scenario, and then we have done 2-D sediment transport bed evolution modeling for focus area 128, again for these different scenarios.

Then in terms of the coordination side of things, that's been continuous, ongoing, not only between us and geomorphology, we're really one team anyway, but also with the other studies as well, and so one example of that would have been the 2014 proof of concept exercises we went through.

Technical memorandums, we've had a couple versions of our modeling approach technical memorandum. There was a 2013 version, 2014, and that is where the results of the first proof of concept exercise is reported.

Another technical memorandum on the selection of the hydrology that not only included the 50-year selection that we were going to analyze, the 50 years in the hydrologic record, but also the representative years, the wet average and dry years, and also looking at the Pacific Decadal Oscillation and why we determined that wasn't a factor in the open-water season.

Then the question earlier about the winter bed sampling, the bed material sampling, that's reported in a technical memorandum from 2014. The decision point for whether to model below 29.9, Susitna Station, is a technical memorandum from 2014, and then the most recent, and maybe unfortunately, the most voluminous technical memorandum is the model development TM, which is part of the SIR and it -- the SIR has this technical memorandum as an appendix and then the appendix has two attachments, the 1-D modeling and the 2-D modeling, bed evolution modeling, so a good read.

So decision points, a number of past decision points, which I don't think I really need to go into, but we do have some modifications, proposed modifications that -- some of them kind of result from that. One of them is that, you know, to use Ackers White instead of Wilcock Crowe.

The other one is the groundwater sources and the third one is the PDO. So those are proposed modifications in the fact that they're not currently approved, but those are the directions that we have gone.

Then additional proposed modifications, in terms of the uncertainty analysis, we proposed to use critical shear stress as part of our uncertainty analysis. The Wilcock Crowe function doesn't specifically have critical shear stress in it, so we'd be using a similar alternative parameter.

Also looking at bank erosion, we were initially planning on using Bank Energy Index to use as part of that evaluation. We found at focus area 128 that it really wasn't a very good descriptor of the bank erosion at that location. So we're proposing to not do that analysis for future focus areas.

The other thing we learned at focus area 128 was that we might need to do more than just the three years, the wet average and dry years, to really characterize the development of a fan from a tributary and so that we, under certain circumstances, might extend the time period of that modeling. So that would just -- to be to better characterize fan development.

Then the final modification is that we feel that there are going to be situations where we won't need to do the complete set of 2-D models for every focus area and so that would be informed from the 1-D modeling and from the 2-D modeling at other focus areas, so that in terms of a future decision, we might be just simply trimming back on the amount of modeling that's done in some of the focus areas. So that's really a future decision that's reported in the ISR.

Steps to complete the study, we need to finalize the 1-D bed evolution model. The one that we have included in the current reporting didn't have all of the cross-sections, doesn't have all of the sediment inputs, needs to have updated hydrology. So there are a number of things that need to be done with that.

We have a lot more 2-D models to develop and we need to finalize our sediment supplies from tributaries and then we also need to look in more detail at aspects of large woody debris and ice.

Then that would obviously carry forward into with-project condition modeling and then really where this whole thing is leading to is the interpretation of the results and working with the other studies to provide them the information that they need for the habitat analysis.

Okay, so maybe we should get Becky's question, not Becky's question, I'm sorry.

MR. PADULA: Betsy's question.

MR. ZEVENBERGEN: Yes. So could you repeat that?

MS. MCCRACKEN: Yes. This is Betsy with Fish & Wildlife Service and my question was related to the response I got on the literature search for the impacts to -- impacts downstream from dams and I was wondering, since Mike was saying that the impacts are very site specific and that there's no predictive capability, he was summarizing the results of the literature search, and so I was wondering if that information, since we need site-specific conditions, if that could be applied and used as rationale for allowing you to look below project river mile 29.9 for project impacts.

MR. ZEVENBERGEN: Okay, so the -- so I think the part that I needed to answer was related to the decision to not do fluvial geomorphology modeling below 29.9, and so that whole question, and Bill gave a good summary.

We looked at changes in hydrology, changes is sediment transport, changes in velocity and depth, changes in channel width, and also aggradation, degradation related to, in this case, the max load following scenario, and the rationale was that we needed to characterize the range of each of these variables, so the range of velocities, the range of sediment transport, and then relate that -- compare that to the changes that the project would have, and in each of those cases, the -- once you get, you know, past the Talkeetna River, the Yenta, especially, the Chulitna, you know, all of the project effects get dampened, both in terms of hydrology and sediment.

By the time you get to 29.9, the project effects are minute in compared to the range of, you know, those -- of each of those variables, so that to even be able to identify a project effect within that range of, I wouldn't call it uncertainty, it's just the range of that parameter, would be extremely difficult. So our recommendation was that you would not need to do this modeling below 29.9.

MS. MCCRACKEN: Okay, so I think what I'm hearing is that there's site-specific conditions (indiscernible - too far from microphone).

MR. ZEVENBERGEN: So that -- so you're saying -- I would like to say, no, we did specifically look. So it's not that we didn't look. We specifically looked at each of those conditions at 29.9, and if you can't determine a change at 29.9, determining a change below 29.9 would be impossible.

So we did -- I mean, so we are looking at specific project effects. So how else can I say this? We had a decision to make as to whether to model below 29.9. If we have to model below 29.9 in order to make that decision, that kind of removes the whole reason for making the decision. So let me show you -- I think how we made the decision...

MS. MCCRACKEN: Well, the reason I'm asking is because we have concerns below there related to the resources and the river productivity and hooligan and belugas and birds, and you know, many species of fish and habitats and especially the (indiscernible) habitats and so I'm just -- I don't know, I'm wondering how we're going to account for that changes from the project.

MR. ZEVENBERGEN: The -- let's see, so there, you know, there are beluga, there are the eulachon other resources. In order to determine an impact on their habitat, you would need to have an impact on the hydrology, on the sediment, on the flow depths and velocities, and that's how we would base that.

So if we can't determine an effect on those, you know, those level one variables, how would we determine an effect on the habitat, and so it -- I've just put up an example here and this is the flow duration curves for each of the 50 years during the open-water flow season for existing conditions that, you know, the without project hydrology versus the max load following hydrology, and you can see in this graph that yes, there is a change in the hydrology during the open-water flow season.

The green lines are shifted slightly down from the blue lines, but the range of that variable is very large. So there's a large range in the variable and a small change in the with and without project condition, and so we looked at -- I mean, and so we did look at the specific variables, velocity, depth, sediment transport, and so you know, with any kind of an analysis, you're looking for, is there a change? Yes, there is a change. Is it a large change or small change? In this case, it's a very small change relative to the nature variability.

MS. MCCRACKEN: Thank you for that explanation. You know I think -- I think we'll keep talking about this more, but we also have concerns about the water temperature and (indiscernible - too far from microphone) downstream, so I think at some point that will come up again, but thank you for that.

MR. MUNTER: This is Jim Munter with JA Munter as part of the (indiscernible - background noise). If I could follow up on that question, you know, how do you evaluate this, as I look at that curve, there's a lot more peak flows with current conditions that would not occur under the project and as I recall reading the literature review, I think one of the findings was that you kind of only find water table reductions with hydropower because, partly because you have fewer over main flows that go out and flood those areas and raise up the water table.

So I guess my question here is, it could be that the absence of those peak flows could have some impacts in those habitats and how do you evaluate that? It's not new conditions. It's the absence of the old conditions.

MR. ZEVENBERGEN: Well, I think if you look at the -- if you actually look at this, the flow duration analysis, you know, does show that there is a peak flow of approaching 300,000, you know, it's probably one day in 50 years that hit 300,000, where the with-project, you know, gets up to 280,000.

So the -- so one day at 280,000. So the -- in terms of that one data point, it's not going to affect groundwater and it would only, you know, be expected to happen once in 50 years. So the range is -- and I agree that the range is slightly shifted down, but in terms of an overall impact, you know, our approach was to look at it relative to the natural variability.

So the natural variability is very large and the project effect, you know, remember we are very far downstream. The project impact is very small.

UNIDENTIFIED SPEAKER: (Indiscernible - too far from microphone).

MR. VASQUEZ: Pepe Vasquez and (indiscernible - too far from microphone). Is it working?

UNIDENTIFIED SPEAKER: You don't have to hold the button.

MR. VASQUEZ: Thank you. Sorry, sorry about that. What I was really interested to see finally, there are such results of the bed evolution. There is a profile that you presented on bed changes along the Middle River and the Lower. So actually, it was very interesting to find that you see some of the results and you also posted on the internet, actually, the bed evolution model, which was great.

So I downloaded the models, the Middle River, and I just wanted to make a (indiscernible) look at your models. So I looked at the Middle River, the existing condition and the maximum load following 1-B. I noticed that all of the input data is there, but there were no results in the model (indiscernible) and I just press the simulate button to let the model run.

It stuck results. I'm trying to -- of course, it should be identical to what you presented, but they are not. They are very different. So when I run these models, I'm getting data -- the model is predicting (indiscernible) 10 feet upstream and also the -- what is very disturbing is that if they predict more degradation from the existing condition. So without a dam, there's no degradation, but with dam, which of course makes no sense at all, and so why -- and like do you have an idea why that is the case or what is happening?

MR. ZEVENBERGEN: The -- I can't imagine why it would predict degradation for the existing condition and not for the with-project condition, but in terms of getting different results, the only explanation I can think of is that, you know, when we were doing that 1-D bed evolution model, we were using beta software from HEC, from the Corps, and we have not rerun the model with the final software. So it would be a matter of seeing, you know, what the difference in the computations would be in the data versus the final released software.

MR. VASQUEZ: Yes, well, I can tell you something. I understand that you used the (indiscernible) or something (indiscernible) '14. I ran it in 2015. So the data, just last Friday, I tried to run it using the official reads and it didn't run. It gave me an error message that it couldn't run and -- but that would be really a concern. I mean, if you changed the version of the software and you get different results with the same input data, would that be really a concern? Is that what it is?

MR. ZEVENBERGEN: Well, I'd have to look and see why that occurred. You know, we, obviously, when we did the modeling, we calibrated it. We tested it and the results, in terms of the sediment transport, looked very comparable to the data, the USGS data.

So I would think that there is something not translating through into the new version that should be, is what I would think. If you're getting huge amounts of degradation in that Upper River, that's a result that doesn't make sense. So I would say that there's probably something in the old input files that are not carrying through to the new software, but you know, thank you for pointing that out. I'll definitely need to look into to why that's the case.

MR. VASQUEZ: Yes. So I mean, if I can offer a suggestion, if it were possible that once you have a review of the models and maybe it's running in the current (indiscernible) if you could upload it to the Internet, yes, it will be (indiscernible). So I think it will be a good thing where anybody is able to replicate a result that you present in the report, because right now, that's not the case, and I have also another question.

I noticed that in, I think it's 70 cross-sections, not all 160, are set as pass-through notes, and just for the benefit of the people here, a pass-through note is a note where you actually tell the model that bed evolution is zero. There's no evolution there, which makes sense probably in Devil's Canyon, because I assume that is a bedrock control and there's no change in there, but because -- I understand because of the instability problem in your focus areas, almost maybe 40% or more of the cross-sections now, you're actually telling the model the bed evolution is zeroed out and so it kind of defeats the purpose of the model because you're -- this model is intended to predict bed evolution and you're telling it, well, bed evolution here is zero, in areas -- actually in the focus areas, which are the most important ones, and I understand the reason of this, is that I read, it said it's a (indiscernible) problem with the model that the model cannot handle flow around the spit areas, channels, and so to me, that's -- well, that's concerning and the -- one of the things that you said in the report is that (indiscernible) have fluids, big areas in your model and has not increased to 12.

So does that mean that you're going to use even more pass-through notes in your future models or how are you going to address the situation? I think it's clear that you have to remove it outside of Devil's Canyon.

They're not justified in any area of Devil's Canyon, to use pass-through notes. How are you going to address this problem?

MR. ZEVENBERGEN: Yeah (affirmative), so that's a good point. The, as again, we were using the data version of the model available from the Corps and in Devil's Canyon, of course we use pass-through notes because that really is a bedrock channel.

At the junctions, where we have split flows, we originally were not using the pass-through notes there, but because of instabilities and limitations of the software, we resorted to doing that just at the junctions.

We've worked with ATC and to -- on this particular issue and now, in this new version, the pass-through notes are not required, and so we would be removing those in the final version of the model. That was a necessary step for model stability at the time, but not at all part of our plan moving forward.

MR. VASQUEZ: That's -- I mean that's great to hear, and I think Bill asked a question to you that actually (indiscernible) but he said that you were going to talk also about the uncertainty analysis. The uncertainty analysis is going to be part of your (indiscernible) with that?

MR. ZEVENBERGEN: Our -- in terms of the RSP, we've identified to do a sensitivity analysis to address uncertainty. So we're not doing the, as David was saying, the complete uncertainty analysis of the full range of possible outcomes and then have that translate to the habitat, but more of a model uncertainty or a sensitivity analysis to start addressing that range of uncertainty. So that's the -- in terms of the modeling, what we're intended to do is a sensitivity analysis.

MR. VASQUEZ: Okay (indiscernible) much time, maybe just a final question, and so I noticed that you use different transport questions to run your model. The thing is within the Crowe, the 2-D model, do you use Parker for the (indiscernible) test and then modify accuracy, the 1-D (indiscernible) model, how will you reconcile these, especially in the focus areas, because you're going to -- the idea is (indiscernible) to take the 1-D model, the results from there and then apply those (indiscernible) conditions for your 2-D models, but if you're using different transfer rates from different equations, how are you going to, I mean, put them together? Can you explain a bit about that?

MR. ZEVENBERGEN: Well, that's right. That's what we did. In the 1-D model, we used the Ackers White. We modified it in the Middle River, but then we did use the results from that model to drive the Lower River model, where we used Ackers White unmodified and so there was definitely a transition from one approach to another, but the actual channels differ quite a bit.

I mean, the Middle River model or the Middle River is a very different river than the Lower River. So moving to a different transport function and a different transport regime actually makes a lot of sense.

Now in the focus areas, again, we used the 1-D model results to drive the 2-D model and so we did use Wilcock Crowe coupled with Engelund-Hansen for suspended load in the focus area of 128 and found that worked quite well.

So our preference would be to use Wilcock Crowe coupled with the suspended load function everywhere, you know, but that's not an option in the 1-D model. So we did make that transition and we were happy with the results.

MR. VASQUEZ: So I assume it (indiscernible - too far from microphone) all of the questions then?

MR. ZEVENBERGEN: They were similar enough that it didn't cause any problems, yes.

MR. PADULA: Thank you, and I know we have some additional questions and Cassie's going to start us off right after a break, so why don't we do a 15-minute break and be back here at 10:45? Lyle and Bill will remain -- both will remain available to us.

10:32:03

(Off record)

(On record)

10:48:08

MR. PADULA: Great, let's get started and I'm going to give this microphone back to Cassie and where did -- Lyle's up there. Where's Bill?

MR. ZEVENBERGEN: He'll be right with us.

MR. PADULA: Okay, here's Bill. Cassie, you've got them both.

MS. THOMAS: So I understand that we're dealing with all these studies in series, rather than parallel, and there's a lot of interdependencies -- Cassie Thomas is my name, but my question was about whether we've looked at the effect of vegetation changes near the mouth of the river?

We've already heard the 100-year floodplain may narrow a little bit for a couple of reasons and I know that, you know, ice processes may also play into the vegetation, but if we were to get more woody vegetation coming in into areas that right now are just, you know, pretty much plowed out every spring during break-up, I'm just wondering whether -- with the aggradation that's already happening in the delta and fan at the mouth of the river and whether we could see some narrowing and changes to the morphology of that fan due to veg?

MR. ZEVENBERGEN: What specific location is this?

MS. THOMAS: I think we're -- I was really interested -- well, really the whole river, we've already heard what is probably going to happen in the Middle River where, as you said or someone said, the geometry of that river isn't going to change, but the amount of vegetation along its banks will, so then we'll have a different -- a little bit different character.

I'm wondering if we know what's going to happen from Susitna Station to the mouth of the river.

MR. ZEVENBERGEN: In that area, we're using hydraulic geometry relationships and the change in flow to say that the channel would have a tendency to narrow slightly. I think that would -- the, you know, that would coincide with probably a little bit more vegetated floodplain and vegetation on the islands.

MS. THOMAS: So I guess what I was really asking is, as you have more vegetation and especially more trees or willows, you know, trees and shrubs, things that can trap stuff and vines, especially, do you get a feedback loop where even though based on flow duration curves you're not expecting a change in fluvial geomorphology, you, nonetheless, get a bit of a change because the plants are constricting the channel and causing aggradation, you know, around their roots that causes that constriction?

MR. ZEVENBERGEN: I think that's part of it. I think that there is a feedback between the change in hydrology and the vegetation, and then the feedback that the vegetation would trap more sediment, but that would be part of that process. So it would all get...

UNIDENTIFIED SPEAKER: Together.

MR. ZEVENBERGEN: Yeah (affirmative), kind of lumped up -- lumped into one process.

MS. THOMAS: But we didn't model that below 29.9?

MR. ZEVENBERGEN: We didn't model that below 29.9, right, but we did model that above 29.9.

MS. THOMAS: So we don't -- but we don't really know, I mean, if there are species that need a certain kind of habitat that doesn't involve large woody shrubs and trees, we don't -- then are we able to estimate the change in habitat types below 29.9 due to vegetation changes?

MR. ZEVENBERGEN: Our, yeah (affirmative), our...

MR. FULLERTON: If I show the width variation...

MR. ZEVENBERGEN: Yeah (affirmative), I can do that, before I showed the width variation, it is the wetted area and so there'd be a little bit more floodplain, a little bit less wetted area under the new hydrologic regime and so just in terms of estimating that amount of change, I think that can be done without modeling and that would probably be the most reasonable way to do that.

The -- in the decision point, and I think that -- I don't remember where, it was at...

MR. FULLERTON: I think it might be...

MR. ZEVENBERGEN: It was -- yeah (affirmative), earlier, yeah (affirmative). So we did look at the channel widths, and again, an incredibly dynamic system with these channels shifting around all the time and in looking at the existing width, let's see here, there we go, starting at 29.9 there on the right-hand side of this figure, we looked at the variability of that width by summing up those channel widths by river mile and you get below -- you can see that it's widening.

It's braided. It's going into that -- kind of the tidal flats there as you move further down, which get very wide, but the amount of change that you'd see, and I used 6%. The estimate would be like 5.5% narrowing due to the hydrology, so we used 6%, and so the red line versus the black line is kind of the anticipated change in width versus how much the width varies already, which is over thousands of feet.

MR. FULLERTON: Yeah (affirmative), it might be hard for folks to even see that line up, but that's the difference. It's small compared to the scatter of how just the width changes from one location to the next.

MR. ZEVENBERGEN: So the hydraulic geometry relationships take into account kind of the existing condition, the future hydrology, which the existing condition already includes the interaction between the sediment and the plant communities and so the change would be relative to that, you know, to that original condition.

MR. EAGAN: I have a couple questions. One is we were asked to evaluate the stuff that was given to us on November 5th, and you know, we're evaluating a (indiscernible) model with 70 nodes. It's hard when you guys keep changing models and saying, well, you really evaluated the one that was -- the old one. Is there going to be another new one in the next couple of months or when will you say this is the final one?

MR. ZEVENBERGEN: So first of all, the bed evolution model that was used for the decision point is the only bed evolution model that has been reported on and so the new -- the newest TM is providing information on that original bed evolution model. So you only have one bed evolution model.

MR. EAGAN: With the 70 nodes?

MR. ZEVENBERGEN: Seventy nodes in the Lower River. There's a Middle River and there's a Lower River.

MR. EAGAN: The Middle River one we -- I saw had -- you had put 70 nodes in there.

MR. ZEVENBERGEN: Okay, so the Middle River has 70 nodes, okay, the -- and the Lower is 50, okay. I'm -- the numbers escape me, but we have not -- and we made this decision in order to keep that problem from occurring. We've only reported on the initial bed evolution model. We have not changed which model we're -- we do -- we are going to update that model to a final model, but it's the initial bed evolution model that you have.

MR. EAGAN: Okay, thanks. All right, here's a harder question. You've got three models, 1-D models. You've got the open-water flow model version 2.8. We've got your bed evolution model. We've got the river 1-D model. They're all based on -- my numbers might be off, but 166 survey cross-sections and then all three groups put in a different amount of interpolated cross-sections, one who puts in 1,000 meters, open water, 12 people put in 1,000 meters below the survey, 1,000 feet below the survey cross-section.

I think you guys spaced your interpolated ones kind of evenly. The river 1-D people put them -- lots of them in. You can't completely represent the river with numerical models, but you do the best you can and that's what everyone does, but shouldn't all three groups use the same set of cross-sections?

If you're the bed people, shouldn't the other two groups kind of be forced to follow suit or whoever -- shouldn't somebody call trump on (indiscernible - background noise) a derivative process should be.

MR. ZEVENBERGEN: Believe me, I tried. I tried to impose my will on the other studies, no. The answer is really quite the opposite. Each study, you know, needs to answer particular questions related to their study using the model that -- or the software that is most applicable to their study and then based on that, you decide what is required.

For fluvial geomorphology, we need to have relatively evenly spaced cross-sections. We don't like to have some cross-sections that are very tightly spaced and others that are very spread apart because of the sediment volumes and the sediment continuity. You'd be attributing lots of change to small areas.

So we really need to abide by the rules and then I'm sure that the ice processes need to abide by the rules associated with their physical processes that they're simulating and so it would just be untenable to try to get all three of the different types of models to work under the same framework. It just -- it couldn't be done.

MR. EAGAN: But 25 years from now or 50 years from now, your study is giving us what the bed looks like. So they have to then use -- at year 50, they have to be using your cross-section, your bed to run their models, not their bed, right, because you're the ones who model the change?

MR. ZEVENBERGEN: So if I say that there is going to be two-foot of degradation in 50 years over this reach of river, they would be able to apply that two feet of change to their model. I wouldn't have to give them, you know, here's your cross-sections that you're going to use. They're going to be able to apply the bed elevation changes from my model within their modeling framework.

MR. EAGAN: So what you're saying is rather than using your cross-section at year 50, they would take your general number that you got, a foot-and-a-half of degradation or -- and take theirs and pull them down by that amount?

MR. ZEVENBERGEN: And you know, this was something that we, I think stated back in the RSP, that the 1-D bed evolution model should not be looked at, specifically at will this cross-section change a certain amount, that it's really meant to be a reach -- more a reach representation.

So we would always say that we're interpreting this model, that you're looking at multiple cross-sections, looking at a reach and looking at trends from the reaches anyway. So that would be, I think, the most appropriate way for them to use that information.

MR. HOLMQUIST-JOHNSON: Chris with USGS, just a follow-up on that would be then taking those results and then how we apply that then in the focus area utilizing the 2-D model, which now we are doing much more of a, how does the focus area channel and geometries and off-channel habitats change based on that model? Those are all driven by what the input or output from the 1-D bed evolution model is and so there is a linkage there and then trying to understand how that output from the 1-D bed evolution actually drives the 2-D bed evolution model and then with that, as well -- well, I'll stop with that for the moment.

MR. ZEVENBERGEN: And so that is, again, an aspect of our study is to provide that linkage between what we call the reach scale modeling and the local scale modeling and so the reach scale modeling is meant to address the general trends through a longer river reach that we can then apply within the focus area modeling for future conditions. Yes, that's our plan.

MR. HOLMQUIST-JOHNSON: So with the 2-D, I guess when you take your existing conditions, say the mesh bathymetry for that 2-D and you see that there's a trend of, you know, two feet of erosion at a certain upper boundary transect, how does that get applied as input to the 2-D model for it to be able to run that next simulation for that timestamp? Is the entire area of that 2-D adjusted by that volume or how does that -- or amount or how does that get applied to the 2-D modeling and how it marches forward in time?

MR. ZEVENBERGEN: So the 1-D model is looking at the channel and so that if you have, again, a lowering of the channel in the 1-D model, we would lower the main channel area in the 2-D model to, you know, be similar to that. We're not lowering the entire 2-D model, just the channel areas.

MR. HOLMQUIST-JOHNSON: So you lower the channel and then let the side habitats then step through your timestamps to see how those change based on your main channel alternation?

MR. ZEVENBERGEN: Yes.

MR. EAGAN: Sean with Marine Fisheries again. So we had some big flows in 2012 and 2013, and I'm wondering if you were able to use that data to validate whether your model actually correctly showed changes that could be measured, could be seen in the cross-sections that were surveyed and after those two large events?

MR. ZEVENBERGEN: Our bed evolution model, you know, we did a hydraulic calibration that involved those events in those years. We did not do sediment transport modeling of those particular years. We did the sediment transport modeling of the 50 years. That was our plan, but -- so we do not have -- and we have some cross-section comparisons from the '80s to 2012 that we did use as a comparison. So we did not look at specific change within one year, no.

MR. EAGAN: Are there plans to validate the true bed change element in your model?

MR. ZEVENBERGEN: Not within the 2013/12 timeframe, no.

MR. EAGAN: Okay, thanks.

MR. PADULA: Here in the back.

MR. MOUW: Yes, this is Jason Mouw. I have sort of a conceptual question, followed up by a specific question regarding bank erosion you mentioned in your talk. I struggle overall with the general perception that the Middle River is not alluvial and relatively resistant to change.

To me, it seems to be alluvial and characterized by an oversupply of sediment, not like the Chulitna or further downstream, but that oversupply manifests itself in, you know, vegetated islands, exposed gravel bars and also side sloughs.

So these are features that speak of an oversupply of sediment over time and whereas, the (indiscernible) itself may be extremely coarse and we might not expect a whole lot of, you know, bed denudation or erosion, when we see a suspension of that sediment supply for long stream sources, you would expect, again, specific responses, of course, are not predictable, but you would expect that over time, a lot of these features would erode and perhaps be compromised and with or without ice, because we see, you know, rivers across the world, I've done, you know, the literature review too, and found yours very helpful, but with or without ice, we see these same features, these same drivers and so my concern is, is there a way that some of these lateral features, lateral migration, bar evolution can be addressed in some other way than by looking at the ice, you know, as a driving factor?

Is there another tool that could be used to evaluate how the -- some of these features might respond below the dam face?

MR. ZEVENBERGEN: So yeah (affirmative), first of all, I want to agree with you that there is alluvium in the Middle River. The sediment supply, predominantly sands and silts, that there is alluvium in transport. When I said that the channel wasn't an alluvial channel, I really was focused in on the bed, you know, how coarse the bed is and how the material that's being transported is really just, you could call it a wash load or a throughput load, where the sand is just being throughput through this very rigid bed.

So there is alluvium and that alluvium is responsible for creating the island features and the bars, but the bed, itself, is really just a conduit. So I agree with you on that.

When we initially were going to look at this, the bank erosion, now the banks do move. The banks of the islands, the banks of the channel do erode. They do build and they do change with time and that's the -- all of the aerial photography over time really demonstrates that.

When we looked at the fluvial, the open-water energy available to erode the banks and where the bank erosion is occurring, we could not correlate the open-water conditions to that and so our plan to -- and we're not going to ignore bank erosion, but we think that there's a really dominant ice process in the Middle River and that we will be evaluating that in more detail and probably still using a similar idea as the Bank Energy Index, but relating it more to ice break-up conditions than to open-water conditions.

MR. FULLERTON: I think Mike might want to comment about that.

MR. ZEVENBERGEN: Mike, you want to add anything to that?

MR. HARVEY: Yeah (affirmative), I think can. You know, I -- one thing I would say is that when we said it's not an alluvial river, we're not saying that there is no alluvium in the system, but what we are saying is that the locations where the river is dynamic and where there is alluvium localized in the Middle River, they're all upstream of local constrictions in the form of bedrock or bedrock alluvial fans or, you know, some other (indiscernible - interference with speaker-phone) constriction and so they're dynamic within relatively short reaches.

Now, the other issue is just no, it's true that there is -- there are eroding banks, but we have pretty much of 60-year record of what's happened in the river. Now what we find is that the rates of erosion are extremely low, bank erosion, are extremely low with respect to what will be expected on an alluvial river of that size, and that's an interesting question in itself, you know, how do we have this big river or why do we have this big river that has fairly (indiscernible - interference with speaker-phone) hydraulic energy, has ice impacts, and why are we seeing so little, relatively speaking, in terms of bank erosion, and you know, as Lyle said, part of it is, is the, you know, in the open-water season -- well, it -- well, let me put it slightly differently, we have a conditioned system.

It's inherited a whole bunch of characteristics from a long span of (indiscernible - interference with speaker-phone) geomorphic processes with (indiscernible - interference with speaker-phone) and ice. So I would sum it up, bank (indiscernible - interference with speaker-phone) and so, you know, a lot of time if you're getting bank erosion, what drives it on the outside is scour of the (indiscernible - interference with speaker-phone). We're not getting that.

We have the upper banks that are very heavily vegetated. What we see in a lot of places is that we have cantilever mass of roots that protect that upper bank. You get erosion. You get cantilever and then you get effectively (indiscernible - interference with speaker-phone) in the upper bank.

So we've got -- it's a slow process, not that it doesn't happen, but it just goes slowly. It's much slower than we would expect it to be and then ultimately, you know, when you put a project in effect, we're actually reducing the peak flows, because of upstream storage and so you take energy out of the system, as well. So if you do that, yeah (affirmative), there is no reason to believe that your erosion rates will increase over existing.

MR. WOOD: This is Mike Wood, Susitna River Coalition, and I apologize, I had to leave. So maybe this question was answered, but you said before I left that you didn't -- the sediment in the river post-project, your model didn't really show much of a difference between pre-project and post-project in terms of the sediment in the river, and so a question that I have is, you know, I used the seasons and the weather events to model in my brain every day and I've had the luxury of being able to watch the ups and downs of flow on that river.

I agree, and I learned from this last ISR process that through Wade and whatnot, that the bank -- the bed is very stable. I get that, but summer precipitation events and then winter solar events are what drive the flooding in that river and Mike from New Zealand is right, I mean, it's amazing up there and I think the reason it's amazing is it's completely perfect, that the terrain on either side of the bed surface absorbs that water exactly the way it's supposed to and year after year of living on the edge of that, I'm very grateful I put my house where I did and then sometimes I'm not, because it looks like it's just going to disappear and so I just want to say that if you stop the sediment from coming down because it's behind a dam, you're going to have a much clearer river and just like you will have right now.

It's flowing as clear as a bell and then -- and that's not good year-round to have it like that. I've travelled with Kevin Featherston and whatnot through all these backwoods beyond belief and there's a reason why this water and flooding needs to go back there and winter is one of the major causes of why that flooding is back there, why those fish are back there and why the elevation of the (indiscernible - background noise) was up and down back there. I've got to watch that in my well seasonally.

So I just think that the flooding is not only -- that the exciting flooding is what's coming down the river. The ice flooding that happens when the ice jambs in the river is incredible how it raises the overall water level and I think the flooding is what defines that river and so I've got to tell you that if you say your models are the same post and pre-project, that your models must be wrong, because there's no -- there's -- that cannot be true. So that'll be all I say.

MR. ZEVENBERGEN: Okay, so I want to clarify that when I said that there wouldn't be much change in sediment, I was specifically talking about below 29.9, but I'm not talking about the Middle River.

The Middle River, there will be a huge change in sediment transported through there and as you stated, you're going to have a clearer water river in the Middle River during the open-water season, where now we have the glacial silts and sands that are being fed into the river.

So we're in agreement that it will be a clear water river during the open-water season in the Middle River going by your house, but if -- that does not translate down to 29.9.

The -- in terms of the modeling that we're doing, the sediment transport and the bed change is the focus for our modeling and so the bed change in the Middle River due to its coarseness, which you indicated, is limited. So the bed change will be limited during the open-water season.

That doesn't mean that we're discounting ice processes. That's why we have an ice processes study and we understand that the ice processes are very significant and important for this river, both in terms of the morphology and in terms of the flooding.

MR. WOOD: Thank you. I just want to say that I always have to refer to the model in my brain that sees more water coming out of the project in the middle of winter and -- than exists now and volume is what seems to scour things and transport more material and so I could potentially see what -- what the increase in winter would look like with higher volumes and what potentially could be carried away at a different time of year even.

I just want to go back and revisit something that Phil said yesterday how the Susitna River contributes 16% of the volume down at the mouth and I don't know if that's in the summer or winter or when that is, but right now, in the wintertime, the Susitna is a much larger contributor than the Talkeetna and the Chulitna Rivers and so I look at that and I think about it and I'm down there fishing in it, down in the Lower River, and believe me, it's hard to root-find in the Lower River of the Chulitna, I get it.

In the wintertime, if you increase water levels, you're suddenly adding more water to the system in the winter out of the Susitna and it is a much larger contributor, post-project, and I'm curious about, you know, what the -- I mean, that model in my brain looks pretty significant beyond Talkeetna, beyond Willow and beyond your Susitna Station and makes me question salinity all the way down at the very mouth of the river, even in mid-winter, so -- and sediment transport, and I'll shut up.

MR. ZEVENBERGEN: So you know, those are -- those are all aspects of the study. There are the, you know, we have the ice processes study to deal with the winter flow conditions, the ice conditions. In terms of salinity, we have the water quality study that is looking at things year-round.

In terms of the sediment transport, we're focused in on the open-water conditions because with the ice cover, the velocities are so low that we get basically clear water in the winter and virtually no sediment transport and so that would, you know, so that's why the focus is on the open-water season for the alluvial -- the bed evolution modeling.

MR. WOOD: One last thought on the sediment transport is -- I want to say, too, and John will be able to attest to this, is that ice picks up a lot of those really solid bedrocks in the riverbed and he moves them around and that's pretty helpful for moving that large woody debris and massive granite around. So it's -- they get trapped in the ice and then float down and get redeposited and these are boulders the size of your tool shed.

MR. PADULA: We have Becky with a comment in the back and then we'll come up to Walker.

MS. LONG: Hi, Becky Long, SRC. I just have a process question, which AEA or FERC can answer. So when you guys do the modeling and you come out with before and after project effects and then you analyze it, is that going to come out in the USR or is that, the analysis and all that stuff that's coming out of all of these great models, will that be in the draft license application?

MS. MCGREGOR: This is -- can you hear me?

MR. PADULA: Yes.

MS. MCGREGOR: This is Betsy with AEA. The modeling of potential scenarios is an iterative process because we want to try to, and I think the instream flow guys can talk about this tomorrow, you want to balance optimal operations for various resource areas.

So it's an iterative process, but ultimately, the output would be impact assessment and the draft license application.

MS. LONG: Thanks.

MS. WALKER: Hi, this is Sue Walker with NMFS. This is also a process question. In the agenda for these three days of meetings and next week, I may have missed it, but I don't see any point where requests for new studies are made and the reason I ask is that we do have and have had, since last year, a draft study request for a model integration study that we will be submitting and we think that would be a good part -- a good step to start off a resumption of this project. So we'll be updating that.

I think that's something that probably everybody would support when we did, at Chris' suggestion, and AEA took up a suggestion and started the model integration effort.

I think all of us involved in those efforts, including the POC effort, felt that was extremely helpful and would like to see that continue as a very important next step. So we will be submitting a new study request for model integration. I didn't know if that was on the agenda anywhere to bring up, so now seemed good.

MS. MCGREGOR: This is Betsy with AEA. We didn't specifically put a place on the agenda for new studies, but by all means, that's partly why we have all of our modelers here for these two days.

So it would make sense maybe at the end of tomorrow or at some point, but these are the people that would be involved in those discussions.

MR. WOBUS I have a question from the phone. This is Cam Wobus calling on behalf of the (indiscernible - interference with speaker-phone) Center. Can everybody hear me?

MR. PADULA: Yes.

MR. WOBUS: So I'm curious, in your -- in the steps that are remaining to be completed, one of them was finalizing the development of sediment supply from the smaller tributaries. I presume that's happening in the middle reach, in addition to the other reaches, but I'm curious what additional data is going to be collected to inform that sediment supply from tributaries, because it sounded like from the previous study, you know, material, sediment characterization from at least Tsusena Creek was cut off.

So is there more data going to be collected on sediment input from the tributaries because I image that could be important for informing, you know, development of deltas in these tributary junctions and sediment transport and natural reach.

MR. ZEVENBERGEN: Well, the first answer is that we think we have sufficient data. It's just that it's going to be more analysis, in terms of finalizing those sediment supplies.

MR. FULLERTON: Yeah (affirmative), and this is Bull Fullerton. I just want to clarify when I said the measurements were cut off of Tsusena

Creek, that was the Susitna River at Tsusena Creek. We were not -- or the USGS was not collecting sediment transport data on the creek itself and the analysis Lyle is speaking to on the tributaries is to take our cross-sections that we surveyed and the bed material samples that we collected and then develop bed load rating curves for that supply and then integrate that with our model and looking at the overall sediment balance and the information from the USGS and kind of calibrating those loads so they fit with the current reality.

MR. LACROIX: I'm -- yeah (affirmative), this is Mathew LaCroix with EPA, and I'd like to just zero in a little bit on Mike Woods' comment about how, you know, a significant change associated with the project would be an increase in the winter flood and I'm confused as to how potential new sources of sediment are being identified or characterized in the Middle River.

So you know, we've had a little bit of discussion about the bank erosion and then folks have indicated that the primary channel is relatively stable, but you know, Jason raised a good point about mid-channel bars and islands and floodplain over-bank surfaces, so you know (indiscernible) the formation or maintenance of those over-bank surfaces, in some cases ice, so I'm curious whether or not the susceptibility to erosion of the various over-bank surfaces of the Middle River have been identified or characterized in any way and how explicitly the maintenance of specific over-bank surfaces have been tied into these processes.

I know the ice is a complicated factor, but you know, but sediment transport in the winter is potentially a key element in bed evolution, because that's where we're going to see a significant change, in terms of the discharge and that's going to be, you know, essentially hungry water.

So it's going to have the ability to do work. So perhaps, you could explain a little bit more of how that issue is being addressed?

MR. ZEVENBERGEN: So the -- as I said, the modeling is not going to factor in bed evolution modeling during the winter cover time. The winter, the sediment supply is cut off from the glaciers and as we see, and why we were able to do the winter bed sampling, the video of the bed, is because it's clear water.

It's also very low velocity and so it cannot mobilize the bed and so you could have a very long period where the flows are, you know, instead of a couple of thousand, or you know, 10,000, the velocity is still going to be very low in those areas and the -- right now, the river is basically a conduit of that sediment and the sediment supply is cut off (indiscernible) based on the glaciers freezing up.

In terms of the bank processes, the bank, you know, the bank-attached ice, and John Zufelt will jump in and correct me as soon as I go astray here, but the bank processes during the winter with the bank-attached ice is, you know, it's all locked up. So there's really no bank work being done through the winter, but there is a period, the break-up period where there's a lot of energy expended from ice on the banks and doing the floodplain processes and to eroding floodplain features, building floodplain features and so that is where the geomorphology studies and the ice processes studies will need to integrate and develop a model, maybe it's more of a conceptual model than a numerical model, on how the processes will translate into operational conditions.

MR. LACROIX: Thank you for that. So on the last point, so is there going to be development of a model that identifies that in some way can characterize the specific effects of those -- that break-up process?

MR. ZEVENBERGEN: The -- in terms of the numerical model, no, I don't think there's one that exists, but in terms of the energy process, I mean, because we were talking about the Bank Energy Index as our fluvial index for bank erosion, that we can look at quantifying, and I think we will be able to quantify the energy associated with ice break-up and then start associating that with the bank erosion process and that's something that we'll work at with John.

MR. LACROIX: Okay, so to follow up, so it sounds like there will be erosion during the break-up process and your model will account for that, but in terms of winter, per se, even with increased flows, you will still not reach a point of effective discharge to mobilize the banks or the bed?

MR. ZEVENBERGEN: The bed doesn't -- in the Middle River, the bed really doesn't mobilize now. You know, the -- there is, as Mike Woods said, that the ice can attach and move large material, but in terms of the sediment transport, the overall sediment transport, that's not part of our modeling, and maybe I'm not quite answering your question.

MR. LACROIX: No, I think -- I think you are.

MR. FULLERTON: I think -- I think we do say, though, in the RSP that we would be looking at the hydraulic results from John's model and looking at bed mobility and incipient motion, that kind of thing, to see if our hypothesis is correct or not about it still being fairly immobile during the winter with the increased flows.

MR. ZUFELT: Do you want me to say anything? This is John Zufelt with the ice processes studies and yeah (affirmative), there will be changes in the wintertime because we're going to have higher, you know, the proposal is to have higher discharges. We are currently not certain about the attenuation of those peaks from the dam as you get downstream.

There will be attenuation in the flood peaks. So we may not see two hours of 10,000 followed by, you know, six hours of 2,000 cfs. We may see more of an attenuated flow reaching downstream. It'll further attenuate as you go downstream just because of the roughness of the ice.

As Lyle mentioned, as the ice forms during the freeze-up process, you end up with these shear walls along the side of the channel and you do end up with more or less like an ice rip-rap all along the channel banks, but that said, with the increased discharge in the wintertime, we will have higher water levels than we do currently.

The potential is to have some higher velocities, but again, those will primarily be in the main channel area. So where you do have islands, bars, fringes, there's potential that you could have some increased erosion of the edges of the bars and such, and I'm sure we'll talk more about this tomorrow.

MR. PADULA: Thanks, John. Chris, you've been patient. Do you have a comment you'd still like to make?

MR. HOLMQUIST-JOHNSON: Sure. I wanted to -- Chris with USGS. I want to follow up on what Steve said and I think ties a lot of the questions and again, kind of -- and this will come up again tomorrow, I'm sure, with kind of the integration side of all of this.

A lot of these models, you know, we had the EOC meeting and that was very helpful, I think, for everybody to understand and kind of go through the process of conceptually how these all tie together, and so along with kind of the studies, the integration side would be -- at that time, we didn't have the data to actually do, you know, put into the models.

A lot of it was very initial data, we -- you know, hadn't done QAQC and now we have a full year of study of a lot of those models and information that can into them. So a suggestion with that might be as kind of a next step is looking more of like a pilot study application where we could utilize that first year of data to actually get results from all of these and put them all together and actually look at what are the end effects of the results that we get out of all of these being (indiscernible) and that might then help also bring out like limitations for discrepancies there might be and how that would drive second year data collection or other processes that we may even find are deficient in our conceptual model, in terms of moving forward, rather than waiting until, you know, the final process of having final models, you know, utilizing this step approach, which I'm sure you guys are doing internally, but from an outside review, you know, we really don't have a lot of that data to review to see how well they are applying from the end metric that we ultimately want to have some sort of habitat metric to look at project effects.

That one metric is driven by all of these other models being pulled together and I think a pilot study could really show the initial effects of that, even though we know there's only one year of data.

MR. PADULA: Thank you.

MR. WOOD: This is Mike Wood, Susitna River Coalition, and for modelers, I wanted to ask you to imagine with me or bear with me for a second, but in terms of open water and flooding at the confluence of the three rivers during the summer, when these massive high water events, rain and whatnot, or solar events, like up on the glacier for the Chulitna, you get these huge flows coming down.

You've got three rivers. You've got the Talkeetna flowing down lower, the Susitna and the Chulitna, which is just a monster, and having been able to work with Michael (indiscernible) and watch the double diurnal flow that goes on in the Chulitna, it really makes you wonder as to the characteristics of the lower -- of the Su are more of that of the Chulitna than the Su at the confluence, but quite often what I see in the summertime is if it weren't for all three of these rivers coming together at the same time, the Susitna often floods later than the Chulitna, you can get a really strong right shoulder pushing that Chulitna over in the direction that keeps it in its channel and then you've got the Talkeetna adding to the power of the Susitna to keep it over in its channel, but I wonder if you modeled the reduction of volume in the summertime and you take away that right arm or that right shoulder of the Susitna, where is that Chulitna River going to go, and if that -- if you don't have the force of those two rivers coming in at the same time and often buffering the Chulitna, Talkeetna's adios, and I just wonder if you have models that look at the confluence of these three rivers and how you integrate these massive solar events up on the glaciers mixed with rain coming down the Chulitna and the Chulitna just moves like mad at the confluence? It would take a stupid town like Talkeetna away. Has your modeling looked at that?

MR. ZEVENBERGEN: The, you know, the model does -- the 1-D model does include the three rivers. It is not a two-dimensional model. It is, you know, it's a one dimension model. So it's dealing with the full channel through that area. So it's not -- once the river is combined, it's not differentiating.

MR. WOOD: (Indiscernible - too far from microphone).

MR. ZEVENBERGEN: I understand your (indiscernible - background noise) yes.

MS. WOLFF: Steve, this is Whitney. Could I follow up on Mike's question?

MR. PADULA: Sure.

MS. WOLFF: This is Whitney with the Talkeetna Community Council and this was a question I've been holding onto (indiscernible - interference with speaker-phone) I can't tell if all the agencies have gotten their questions out, but during the development of the RFP, the Talkeetna Community Council did request those additional regions of modeling of the Chulitna and the Talkeetna Rivers within conjunction with the Susitna because we were concerned there wasn't enough attention being paid to the (indiscernible - interference with speaker-phone) because the confluence there and that relationship that Mike's asking about and we did request 2-D modeling of that and FERC agreed to request you guys to do the 1-D and I guess I'm just curious if, you know, you've identified that relationship at all or if we need to wait?

I don't know if that will be better addressed tomorrow in the integration or whether this would be more falling along the lines of what Chris suggested of a pilot study, because I'd hate to see that we're not going to understand that relationship until the draft licensing application, according to Betsy, that some of that integration (indiscernible -

interference with speaker-phone), but just wondering if you've summarized any of those findings at all, if there's anything in any tech memo because I haven't seen that and I'd also like to just put on record the -- it would be very important to know how that involves (indiscernible - interference with speaker-phone) to be combined study for the Talkeetna area.

MR. ZEVENBERGEN: So the Talkeetna and Chulitna tributaries are currently flow and sediment sources in the initial condition -- the initial version of the model and in the updated version of the model, they will be separate reaches.

So the -- as we indicated, we would -- there'd be -- thereby be able to look at the effects of the different channels independently from their confluence upstream, but as I've just indicated, once they are connected in, then it is a single channel. So -- so that -- so we did...

MS. WOLFF: Right, but so are you confirming you will identify some sort of relationship between the three regions at the confluence itself?

MR. ZEVENBERGEN: Yes.

MS. WOLFF: I'm sorry, what did you say?

MR. ZEVENBERGEN: I said yes.

MS. WOLFF: Okay, and -- and do we have any of that information, other than the raw data, at this point or no?

MR. ZEVENBERGEN: Right now, the model includes them as sediment sources, as I said, but not as independent reaches. So that will be something that's in the next version of the model.

MS. WOLFF: Okay, great, and then will this be discussed tomorrow during the integration discussion, as well, or -- because it's -- this necessarily might be -- how these sediment models are being integrated into some of the (indiscernible - interference with speaker-phone) studies?

MR. ZEVENBERGEN: So I don't think that's really a question for me. Betsy, is there going to be an integration discussion?

MS. MCGREGOR: This is Betsy with AEA. We're not going to have a specific model integration discussion tomorrow. I think it's important to understand where we are in the ILP. These are the ISR meetings. We are looking at the progress of implementing the FERC approved study plans, proposing new modifications and new studies, ultimately -- not the applicant, the stakeholders proposed modifications to new studies will have to be filed with FERC, and you know, maybe the criteria that we have per the regulations up on the board.

MS. WOLFF: Yeah (affirmative), I understand that. This was just -- this was a request in the RFP for a specific goal and I just want to understand whether we're actually achieving the goal.

MR. PADULA: Hold on just a second, Whitney.

MR. REISER: Yeah (affirmative), this is Dudley Reiser with R2 Resource Consultants. We will touch on the whole aspect of study integration tomorrow during the instream flow discussions, but as Betsy said, it's not going to become a specific lengthy topic. It will be one of the tasks that we have as part of the RFP and we'll certainly touch on that and provide you an update.

MR. EAGAN: Lyle, do I correctly understand -- to not push your model too far, when it's all done, it'll tell us that middle reach five and -- do you think middle reach five will be stable? Middle reach six might have a slight bit of aggradation? On a reach-by-reach scale, it will give an indication of what should happen on the general up and down, is that more or less correct?

MR. ZEVENBERGEN: That's the primary use of that model, yes.

MS. EAGAN: So and we're interested in -- the Middle River has bars. It does split and come back together again. I think those processes going around the island is what pushes the water over and gets the side channels and side sloughs over time. If we're interested in if those islands are going to disappear over time, if those bars are going to disappear over time, will your bed evolution model tell us that or not really?

MR. ZEVENBERGEN: The 1-D bed evolution model is not intended to do that. Although, along with the ice processes models, the 1-D and the 2-D models, we, again, I said we would look at the energy associated with the with-project versus the existing condition and try to -- and well, not try to, but address the issues of, you know, how will bank erosion change around these islands, but that will be informed, I think quite a lot by the two dimensional models in the focus areas.

MR. EAGAN: Okay, so in the -- where we have a two dimensional model, it'll have that information and we really won't for the rest of the middle of the river, whether islands will sort of disappear or whether they'll remain in existence?

MR. ZEVENBERGEN: Well, and that is why we're doing the focus area model is so that we can then start to extrapolate beyond the focus areas and come up with trends for the whole Middle River.

MR. EAGAN: Thanks.

MR. PADULA: Great. I would really love if we could move this on. John's going to be with us tomorrow and we have a significant amount of time on ice processes tomorrow. So if there's questions that may be could be brought up in, you know, we'll have some -- you're going to be here tomorrow, Lyle?

MR. ZEVENBERGEN: Yes.

MR. PADULA: Yeah (affirmative), so we've got a significant amount of time for that tomorrow.

GLACIER AND RUNOFF CHANGES STUDY (Study 7.7)

MR. PADULA: I'd like to move us on today, because we have folks on the phone for this next agenda item before we break for lunch and Gabe couldn't be with us today, so Bryan Carey from AEA is going to summarize the Glacier and Runoff Changes Study status.

MR. CAREY: Okay, Bryan Carey with AEA. As mentioned, Gabe is the main author of everything, but he's unable to be joining us today. So I'll go along and we'll quickly try and summarize some of what the study findings are.

So the initial study report, we filed an initial study report for the climate change back in June 2014, and from that portion of the study, we believe that has been completed.

The purpose, the primary purpose of the study was to look at the potential impacts of the change of glacier wastage on the runoff on what's coming into the project area and so that had two different components. One is review existing literature relevant to glacier retreat into the interior area and this was part of the revised study plan that FERC ruled on, because it was a study plan dispute, and then there's also a second component that was to investigate the potential for the additional sediment loading to the reservoir from a glacial surge, which was discussed a little bit earlier today.

So we had no variances. The literature review was done and we also had the technical memo on the glacial surge sediment. As I mentioned, the glacier or the literature review was filed with the June 2014 ISR and the petition for changes in sediment delivery was filed in November 2014.

Decision points from the study plan, looking at them in regard to the sediment load, there again, it's not seeing really much difference. If you look at the different years, hydrologically, when there's been glacier surges or not, there's been really no difference from the regular years and when you look at the potential changes for filling up the reservoir otherwise, even under kind of a very conservative increasing the amount of sand, it has a very small effect on the lake, what the reservoir would be.

So being that AEA feels that the study is now complete, we plan no modifications and we've met all the study objectives. So comments?

MR. PADULA: Yeah (affirmative), Becky and Mathew.

MR. PADULA: Sue and then Becky.

MS. WALKER: Hi, this is Sue Walker with NMFS. Thanks, Bryan, for that summary. It's surprising that Gabe's not here. We do have Andrea Ray, she's a client and scientist with our Earth Systems Research Lab out of Boulder, Colorado on the phone. We do appreciate that AEA has undertaken this study of, basically it is of climate change, in addition to these two functions of the literature search and the glacial surge, and we do have need for asking Gabe some technical questions. Are you, Bryan, prepared to address those?

MR. CAREY: No, I'm not a, you know, one is the literature research part, I don't really see as being part of the modeling report. The modeling was not part of what the mandatory study plan was and so I suspect that your technical questions may go more toward the modeling and -- but from the literature search, no, I'm not able to, you know, I can give some answers, but on a bunch of the technical ones, I would have to defer those and we'd have to take those comments in writing.

MS. WALKER: Let's give it a whirl.

MR. CAREY: Go ahead.

MS. WALKER: Andrea.

MS. RAY: Sure, yeah (affirmative), first, I'd like to just -- this is Andrea Ray from the NOAA Earth Systems Research Lab in Boulder, Colorado, and I just want to compliment Gabe and -- who's not there, of course, and Bryan on a really nice study. The lit review is really comprehensive and just well described. I learned some from it, as well, and Bryan, while I understand that you can't necessarily answer these questions, I want to make a couple of points.

One, again, the -- just to say (indiscernible - interference with speaker-phone) about the modeling the (indiscernible - interference with speaker-phone) appears to be -- I only had a little bit of time look at it, but appears to be well done.

My concern though is by only downscaling one global climate model, we have a really deterministic idea of what the future is. Although, we (indiscernible - interference with speaker-phone) the spread of the different GCMs is essentially -- if you were to plot them, say change in annual change in temperature versus annual precipitation, we'd get kind of a scatter blot and we feel as if a large proportion of that is really a possible future.

It represents the variability in model and the (indiscernible - interference with speaker-phone) the model, but I'd also represent natural variability. So two concerns for me are in this document (indiscernible - interference with speaker-phone) how -- where in that cloud, is what I'll call a cloud of plausible climate futures, that CES end model falls.

So just (indiscernible - interference with speaker-phone) here, I'm on the phone. I can't wave my hands and let you see me. You could imagine that GSM is fairly easy to find out. It's just not obvious in there. It could be on the cooler and drier or cooler and wetter part of that cloud possible future, in which case, it might represent a less challenging future and yet, there may be more challenging futures or it could be the other way around.

This could be one of the worst case scenarios and being able to handle what, in this particular GPM might represent of the operators being able to cope with -- I mean with the worst case scenario. We need to know that one, in particular, and then depending on where that is, and probably even either way, we'd want to be able to, at least qualitatively estimate what the other kinds of futures would be for the reservoir.

So you will think about what (indiscernible - interference with speaker-phone) warm and dry might be versus warm and wet or hot and dry versus hot and wet. I actually -- the decision to go and do (indiscernible - interference with speaker-phone) just for Alaska is great, but I actually think that the CORDEX and the NARCCAP could provide some of the energy input for some other ranges of (indiscernible - interference with speaker-phone) that needs to be looked at (indiscernible - interference with speaker-phone) from the DSM work that you've done that I know (indiscernible - interference with speaker-phone) in your contract.

So that's -- both of those together are kind of one of my major concerns and the other is that it's going to be interesting to get down to the bottom of this conclusion of 7% or so increase in runoff by 2080, although it actually sounds like it might have -- might be starting before then.

So what are the implications of that from the downstream (indiscernible - interference with speaker-phone)? This is the kind of thing that National Marine Fisheries (indiscernible - interference with speaker-phone) in order to do their part of the assessment of the impact, of the combined (indiscernible - interference with speaker-phone) and climate change, all of which is downstream.

Even 7%, I think, has the potential to change the downstream nutrients, how the nutrients are being (indiscernible - interference with speaker-phone) downstream, what types of materials are brought downstream. It would certainly be less (indiscernible - interference with speaker-phone) is another type of change and then also, what does that mean for maintaining (indiscernible - interference with speaker-phone) of the reservoir and what kinds of operations you have to do in order to maintain, in order to have floods that are upgradient of the (indiscernible - interference with speaker-phone). So that's what I'm at and that probably (indiscernible - interference with speaker-phone).

MR. CAREY: Okay, comment noted. I'm not able to answer much since it's in regard to the different models and everything. This...

MS. RAY: Yeah (affirmative), understood. I just wanted to get those in on the record.

MR. CAREY: Okay.

MS. WALKER: Andrea, this is Sue Walker. I'd just like to comment on a few more things. Of course NMFS is very interested in what the climate-induced physical changes on the watershed both without the project, but then with the project have and what, particularly, the biological responses to those physical changes are.

As we've heard earlier today, these are important in the alluvial geomorphology studies, in many of the other studies. We are planning to submit a study modification. There is a study that was ordered by FERC and there was an accepting opinion that's resulted from our study dispute process way back in, was it 2013? Yeah (affirmative), time really flies.

MS. RAY: Yes.

MS. WALKER: But there's been a lot of change in this area of study and there's also been a lot of application of climate change to water management projects, not just in Alaska, but in the country, in the United States and locally. So we are prepared. We actually received funding to update our study requests. It's not just for Alaska, but nationwide and we're being assisted by (indiscernible) climate scientists, both in projects in Maine and in California and in Alaska.

So we will be submitting a request for study modification that considers all the new information since, I think it was July of 2013, which is considerable, and it's -- I'm sorry that Gabe wasn't here and I do wish that we would have known that before now. I'm sorry, there's just so many questions...

MS. RAY: Yes, Sue, just to add -- just to add to that (indiscernible - speaking simultaneously)...

MS. MCGREGOR: Can I -- I just want to clarify something for (indiscernible - speaking simultaneously)...

MS. RAY: Go ahead.

MS. MCGREGOR: This is Betsy with AEA. I appreciate your comments, Andrea, and Sue's points and by all means, you know, put in a request for a modification and we look forward to addressing that.

To help clarify for the other people, the study that Andrea was providing comments to is not part of the FERC approved study plan. So the reason why Gabe is not here, he had a scheduling conflict, but all of the information that he had produced was covered under the October 2014 meeting.

MS. WALKER: Yeah (affirmative), well, there's his report, which...

MS. MCGREGOR: That's not...

MS. WALKER: ...was available in October of 2014. I know that's not part of this FERC order study, but it's a small part of -- and also, we would really like to commend AEA for the work that you have done through Gabe. This is an excellent study. So don't take anything that we're saying today as any kind of criticism. It is not. This is excellent work and we do appreciate it.

MS. MCGREGOR: We appreciate that. I just want to say for this forum, we're talking about FERC approved study plans. So we don't have people who are aware of the report that Andrea's referring to.

MS. WALKER: It was...

MS. RAY: No, but this is all part of what -- of the glacial and runoff study, unless there's something different. I didn't refer to something different. This is the glacial and runoff study. That's what I'm referring to. Are there separate reports?

MS. WALKER: Only a small part of -- well, maybe FERC could address that.

MR. CAREY: Well, the FERC mandated part was the literature review portion and so from the standpoint of going forward to doing modeling...

MS. RAY: Okay.

MR. CAREY: ...and sampling, that would not be part of the literature review.

MS. WALKER: No. Where we're hanging up now is our study modification request.

MR. PADULA: Thanks. So anything else or -- I've got Becky in the back.

MS. LONG: Becky Long, SRC. Well, I'm just really confused and maybe I'm dumb. I did -- so this study's been really hard because in the beginning, you know, we requested climate change stuff and then FERC didn't accept it and then there's the dispute and then there's what FERC accepts and whatnot, et cetera, and I've lost track.

There actually is a model that came out, a climate change model that -- I know it's not part of the FERC thing, but did I miss that and where is it on the website? Is it under documents and what's it called? I mean, there's like 10,000 documents and I can't always figure out which one goes to -- because I was left thinking that there was -- nothing had been done, you know, so like maybe, that something was done and I didn't know about it though.

MR. CAREY: There is a document on the AEA website under the documents section at the very bottom of the website or the page. It's titled, which I think -- I don't know if it's "Glacier Change" or otherwise. I forget what the exact title is, but it's at the very bottom of the page where the documents are found. So a glacier runoff changes study and so you can go look on that and that has all the results from both the literature review and the other additional work that he's done.

UNIDENTIFIED SPEAKER: And literature (indiscernible - speaking simultaneously)...

MS. RAY: Yes, it includes the literature and the work that I was referring to.

MR. PADULA: Thanks, Becky. Anything else on this? Again, we understand the limitations with Gabe not being here, but Bryan, appreciate you stepping in. Any other questions or comments for today? Mike, back here.

MR. WOOD: Mike Wood, again. I just have a clarification about surges. I'm just wondering if -- when I picture what's going on up there in the glaciers, I spent my 20s, teens, 20s and 30s up there in the Eastern Alaska Range (indiscernible) in Cantwell and whatnot and (indiscernible).

In those years, I watched two glaciers that I traveled on years before just drop 500 feet below their bergschrund. I was on the Black Rapids where it surged, this one where I lived was alive, but it came out into the Delta River almost. I don't know when you define surge, if that's more ice and it's going to roll down the hill or you have a large amount of melt happening that's stored up underneath the glacier and then all of a sudden, it just releases and the glacier drops.

Both the Susitna Glacier on the other side of the Black Rapids dropped from it's bergschrund about 500 feet about 20 years ago, 15 years ago, when we were up there and the same thing happened to the Canwell Glacier, all in the Eastern Alaska Range and Delta Range and so we travelled down the West Fork, and just wondering, in the time that I was up there, there was obviously a lot of changes going on and it's been 15 years now since I was up there at the spot, so I don't know what's happened to those glaciers, but I -- whether they're going to start growing again and surge downriver or if they're going to melt like heck and then release large bodies of water into -- and down the river, is curious just to see what might happen there and if -- I hope that's part of your study.

MR. CAREY: I'll see if I can answer it and I can get some assistance from Bill or otherwise (indiscernible), but the technical memo -- the last time the Susitna Glacier surged was in -- they have down as the 1950's, I believe, and then West Fork was a different year.

The Susitna Glacier was put as being about a 50-year return period for a glacier surge on it and it has not done it since then. There's speculations, since the terminus area has a lot of potholes, which they indicate in the technical manual -- technical memo is more of a stagnation -- sign of stagnation. There's a question of whether it will be surging in the future or not, but regardless of it, surging and changing around with the amount of melt, you have the large area of Susitna Flats of 90 miles or so of relatively low-gradient, pretty flat.

So even if you have a large increase in the amount of the -- the amount of water and sand that you would have to have, it still gets caught up in those first 90 miles and when they've looked at the Gold Creek record of Susitna for the last 60 years or so, you can't pick out any year where there's been a surge without knowing the year that the surge occurred, because there's no difference in the annual or the open-water period or even going down to, I think, the monthly or daily changes, in terms of what the volume water coming off. It's -- surge years, when it has surged, they're not showing the change in what the water volume is at Gold Creek. So it's still getting caught up in that first 90 miles or so, and Bill, I don't know if you have anything more to...

MR. FULLERTON: No, I think that was a good characterization.

MR. WOOD: Thanks, Bryan.

MR. PADULA: Anything else for this study today? Okay, we're running a little bit late, not bad though. We covered a lot of material this morning. I'd still like to try to get started at 1:00 or a little bit after. Again, I appreciate best efforts for folks to get back by 1:00, if you can.

We've got two hours cumulative after lunch on water quality, so keep that in mind, as the three of them work through their presentation. Thank you.

12:09:10

(Off record)

(On record)

1:10:05

MR. PADULA: ...folks get back from lunch, but before we get going, anybody in the room who has joined us since lunch? I just want to get a name and affiliation down for the record.

New attendees introduced themselves.

BASELINE WATER QUALITY STUDY (Study 5.5)

MR. PADULA: Thanks, I think we've got everybody identified now. Before we start, Bill had one action item from the morning to identify tables.

MR. FULLERTON: Yes, the table that had the tributaries, in the study 6.6 in support of the barrier studies 9.12, the table is in the 6.6 ISR Part C and it's Table 7.1-1, and the table for the process is discussed on page four and five of the same document.

MR. PADULA: Thanks, Bill. A reminder for folks on the phone, if you could mute your phone if you're not making a comment, it'll help with feedback in the room, and again, please don't put us on hold, so we all don't have to listen to music, and with that, we've got Rob Plotnikoff. He's going to start us off with Baseline Water Quality Study and then we'll move right to the water quality modeling and the mercury discussions, try and make that all happen by 3:00. Thanks, Rob.

MR. PLOTNIKOFF: Thank you, Steve. The focus for this -- on this presentation is on the results of...

(Microphone feedback)

UNIDENTIFIED SPEAKER: Sorry.

MR. PLOTNIKOFF: So the focus for this presentation is on baseline water quality monitoring results, those published since June 2014, including up to November 2015. Several objectives have been laid out as part of the study plan. Those are addressed with the components on the fourth page of this presentation.

Variances, water temperature monitoring continuous data will be developed. Were collected at 28 of the planned 37 sites in 2013, and that increased to 36 of the 37 sites.

Winter data collection occurred on both those winters, 2012 to 2013, 2013 to 2014. We had some minor adjustments in the baseline water quality monitoring program where we had moved, because of access issues, three of those locations, just slightly from the proposed locations.

Those two, the following bullets, from that third bullet down, actually describe what those, and where those locations were and where they were moved. A clarification on the last bullet, that's baseline water quality sampling occurred again in 2014. We were required to collect one year of data. We flagged some data in 2013 and recollected a select number of parameters so that we could complete that one year data set.

Groundwater sampling occurred in focus areas, four focus areas. These, mainly to supply the water quality model with some input data for calibration, temperature calibration. The other was for the fisheries resource studies.

The sediment samples that were planned for 10 sites all were collected over a course of two years. Rain gauges were installed, as well, at MET stations. They were installed in 2013 for two of those and in 2014 at the last. Now, there is a remaining MET station at the Watana Dam site. That is continuing operation. That also is measuring snow depth, as well as precipitation, and then two at the focus areas.

We continue to monitor in 2014, that again, to replace that select set of data that we flagged as -- had Q/A issues. Those, though, were a more robust sampling and that we sampled three transects at each focus area and then also three samples across each of those transects.

We have one clarification to the ISR Part D. We had reported that we had not collected water samples at the point locations. Those point samples, if you recall in our documentation, are locations usually on side channels or sloughs and they were just one location, not a transect.

The continuous temperature monitoring data was collected, as I had mentioned, at 28 of the sites in 2013, 36 in 2014. We did collect at a number of sites, the over-winter data and that was not possible at all of the sites, all of the time. Conditions actually prevented collecting the full set. Usually what that was, was we had lost equipment due to -- during the ice break-up portion of the year.

The meteorological data, I have listed here the two separate sets that have been reported on the web. The 2012 to 2013 data had the list of variables on this slide. The data collected in -- from the 2013 to the 2015 period included precipitation now and snow depth at one of the locations.

Baseline water quality monitoring, in this case, as within the focus areas, we had completed collecting our one year of data by combining -- by creating a complete set by combining the 2014 presample data with the 2013. The data was collected at each of the baseline water quality monitoring sites and were comprised by the conventional water quality parameters, the nutrients and metals, and we had one time sampling in 2013 of radionuclides and the petroleum hydrocarbons.

We sampled at five sites during the winter of 2014, repeating the same parameters in conventional, in nutrients and the metals.

Focus area monitoring had a shorter list of parameters and the reason for this is that it was in support of the fisheries resource studies and so there were very specific elements that we needed to generate for those studies.

We collected at all seven FAs in both 2013 and 2014, those being the focus areas, and then winter collection was at three of the focus areas, and those are listed there, FA 104, 128, and 138, and I've listed the -- both the field data that was collected during those visits, as well as the lab data.

Groundwater collection occurred in 2013 at all seven FAs. This, again, in support in part of the fisheries and water quality temperature model calibration. These were collected at a different interval than monthly. The summer were collected at two-week intervals, beginning in the middle of August and ending in the beginning of September.

The winter data now, though, is a little bit different frequency for sampling. It was collected on a monthly basis at those same four. The parameters listed, again, below each of those sampling intervals during the winter.

Sediment and pore water samples were collected at all 10 sites and they comprise mainly of parameters that were metals and then some of the other physical characteristics of the sediment itself.

Fish tissue samples were collected in 2013. They were -- they are in support of Study 5.7. We'll have more discussion on that in that presentation and we had mainly focused on the mercury bioaccumulation and then some of the fish morphometrics are listed here on this slide, the length, weight, and estimated age of each of the fish, where possible.

Thermal infrared remote sensing, the -- this map shows that we've collected at all 10 focus areas. Imaging was completed at all 10. An additional nine sites embedded among those 10, and then at 73% of the Lower River and this extends from Maid Lake, which is PRM, project river mile, 12 to Chulitna River, which is project river mile 102.4, and the missing information here, the 27%, was below Talkeetna. A heavy fog during that time of year prevented any kind of collection. We had repeated attempts and it didn't (indiscernible).

The purpose of this data originally was the detection of groundwater influence on surface water. Also, it was to determine the spatial extent of refugia for life stages of salmon and certainly, some of the questions that might arise from this effort in this study -- I'll ask Dudley Reiser to help in that response.

This study is now complete. There are no future modifications of the methods for Study 5.5. We've met all of the objectives with the dataset that has been finalized, quality assured, and we've completed this study. At this point, I'd like to see if you have any questions.

MR. KRISTANOVICH: Felix Kristanovich from Ramboll Environ, we have like six main comments that we identified by looking over this. So I don't know whether I should go one-by-one or...

MR. PLOTNIKOFF: Yes, please.

MR. KRISTANOVICH: One-by-one, okay. The first comment by reading your report, and you probably remember from previous presentations when we met, there was an issue with the data in 2013 data collection and we felt there were a quite a number of, you know, samples were rejected during that analysis and reading through your report, we didn't find other good explanations on why this was rejected and what was exactly done.

Now, I understand, you know, some of the samples -- some of the data was resampled back in 2014, but we felt while originally studying your original data in 2014, there was a significant number of samples that were rejected for different reasons.

Right now, reading through your reports, it seems that there is only a small sample was rejected. So can you elaborate on that?

MR. PLOTNIKOFF: I sure can. Yeah (affirmative), this issue did come up. It was -- what the request was, to provide a table of percentages of samples that were rejected and the reasons why and so we did include those in the current SCR, Table 5.1-1 and 5.1-2 report, first for the year 2013 and then 2014, and certainly for the baseline water quality monitoring program, 9% of the samples were rejected. This is what reads from the table, focus areas, 33%.

Now, the reason for the difference is that we have fewer parameters, fewer water quality parameters that were -- that we monitor there, but the same set had not been passed as acceptable data in both the baseline, which had 19,828 observations and the focus area for 4,217 observations. So the proportion was much greater that were rejected for focus area monitoring because of that.

We also looked at holding time exceedances and temperature exceedances. So those are all listed in those two tables, as well, and what you will find in the second table, 5.1-2, is that the percent rejection has been reduced dramatically in 2014, and when combined with the 2013 data to make the one complete dataset that we needed, that we were required to produce, now we fall within acceptable limits of completeness. It's outlined in the ISR. It's Attachment 1. It's the QAPP.

MR. KRISTANOVICH: And the follow-up question, I know originally in 2013, you had an issue with two labs, you know, that provided different results. How was this issue resolved in 2014?

MR. PLOTNIKOFF: Well, we have a discussion of that in the SCR and it actually is -- it's a total phosphorus correction factor and one of the things, one of the -- the method that was spelled out that we needed to use for determining total phosphorus, when we look back at the method itself, the EPA-published method, it tells us there are issues in highly turbid samples or samples that have a lot of solids. So you have to deal with those in some way.

Usually, it's filtering, but you do filtering after digestion. So let me take you through this just step-by-step. Do you have any questions about the tables that we laid out here and how we did this, because what we really did, was we realized that we were dealing with very high total phosphorus concentrations and the way we knew that is, is that under similar types of rivers had phosphorus that might not have exceeded 200 micrograms per liter, and so you know, we look at that all the way up and down the coastline here, from Washington to Alaska, and we're not seeing as high up measurements as we've had.

We had some over 1,000 micrograms earlier, which Harry Gibbons, my colleague, had mentioned is characteristic of wastewater untreated, very true. So looking at these little checks, we wanted to know should we look into this a little bit further? I need to ask about this.

We also looked at -- we compared ratios called Redfield ratio N to P ratio, total nitrogen to total phosphorus, should be around 16 to one for -- as a constant.

We mentioned this in our SCR, and what we found was we had it in reverse. In some cases, we had one to two, which is -- just doesn't occur, especially in an environment like this, where it isn't -- hasn't been a lot of human activity, might have caused nutrient enrichment.

So looking back at these as our thresholds, tests, we realized there's more here to the story, and the story is, is the sediment, the turbidity, and this is what the method tells us, is the interference is caused by -- and interference means certain characteristics of the sediment or other elements associated with the sediment are being read by the test as though they were total phosphorus.

So our approach was, and we mention it in detail in here, is to separate the signal from the sediment itself versus the whole sample. So that's what we did. We asked our research chemists, the lab chemists to analyze whole sample. We were still getting high -- still getting high concentrations.

We did a test check with another lab, too, and they were getting similarly high concentrations. So we were within the same range. So our research lab isolated the sediment itself and he ended up retesting that using the same method prescribed by the QAPP and found that it was showing above 50%, sometimes a little more, of the original whole sample that we had done. So here, we've got the sediment telling us we've got a very high total phosphorus concentration.

Now, there's filtration that occurs in this method. It's possible that some of that filtrate much finer particles, even smaller -- is there anything finer than clay, are making it through or there may be some other factors like arsenic, and this is spelled out very clearly in the method.

Arsenate often combines with the reagents used to capture phosphorus in its dissolved form. That's how the phosphorus captured antimony-phosphomolybdate complex and then you add ascorbic acid in this test and it turns blue, different intensities of blue, and this is a color metric test. So it's actually calibrated to tell you how much total phosphorus is there.

So what we're seeing, we tested arsenic again in the samples that we were getting quite -- we have recently high phosphate. They appear to be naturally occurring, but they're also complexing with this antimony and molybdate and they're reading as though they're total phosphorus, and so that's how we know that whatever -- what's happening with solids alone, whatever the mechanism for this false reading we were getting, was our culprit, and in fact, spelled out very well in the method, the analytical method. Go ahead.

MR. KRISTANOVICH: So thanks for answering that, because this was our, you know, second comment and we actually looked at your method quite closely, had actually one of our lab experts look it up, and you know, our concern was that, you know, your explanation of the matter is excellent, but you know, by looking at the literature, certainly on TP metal, we felt that this method is great if you have one culprit like sediment, you know, that's distorting it, but we know from the data in 2014, there were several other potential suspects in the data.

So do you still feel that TP, despite, you know, even looking at the influences in several different sources can still be correct?

MR. PLOTNIKOFF: Yeah (affirmative), we do in part -- so we tested using this one method. That was the ascorbic acid method for testing of total phosphorus, that's the prescribed -- our chemist also used another method, 200.8, which is normally used for solids and for extracting metals, for determining metal concentrations and we were getting similar kinds of values here, this reading, still it was a high reading, out of solids.

So a confirmation, and this is listed in our SCR, it's a confirmation, that in fact, yeah (affirmative), we've got some consistently high readings going on here, regardless of different types of analytical methods used and so yes, we do -- and there -- the percentage of signal that we're getting, using each of these methods from the solids is very similar, the signal, how much is appearing is very similar.

So this is why we felt we were justified in moving forward and being able to quantify the percentage of total phosphorus signal that was coming from some other interference factor. The sediment, that's a general category, but in particular, there's arsenic. There may be other organo metals. There may be other metals that complex with the antimony and molybdate in this reagent that actually form the same valence, minus three, and so that actually is an issue that we felt we've researched very well and described very clearly.

MR. KRISTANOVICH: Okay, thank you. I guess I'll just read from my other comments. Just a general comment on the study completion report is, we felt it does not provide sufficient details. In our opinion, study

-- when you write a report like this, you need to look through a number of other supporting documents.

We just felt that the study completion report should be a standalone document and by reading, you need to refer to hundreds of other places and if it's study completion, then we say, "Study's completed," and you know, that said, but then you need to look -- reading through the document, you still need to refer to, you know, a bunch of other, you know, places. So we just, at the moment, felt it really difficult to follow. So that's just a general comment.

So another comment is, again, going back to data quality issues in 2013, we just felt that it didn't have enough explanation on data quality issues with DSS holding time and temperature exceedances. I know this will, you know, it's available in tables, but we just felt it needs to be described, put in the report somewhere, just for the documentation.

Maybe you can explain the -- there were several contradictory statements with thermal infrared remote sensing that was not completed because it -- several -- when we met last time, our understanding was that TIR was going to continue and then it suddenly was not. Maybe you can elaborate more on that. Why was it suddenly discontinued?

MR. PLOTNIKOFF: The repeated attempts at trying to tie the remaining segments that were missing below Talkeetna did not materialize and two, there was a specific purpose for TIR data, mainly related to fisheries resources studies. This may be a point where Dudley might be able to jump in and make a comment.

MR. REISER: Yeah (affirmative), this is Dudley Reiser with R2 Resource Consultants. The thermal infrared imagery mapping that was done was really an extension and a follow-up to what was done in the 1980s. If you look back in the 1980s studies where they were mapping out groundwater areas and so we've got a more sophisticated technique now. So part of that was taking that technology and looking at up and down the river, looking at it within the focus areas to identify areas of potential groundwater upwelling and down-welling that we could relate to fish use, you know, spawning habitat conditions and even outside of the focus areas, then to expand that out into other areas that we're not actually measuring.

So there was a real utility of that particular technique to do that, as well as to identify areas of potential fish use that we could concentrate our

HSCmeasurements on, you know, if we saw a signature, we might put some measurements, some survey work done in those areas to see if we're seeing fish there, as well, so sort of a combination of things, but it's being used and will continue to be used as we go further in the groundwater and on the fish and aquatic side.

MR. KRISTANOVICH: I have a couple of more comments. So additional water quality sampling occurred in 2014 at selected locations for parameters for which 2013 samples were -- qualify as either rejected or estimated, but 2014 samples, some of them were single-grab sample types based on the conclusion that was -- there was no horizontal or vertical variability of the sample location, but that conclusion was based on 2013 samples and some of them were rejected. So do you still feel that conclusion is valid?

MR. PLOTNIKOFF: I do, and here's the reason why; in the case of the 2013 data, much that we reported in the ISR in June 2014 included some figures that are repeated again in the SCR to show that variability laterally and at depth, and in the case where you see some spread of data from top to bottom, some measurements, they're very low concentrations.

So they're different say like in Chlorophyl A, you might have a concentration at the bottom that's one microgram per liter. At the top, it's three micrograms per liter. In effect, that's probably within the margin of error for the analysis, the analytical method. So we would conclude no difference.

So for any of the other data that we looked at that was not finalized, we did not see that kind of spread. We did not see major differences, say percentage-wise, like a 50% difference or 75. They were much smaller and again, within that margin for error in environmental variability, so you repeat sampling each time, you get a slightly different answer in terms of concentration.

Well, the variability or the variation between top and bottom was within that margin, as well, and that's why we concluded that we could go ahead and sample at one location at baseline monitoring transects in 2014 to replace the 2013 data and then also the focus area monitoring.

MR. KRISTANOVICH: Thank you. I would like a comment on (indiscernible) discontinuity in data. There are several 30-mile reaches in the river where no data have been collected. So I'm just wondering about no data collected in this area, how that may affect the calibration of the water quality models? So maybe that more goes into 5.6, but -- or maybe you can comment on that.

MR. PLOTNIKOFF: Yeah (affirmative), there -- we can comment more on Study 5.6, as well, but the basis for these sites selected, 1) if you recall way back in the development of the RSP and the approved study plan, is to repeat some of the monitoring that was done in the 1980s, as well, add additional sites that could be used in a much larger water quality model, and in fact, when our modeler had looked at all of these sites, he was looking specifically at locations above and near tributaries, especially major ones, and then for the really large ones, the three rivers, to be in the tributaries themselves. That was important.

As far as any other influences where you feel that there are two -- or there are very large spaces, there are no major identifiable inputs of water that would change the water quality conditions from one point to the next. So that was considered as well.

MR. KRISTANOVICH: These are all the major comments I had, so...

MR. PLOTNIKOFF: Thank you.

MR. PADULA: Thanks, Felix. Betsy, do you have something you want to -- I don't know where to go to next.

MR. DAVIS: Rob, I've done a lot of, you know, done a lot of quality sampling for...

MR. PADULA: Jeff, name?

MR. DAVIS: Sorry, Jeff Davis. I've done a lot of water quality sampling for DEC in the past and their QAPPs and also some -- a lot of fish sampling. One thing we've noticed over the years is that the distribution of juvenile coho and sometimes the differentiation between coho and chinook is often driven by differences in dissolved oxygen, and I'm wondering in your baseline water quality modeling in focus areas -- you did do Focus Area 128?

MR. PLOTNIKOFF: We did.

MR. DAVIS: In Focus Area 128, in Slough 8A, how many points longitudinally from upstream and downstream in Slough 8A did you measure dissolved oxygen, just your study, not other studies?

MR. PLOTNIKOFF: The 2013 effort, we focused longitudinal sampling around those point samples. Recall on the variances, I talked about point samples being resampled in 2014. So those were located in side channels and sloughs and they're all recorded on our maps and what we were doing there in both the ISR 2014 of June and again, the SCR here November 2015. We, in 2013, we measured dissolved oxygen at five locations below that point sample, that sample point, and five locations above and we did that repeatedly during each of the visits and those were done within two-week -- at two-week increments, three times.

MR. DAVIS: So again, I don't think you answered my question. In Slough 8A, from the upstream point to the downstream point where it hits the side channel, how many different points not clusters around the -- but like how many different points did you measure dissolved oxygen?

MR. PLOTNIKOFF: So 100 meters with the point sample being the center of that 100 meters. Now how many of those point samples we did, I need to just refer back to our map here and we would then know how many of those.

So in this case here, we had -- we had two point samples, one in Slough 8A and one that extended upward on the portion of that slough that paralleled the hill slope. So it is on the...

MR. DAVIS: (Indiscernible - speaking simultaneously)...

MR. PLOTNIKOFF: ...figure 4.4-4.

MR. DAVIS: So at this point, you don't know the difference between dissolved oxygen concentrations as a background at the upstream of Slough 8A versus the downstream end of Slough 8A?

MR. PLOTNIKOFF: We do not have a transect at the upstream end of Slough 8A.

MR. DAVIS: So I -- as a study modification, I think this is important. I think the distribution, a lot of these water quality parameters in these off channel habitats longitudinally and seasonally is an important parameter for describing fish distribution abundance.

In particular, I'm talking about juvenile chinook and coho salmon. So you know, as a study modification, I think -- I'm recommending that we get some baseline water quality sampling longitudinally in replicates of each of these macro habitat types in the Middle River that are important for rearing salmon. Thank you.

MR. PLOTNIKOFF: Thank you, Jeff. Yeah (affirmative), we had reported results on those longitudinal samples and we saw very little variation within the 100-meter increment. That's all I can say from what we know.

MR. DAVIS: I can just say that in the sampling we've done on the Susitna River and in a lot of these sloughs, I have seen some high variations from like 20% saturation at the upstream end to near 80 to 90% saturation at the downstream end, and again, this is following the methods that we generally use and when we sample under an approved QAPP.

MR. PADULA: Any other comments or questions for Rob on 5.5? Hold on a sec, Dudley.

MR. REISER: Yeah (affirmative), just to follow up, this is Dudley Reiser, just to follow up on Jeff's comments about DO, you know, we've done a lot of DO measurements, water quality measurements as part of the HSC data collection seasonally, even in the wintertime, that we have that information.

So in addition to the water quality baseline characterization that we have, there's a lot of supplemental data that has been collected related to DO and temperature and PH, et cetera. So I just wanted to make that point.

MR. PADULA: Thanks, Dudley. Any other comments or questions for Rob? Anyone on the phone have any additional comments on 5.5? Okay, well, Rob's not going anywhere. He'll be here.

WATER QUALITY MODELING STUDY (Study 5.6)

MR. PADULA: So let's move into Study 5.6 Water Quality Modeling. Are Jon and Rui on the phone?

MR. LUDWIG: Yes, Jon Ludwig's here, Dr. Rui Zou, along with Dr. Sen Bai is also here and part of the modeling team to answer questions.

MR. PADULA: Great. So Rob, are you going to drive the slides?

MR. PLOTNIKOFF: I will be driving the slides.

MR. PADULA: All right, so why don't you get us started here?

MR. PLOTNIKOFF: We're up and running. Do you see this, Jon?

MR. LUDWIG: Yeah (affirmative). Can you guys hear me okay?

MR. PADULA: Yes, indeed.

MR. LUDWIG: All right. So we'll go ahead and get started. As I mentioned, my name is Jon Ludwig from Tetra Tech. I am leading the modeling team for this effort. As I mentioned previously, Dr. Rui Zou and Dr. Sen Bai are here with me. They were part of the modeling team that was working with John Hamerick (sp) and we've transitioned due to his unfortunate passing in the middle of this project. So Rui is the primary modeler for this and he will be answering questions as we move forward, once we get to the question and answer session.

So go ahead, next slide. The water quality modeling Study 5.6 is documented in ISR Part D, Section 4, and it focuses on the selection of the water quality modeling platform, the EFDC model and its configuration, as well as the configuration of the higher resolution focus areas.

Next slide. The current status of 5.6 or what was presented in the documentation last fall is proof of concept modeling for the modeling system, which includes a three dimensional reservoir model linked to a full two dimensional riverine model and we calibrated the hydrodynamics based on the high frequency temperature monitoring data that Rob spoke of a few minutes ago from 2012 and '13.

We tested several -- or two main scenarios for a drier and a wet, a slightly more wetter period, '74 to '76 and '79 to '81, that represented large and small pool draw-downs, respectively, and the other component was to focus on establishing the relationship between turbidity and TSS based on the data collected in '13 and '14.

Next slide. The objectives real quick, they're documented in the ISR, basically it's to establish a water quality modeling platform to evaluate the overall water quality, the conditions in the proposed Watana reservoir, as well as the overall impacts of constructing the reservoir on water quality downstream in the Susitna River.

Next slide. The components are documented in Part A. Next slide. In terms of variances, no variances to the study plan. Next slide. I'll talk a little bit about the summary of results. One thing that we tried to do is we established common state variables between the three dimensional reservoir model and the link to the two dimensional riverine model.

The main components for calibration and representation of the hydrodynamics in both models were water surface elevation, as well as velocity, and looking at the water quality components or component with total suspended solids representing very fine sand, silt, and clay, and as I mentioned previously, the established relationship between turbidity and TSS.

Next slide. A little bit about the reservoir model configuration, approximately 1,400 cells, 20 layers deep. The layer dimensions, in terms of depth, range from around two meters to around 17, 18 meters thick, approximately 400 to 800 meters wide, I'm sorry, longitudinally, and about 100 -- roughly between 75 and 100 meters wide, laterally.

The reservoir model was constructed to represent the hydrodynamics and temperature associated with the 45-meter pool variation and water elevation.

Next slide. The river model was configured primarily to focus on the pre and post-project conditions. Pre being defined as existing conditions. So as previously mentioned, the two three-year periods representing a drier and a more wet period, '74 to '76 and '79 to '81, the river model was constructed to receive input from the reservoir model based on the outflow operation of the shutter, the dynamic shuttering of flow, as well as developing a loading simulation of fine and clay-sized material.

The results of the riverine model were, as I mentioned, established existing conditions, which was pre, and then obviously, what our objective here is, is to evaluate what the post-project conditions would look like in terms of water quality and as previously mentioned, hydrodynamic calibration used in temperature data was collected in 2012 and '13.

Next slide. The objective of the focus area modeling was actually to overlay finer grid resolution to embed it and to link it to the boundary conditions of the coarser grid to provide more detailed model output and simulation for the other habitat studies that are currently going on and the demonstrated approach, as someone referenced during the previous discussion, is at Focus Area 128.

Next slide. Finally, I'll talk about the configuration of the reservoir model. The reservoir model results showed robust performance over the three years, the two three-year simulation periods and at the outfall of the reservoir downstream, we observed the model predictions were showing a one to two-degree Celsius higher than pre-project temperatures in the Susitna River and as we would expect, the fine sand sediment particles were entirely trapped in the reservoir, as well as the significant retention of the larger silt clay size material.

Next slide. The updates based on some of the comments received throughout this process to the riverine model was to extend the riverine model to river mile 29.9 and evaluating the post-project boundary conditions at that point and the results from the riverine model show that the post-project temperature, average temperature difference was less than one degree-C at river mile 29.9, and again, as we would expect, the TSS, the total suspended solids in the Middle River was lower under post-project conditions, given the trapping of the sediment in the reservoir.

Next slide. As I mentioned previously, the focus area model configuration was -- is focused on providing higher resolution output for the habitat studies in the specific focus areas. We established upstream and downstream boundary conditions from the coarser scale model overlaying the finer grid within the boundaries of the more coarse grid.

The bathymetry that was used was consistent from the coarser grid model and produced the simulations under -- for both the wet and dry conditions under pre and post-project conditions.

Next slide. The key decision points from the study plan is that the river model will not be extended beyond river mile 29.9, based primarily on the temperature variation of less than one degree Celsius during the worst, I don't want to say worst allowable conditions, but the most extreme condition that we would have and the basis of that idea and conclusion is the fact that there's so much volume of water added to the system downstream of the reservoir that extending the model further on down, in terms of temperature variance or the effects of temperature on the -- of the reservoir below 29.9 is relatively negligible.

Next slide. AEA plans no modifications to the methods for this study. Next slide, and finally, the last two slides here are talking about the steps to complete the study. Obviously, we need to do more work in incorporating the ice model, interfacing with the ice models, modeling studies, as well as doing future work on scenarios and simulation of the 60-year hydrologic period for the reservoir model, as well as really working with the habitat study groups to make sure that we're refining the focus area models to meet their needs.

Next slide, and finally, the last slide here is a continuation of the steps to complete, the sensitivity analysis for temperature and solids, as well as establishing the other water quality components of the model calibration for organic matter and nutrients, as well as mercury, and then establishing the -- continue to perform simulations with the linked modeling system to evaluate alternative operational scenarios. Next slide. I'll now turn it over for questions.

MR. PADULA: Yes, Felix first here.

MR. KRISTANOVICH: Felix Kristanovich from Ramboll Environ. I have some -- I'm just going to read some general comments and I apologize, I didn't realize your John H. passed away, so well, one of my first comments was going to be that I felt no significant progress was made in the last couple of years. Now I realize why, just because -- with respect to the model calibration, I would just like to see more calibration statistics for the model that's calibrated and I know you provided an excellent comparison of the model that was calibrated.

When I say calibration statistics, I mean R-squared, you know, general statistics that you would provide for any standard model calibration. That would be good to see and the second item, when you do the model calibration, you also have to do model validation. So I would like to see if the model calibration results that were shown for the model calibration should also be shown to be validated for the different period of time. I haven't seen that in any of the reports.

In general, I would like to see also a better, you know, description of the model study methods accompanying a calibration report. There's just been some general presentations that were good. I just need to see the so-called calibration report. I haven't seen that yet.

The comments that actually started getting raised this morning is no progress has been conducted on model integration plan. I know in the steps to complete, you are commenting how you're going to incorporate ice cover and thickness from ice processes model into the model, but I would like to see a better plan of how the water quality model connects with other models of the study.

MR. LUDWIG: Okay.

MR. KRISTANOVICH: And I -- one of the comments that I raise is looking at 5.5, effective data discontinuity model results. It's unclear to me how data discontinuity effected the hydrodynamic water quality model. Earlier, it was explained to me that like there were long reaches in the river where there were no tributaries coming in.

I would like to see if the, you know, model in the longitudinal profile, so not only at the certain stations, I'd like to see the grab that shows longitudinal profile of the model through that range where we have no data and see, you know, what the model...

MR. LUDWIG: Okay.

MR. KRISTANOVICH: ...predicts with what we, you know, have based on the points that we know in the river, just to see how far is that off. I know you're saying that it's not much of a big difference, but I would like to see that visually. I didn't see the plot. So you need something to present to convince me that is correct.

MR. PLOTNIKOFF: Felix, you had mentioned there were long reaches where we didn't have data collection. Can you let us know which areas you're concerned about?

MR. KRISTANOVICH: Yeah (affirmative), I can provide you that.

MR. PLOTNIKOFF: That would be great.

MR. KRISTANOVICH: Yeah (affirmative), sure. So these are the major issues I have, yeah (affirmative).

MR. LUDWIG: Yeah (affirmative), Felix, thank you for the comments. I am, as you noted, the no significant progress was discussed earlier, yeah (affirmative), we had to -- had a significant hurdle to overcome with John passing away.

The team, though, was helping John. So it was -- we didn't just go through a transition of -- they were familiar with the project, so -- but the points that you raised relative to more calibration statistics, we can certainly provide those, as well as validation and it is -- it's our intention to provide a more detailed description of the model calibration and in more detail, in terms of a technical memo or a report and absolutely, your question regarding the -- seeing the longitudinal profile, we can provide model output and graphical analysis showing what the temperature simulations look like.

MS. MCCRACKEN: This is Betsy McCracken with Fish and Wildlife Service and I'm just wondering if you can tell me a little bit about how you combined the 2013 and the 2014 data for the modeling purposes? How does that work to get one year of data, complete data?

MR. LUDWIG: The 2013 and 2014 data, was that your question, how to combine the two?

MS. MCCRACKEN: Yeah (affirmative), early on, I don't remember if it was Bob or who said that you combined the -- you threw out some of the 2013 data that was suspicious and then you combined it with the 2014 data that was good to come up with one complete year of water quality data.

MR. PLOTNIKOFF: Well, let me start with this response, if that's okay, Jon?

MR. LUDWIG: Sure.

MR. PLOTNIKOFF: The -- one of the things that Jon, I think, had talked about is the importance of temperature calibration in the model and how that's related to water quality variables. Temperature mediates an awful lot of the activity in water quality variables and they're associated with the temperature by relationship. So Jon, could you let her know a little bit about that, because are you concerned that -- what would be specifically your concern by filling in the gaps from the 2013 data set with the information that was collected at the same sites in 2014?

MS. MCCRACKEN: I'm just trying to understand how you combined it, and you know, maybe you can explain what differences we might expect to see and...

MR. PLOTNIKOFF: Well, we would have expected some very unusual model output if we had data that was not -- that didn't reflect kind of environmental conditions for this setting, like the total phosphorus. There's not reason it was so high. So if we had put that in the model, you can imagine what the model would be saying about chlorophyll A. It would be telling us we would have thick green mats of algae when, in fact, there would be nothing there and so the model would not -- would be an unrealistic prediction. So we're very concerned about getting it right and however long it took to get that complete dataset right.

MR. KRISTANOVICH: This is Felix. I think confusion is -- I don't think the model is at the stage where you model water quality variables here, right? That is the confusion.

MR. PLOTNIKOFF: We are not.

MR. LUDWIG: That is correct. That is correct, Felix. That is correct. I actually was going to add that right now, is the fact that the progress that was presented in the November submittal is hydrodynamic calibration, which one of the key calibration parameters is water temperature and that temperature, as Rob has mentioned, it's also a key water quality component, especially when we're talking about nutrients and (indiscernible) cycle, but we are not at that stage yet, in terms of what was presented in November of 2015. We only presented the hydrodynamic and calibration to the temperature data that was collected in 2012 and '13. Thank you, Felix.

MS. WALKER: Sue Walker with NMFS. I do have some questions relative to temperature. I don't know if it's for Jon, but maybe both of you. Jon, you just mentioned the temperature collected in 2012 to '13, and I'm looking at your reservoir modeling results and your projected future discharge temperatures and additional information on future temperatures discharged from the reservoir.

Are you using future water temperatures based on static conditions of air temperature or are you using the reasonably projected and available continued air temperatures?

MR. LUDWIG: Yeah (affirmative), I can -- that's a good question. Essentially, what we were projecting for the future is actually the scenarios that I spoke about in the presentation, which was two scenario time periods were selected. One is the '74 to '76 time period and the '79 to '81, representing a wetter -- a wet period and a dry period to represent what may happen in the future.

So we don't have -- we can't predict the future on -- in terms of, we don't have the dataset in the future to be able to run the -- to drive the simulation models, the model simulations. So we have to use historical data and the time periods that we selected were the '74 to '76 and '79 to '81, which we're just using the available weather and temperature data during those time periods.

MS. WALKER: So are you using...

MR. LUDWIG: Does that answer your question?

MS. WALKER: Not entirely. Are you using the 1974 through '76 and the '79 through '81 air temperatures?

MR. LUDWIG: Air -- all kinds of weather -- air temperature, precip data, solar radiation, relative humidity, all of those -- various weather parameters are being used to generate the model inputs, which are the drivers for our model.

MS. WALKER: And do I have this correct that you're saying that future projections of those variables are not available?

MR. LUDWIG: To -- in a continuous time set, we -- what we need is we need a continuous time series generally on an hourly time step, especially for precipitation and other variables, we can extrapolate that out, but the concept of developing a predictive water -- hydrodynamic and water quality tool is to be able to construct your model in such a way that you can calibrate your model to existing conditions, using existing weather data, precipitation data and calibrate or measure your model output to monitoring data, water quality temperature data of water column information that has been collected and directly compare the results.

Once you have the model calibrated, the next step is to run -- you have a calibrated model that you're making the assumption that it's -- we're doing our best to replicate what's going on in the system currently and then you can use historical data to be able to say, okay, if we get an extreme event, say an extreme dry event in the future, let's go back and look and do an analysis of our weather data over the past 25, 30 years and pick an extreme event and then run that data, that timeframe in the model to give us an idea of what it would look like in the future.

MR. PLOTNIKOFF: You know, I think what Sue was asking, I think there's two steps here. Jon and his team are building the framework of the model and step two is to use current information to calibrate that framework.

The reason they're using the proof of concept that was presented back in April 2014, they're using long time periods, understanding that there's variations, cyclic variation, the environment that is not captured with one or two years of data.

It's -- and that's the reason why we can collect one year of data, because that variation for the main drivers in the model are captured now in the framework and our water quality data then is attached to something like temperature. It does vary and it -- variation on a daily, monthly, year -- annually, and so it's that basic engine. That's what we have to build first.

I don't think it's intuitive. I don't think we all see this very often and that's why you see the output on Jon's presentation as three years at a time, acknowledging that there are these cycles that occur.

MR. LACROIX: Hello, this is Matt LaCroix with US EPA and I'm just curious on the model, so this is a question for Jon, does the model allow you to simulate spillway releases from the reservoir?

MR. LUDWIG: Could you repeat that, what types of releases?

MR. LACROIX: Spillway releases.

MR. LUDWIG: Spillway, yeah (affirmative).

MR. LACROIX: Rather than through the turbines.

MR. LUDWIG: It can be configured to do that, yes.

MR. LACROIX: So that's part of the project, is to allow -- to model that, effects on water quality? Okay, so I just wanted to verify that. A second quick question, are you building into that -- the immediate downstream dam part of the river model, anticipation of ice-free conditions or the possibility of ice-free conditions?

MR. LUDWIG: Yes, we are considering that. One of the things that we're currently working on is, as I mentioned, in the slide, in terms of the future steps, is interfacing with the ice model, the current ice modeling that's going on and trying to figure out -- and that's what we're trying to do right now, is trying to figure out how to interface the two models and with the understanding that there could be ice-free conditions in that immediate reach downstream of the reservoir.

MR. LACROIX: Thanks, Jon. That's what I assumed was the case. I just wanted the clarification on that.

MR. LUDWIG: No problem.

MR. PADULA: Questions from Chris.

MR. HOLMQUIST-JOHNSON: I have a question on the ties between the baseline and the water quality modeling and what Jeff brought up in terms of the Slough 8A questions with DO and the longitudinal variation in that. While Dudley mentioned that there's additional data with the HSC that ties in with that and variables that we're looking at with that, that we need information from the water quality model for DO to apply to some of these habitat relationships that we're dealing with and I'm curious, everything we've seen so far has all been based on temperature and it's mentioned that DO will be, you know, looked into as, I guess, as the model progresses, and I guess just trying to understand whether or not we'll be able to model the variations of that DO in these focus areas with the model that we have and if so, what data would be used to calibrate and validate that, given what you described earlier, didn't really have much information there, if that's going to be coming from other studies and if those were collected in a way there that you think the same purpose you would need to calibrate this model, collected under a different purpose?

MR. PLOTNIKOFF: Yeah (affirmative), Chris, good question. I think we're bound with this modeling by resolution of the model and Jon had mentioned, you know, the longitudinal extent on the main river and then focus areas as finer.

I mean, I think in our documents, we mention up to 1,000 meters on the main river and up to 250 meters on the focus areas. So those are -- have I got that right, Jon?

MR. LUDWIG: Yes.

MR. PLOTNIKOFF: Okay, so that's one issue that we have to deal with. As far as calibration, I think Jon has mentioned, I mean the model is calibrated. Felix raised the issue of validation, so easily use other datasets that were not part of the calibration dataset to verify. The model can be refined using those other data. If we used it all at once, unfortunately, we wouldn't have a validation dataset and find it hard to be able to do that. That's part of the process (indiscernible).

MR. HOLMQUIST-JOHNSON: Thanks, I just think it gets into, again, the kind of pilot study application of what data's needed by certain studies, you know, from a habitat suitability standpoint and Dudley and others might touch on this more tomorrow in the discussions, as far as how that information is being applied and where that info was coming from, but again, the scale, temporal and spatial scale differences and whether or not we can actually link those together and answer them.

MR. ASHTON: William Ashton with DEC. I was wondering in the report 5.6, it has a note on the bottom of most of the figures. It says, "Proof of concept model runs assumes reservoir withdrawal from the entire intake elevation range, which is not representative of the planned operation of the dam." So I'm wondering in the scenarios that you're planning to run, are you going to be taking various operational scenarios that the Power Authority has come up with and running those through the model to come up with what would be the results downstream?

MR. PADULA: Is that a Betsy question?

MR. DYOK: I'll answer it. The short answer is, yes, we're going to be looking at different operating, you know, scenarios and we can also look at taking water from different strata because we have shutters. We have the ability to do that. So in this, you know, feedback loop that we have, we'll be talking to, you know, the biologists, what kinds of temperatures are you looking for and then we can try to simulate those.

If we don't get those, we can change the shutter operation. We can change the flow operation. So we have variables at our disposal to look at that. We've run, you know, one particular scenario through the office model, but that's just one scenario with some smaller level of load following. We have, you know, tremendous flexibility to run pretty much anything we want and that's something that, you know, we'll be doing as we get these models all, you know, fitted together.

MR. PLOTNIKOFF: Jon had mentioned in construction of the reservoir model that it contains 20 layers and so that accommodates that ability to extract water from different portions of the reservoir and determine what output looks like.

MR. ASHTON: When is that scenario modeling going to be happening and input to that and that sort of thing?

MR. DYOK: So once we have these models calibrated, validated and start operating them, we'll, you know, get into that process, but there's still more work to be done, in terms of getting these models, and then there's the question of, you know, when the -- you know, additional funding becomes available. So we'll need that, but certainly, in a step-wise fashion, you've got to get those things done first and then once they're done, you can start, you know, looking permutations and combinations, and as far as, William, as far as a specific date, we don't have that yet.

MR. DAVIS: Yeah (affirmative), river productivity showed some water...

MR. PADULA: This is Jeff again.

MR. DAVIS: Sorry, this is Jeff again. Thank you. Could you just do that every time I speak? That would -- yeah (affirmative), my name's Jeff Davis and I had a question. The river productivity showed some temperature data that they collected among the different macro-habitats that fed into their estimates of, as you know, algal growth, respiration, fish growth is largely temperature dependant.

One question I had was why they used their data and not your data, but the second question was there were some big difference between a side slough and an upland slough, and I'm wondering, given your current dataset, how many side slough in the Middle River and how many upland sloughs in the river, Middle River, can you adequately model water temperature year-round and longitudinally, within those sloughs, how much variability can you model year-round with your current dataset?

MR. PLOTNIKOFF: Yeah (affirmative), the short answer is, is the area that's being modeled is produced in the SCR. So it's -- it indicates what areas can be modeled and there are areas missing. The resolution, again, is anywhere from 100 to 250 meters. So that's coarser, I think, than the objectives and the purpose for the productivity study and some of the other HSI work going on.

That work is -- appears to be capturing the finer detail in a lot of those areas. The purpose for modeling in this is, in part, to supplement information on a larger scale.

MR. DAVIS: So did I identify some of those gaps in the model -- you said there's some areas that you can't model?

MR. PLOTNIKOFF: No, these were defined back in 2013 and 2014 in our reports where John Hamerick actually had laid out the mainstem and side sloughs where he was modeling, where he was producing grids.

MR. DAVIS: Right, I guess I just still don't feel like I've got my question quite answered. So how many side sloughs and how many upland sloughs can you model water temperature with your current dataset in the Middle River?

MR. PLOTNIKOFF: Those are reported again -- I need to look back at which figures those are.

MR. DAVIS: Okay, thank you.

MR. PLOTNIKOFF: And that would be the extent of the modeling that was developed.

MR. DAVIS: So when I review the model today, I feel like those are some gaps in the ability to predict post-project conditions. So I see some wide variability in water temperatures among these different macro-habitats. I know that water temperatures are important for both the productivity and the fish growth and so I think it's really important that we be able to model those post-project really to be able to evaluate the project effects.

MR. LUDWIG: Understood.

MS. LONG: Becky Long, SRC. I just wanted to know, in your operation scenario modeling, however you should say it, is run of the river one of them, Wayne? I think FERC said that you guys should do that or what?

MR. DYOK: Yes, much to my chagrin, FERC has said to do a run of river case. Bad decision, by the way, guys.

MR. PADULA: Wayne, as a consultant, saying bad decision, not AEA, as the applicant.

(Indiscernible - speaking simultaneously)

MR. PADULA: Any other comments of questions in the room or from anyone on the phone regarding 5.5 or 5.6?

MERCURY ASSESSMENT AND POTENTIAL FOR BIOACCUMULATION STUDY (Study 5.7)

MR. PADULA: Great, if not, I think we're ready to move onto 5.7 and that's the Mercury Assessment and Paul Dworian is with us and will lead that discussion and after this, we'll take a break.

MR. DWORIAN: Hello, hi, my name's Paul Dworian. I'm with AEACOM and I was responsible for the Mercury Assessment and Potential for Bioaccumulation Study. This is ISR -- the ISR documents. I don't think I need to go down the list of everything on this page.

So our objectives for the study was to summarize the available historic mercury information, mostly from the APA studies back in the 1980s, to characterize the existing concentration of mercury in soils, sediment, vegetation, water, fish, to look at the available geologic information and see if there is a geological source of mercury, like a cinnabar deposit or something of that nature, map mercury concentrations in soil and vegetation in the inundation area, use the water quality model to predict the reservoir conditions and where it may be conducive to the generation of methylmercury and use modeling to estimate the methylmercury concentrations in the fish and coordinate with all the other studies.

So study components, you know, as I said, we looked at vegetation, soil, water, sediment, sediment pore water, piscivorous birds and mammals and fish tissue and modeling. We had a number of variances. Most of these we considered to be pretty minor. They can be categorized as a variety of different things.

In some cases, we moved a sample location, either we couldn't get to where we had planned to take the sample or when we got there, the conditions weren't really appropriate for the sampling, so we moved it slightly to a different location on the river.

We changed some sampling and analytical methods slightly. We couldn't get a boat in the river where we wanted to. So we ended up just wading out and collecting samples that way. We saw a significant amount of organic material in a lot of the soil samples. So what we did was we changed the method slightly. We did a split sample, ran one half the way we said we would in the RSP and then modified the extraction method for organics, just to see if we could get a higher number or if any changes would occur.

We said that all the fish would be speciated. We had a couple of fish that we're looking at whitefish species with humpback whitefish and round whitefish and I think we had a couple of strange ones in there that were just difficult to identify. We also found it was just not possible to extract otoliths from all the fish that we collected. Part of that is just the sampling process. Others are, you know, we're looking at slimy sculpin and in fish like that, it's just really impossible to collect an otolith from.

We had some issues identifying the sex and sexual maturity of fish, something we said we would do in the RSP. We don't think, based on the samples we do have, there doesn't seem to be any trend based on the sex of the fish with mercury concentrations and we haven't seen that in other studies either. So we really don't think it's that relevant.

We did have the issue with some of the mercury results from the laboratory that Rob talked about and I don't think I need to go over that again. We also collected more fish than we anticipated and also some juvenile fish. Part of that was just samples of opportunity where we had a fish get stuck in a fish trap and was killed. We went ahead and just took that fish, even if we already had enough samples of that particular species or if we had some juvenile samples that were accidentally collected, we went ahead and analyzed them.

We had a small issue with sediment sampling. We said we would collect -- we're trying to focus in on collecting fines -- sediment samples with a lot of fines in it. However, the locations in the Upper River that we looked at, we just didn't see a lot of fines in a lot of locations. So not all the samples had the required amount of fines in them.

That said, looking at the samples we did have enough fines in, we didn't see higher or lower mercury concentrations in the (indiscernible) samples.

Again, some sample locations were modified. We did make some attempts to collect piscivorous bird and mammal samples and I'll talk about that more at the end of the discussion. In our RSP, we said we would put hair-snag traps at a variety of different locations, creek mouths, looking for -- trying to get hair samples from river otters and mink.

After looking at the aquatic furbearers study, where they were looking aerially for traps or tracks in the snow. We only -- there was only two locations where they saw any tracks at all and so we decided just to focus all of our sampling efforts out on those two particular creeks.

I'm not going to read all these concentrations off, but I'll talk a little about the results. For the vegetation, vegetation, all the locations inside the inundation area, there was not that much variability in all the locations that we sampled. I think we took a total of 50 samples at 10 different parts of the inundation zone. So we didn't see a lot of variation in species. We didn't see a lot of variation in concentrations.

Mercury, we got our mercury results. One interesting kind of finding there was occasional detections of relatively high concentrations of methylmercury in the soils. We believe that's -- you're just getting the right conditions inside very organic materials for bacteria to be breaking down that mercury and forming methylmercury. There were just a few isolated samples, but it was an interesting finding.

Water concentrations, generally what we saw was dissolved mercury concentrations were one or two orders of magnitude lower than total mercury concentrations. We think that's because the mercury is closely associated with the very, very fine material that's suspended in the water column.

The screen just went blank. We didn't see a lot of variation in mercury concentrations with location and depth in the river, you know, left bank, right bank, top of the water, bottom of the water, we got pretty much the same concentration. It just simply says that the water column's pretty well mixed.

We did notice higher concentrations -- concentrations generally decreasing as you move upriver. If you think about the source of the mercury, if it's not a mineralogical source, it's a breakdown of organic materials. That's how the mercury is actually getting into the water.

So where you see a lot of that occurring is wetland features and as you sort of go upriver, you get fewer wetlands, which sort of makes sense that you would see lower mercury concentrations in the river.

We also noticed higher concentrations in spring and diminishing concentrations in the fall and winter. Again, if mercury is associated with the really fine sediment, that's the pattern you'd expect to see.

So again, I'm not going to read through all of these. I'll just sort of note anything of interest. Most of the sediment pore water samples were fairly low concentrations. We were not fortunate in being able to collect bird samples. Our initial effort was to look for piscivorous birds, track them to their nest, collect feather samples, non-destructive sampling. One of the problems and challenges that we were having was there's not a lot of piscivorous birds up there and so we just, you know, if we saw the bird, we tried to track it back. You know, there's step one where we encountered some difficulties and then, you know, getting even at the nest itself to find feathers. I think we did look -- we did look in a couple of nests and just didn't find any feathers.

So we did get some river otter and mink samples. We -- there's a trapper that was working on the river who had some samples downstream from the inundation zone near Portage Creek. We purchased them and analyzed them. They're not within the area that we really wanted, but it did give us a little bit of baseline data to look at and we were fortunate in we did get one single hair trap, got four river otter hairs that we were able to analyze.

Because we had such a small sample size, all we were able to do is do a wet weight sample, but if you sort of compare it to the other samples, a dry weight sample is about three times what the wet weight is, so our fish tissues samples, again, fish -- fish are not evenly distributed.

So you know, there are some fish we only found in some locations. For example Dolly Varden were up on Watana Creek. That's the only place we saw them. We did add a species. Slimy sculpins were found and so we decided to sample those. For the whitefish, we didn't see any humpback whitefish, at least not any that we were sure were that species, so -- but we did find round whitefish.

I won't go down all this list, but lake trout, we collected from Deadman Lake and Sally Lake. In parenthesis there is the number of fish that we collected total, along with all of the other statistics.

This is an interesting graph. You know, whenever you get these concentrations and people look at them and say, "Well, what does that mean," you know, and what we did was we looked around the state to see samples or examples of where they had done other studies of mercury in fish. Arctic grayling was the species we picked because most studies seemed to be for Arctic grayling and we also correlated with the size of the fish because that seemed to be the data that was most commonly available.

A lot of these, I should say, came from DEC. A lot of this information came from DEC and DEC biases their sampling of fish, sampling analysis of fish toward locations where they think there might be problems. So those might be a little higher than what you would normally get if you just took a random sampling out of all the lakes in Alaska, but we also did find information from National Wildlife Refuges that were collected by Park Service that were not biased in that way.

So you can see the three, those green spots. We just sort of split the grayling based on where they were collected. We thought maybe that would make some difference. It didn't. It was the same concentration everywhere in the zone.

We did the Harris & Hutchison modeling. The Harris & Hutchison modeling is a linear regression model. Basically it takes a look at a whole bunch of different reservoirs where they've monitored mercury concentrations in fish and back-calculated what were the critical factors that must be influencing these concentrations.

So Harris & Hutchison, all it can do is it can tell you what your maximum concentration of mercury is going to be in piscivorous and non-piscivorous fish in a reservoir. It can't tell you when that particular concentration is going to occur. So what we found was 1,047 nanograms per gram wet weight total mercury muscle tissue and 212 nanograms per gram for non-piscivorous fish.

I went ahead and put up the Alaska DHSS guidelines just for fish consumption, again just trying to put these numbers into some sort of context for everybody. Also, we compared it to no observable effect from an eco standpoint, you know, where do you start to see ecological impacts, and for no observable effects, about 200 nanograms per gram and for the lowest observable effect, around 300 nanograms.

This graph, this is actually not from our project, but I think -- I thought it was good to show. This is from Hydro-Quebec. What they did was they had a number of reservoirs in northern Quebec and they built the reservoir and then took samples of the fish every single year and analyzed them for mercury to see what was going on, okay, and this is a very typical pattern that you see.

You've got three different reservoirs, ended up with very close -- close to the same results. Mercury concentrations will increase really rapidly right after the inundations. What Harris & Hutchison is telling us is what the top of that little curve is.

The second modeling that we were planning to do was the phosphorous release modeling, which was actually developed by Hydro-Quebec, which actually gives you the shape of this entire curve.

I thought this was interesting just to summarize all the different mercury data that we collected and if you look at this carefully, you actually can see some of the relationships between different mercury concentrations.

Starting -- the mercury really starts, in this case, it starts with the vegetation. Vegetation absorbs mercury from the atmosphere. Vegetation dies. It gets concentrated in organic material. It gets concentrated in the soil. You see the concentration of mercury jumps up in the soil.

Surface water, sediment, that organic material that's in the soil, it flushes down into the water. It gets broken down. That's where it gets methylated and turns into bacteria that has the methylmercury in it and moves up the food chain through the macroinvertebrates and into the fish.

So again, as you get to the non-piscivorous fish, you see the concentration going up again and into the piscivorous fish. It increases again and then finally, you get to the otter and mink stage, where you start to see the really strong concentration of methylmercury, if you can make sense of that.

I mean, the basic idea of this slide is to show that the movement of mercury inside the ecosystem is actually pretty complex. Mercury is evaporating out of water. It's being deposited from the air. It's being absorbed by plants, which breakdown and fall into the water and then gets turned into bacteria and then to macroinvertebrates.

It gets stuck down in the sediment at the bottom of a reservoir. So it gets taken out of the system -- so it can be a very complex process of how the mercury is moving through the environment.

So proposed modifications, like I said, we didn't find any rainbow trout or stickleback and maybe two questionable humpback whitefish. So our -- we would propose, obviously, we're not going to sample for species that are not present.

We are consolidating, I think in the RSP, the mercury sampling for all kinds of different biota was spread out over several chapters. We want to consolidate it into this study.

The need for additional sampling of wildlife tissues right now, based on what we're seeing in the fish, and the difficulty that we had in collecting terrestrial animal tissues and analyzing them for mercury, what we want to do is get done with the modeling, the predictive modeling to see where we're at, the phosphorous release modeling and the reservoir modeling, and at that time, we can make a decision on moving forward and how we want to move forward with that additional sampling.

So what's going to come, phosphorous release modeling. What we're waiting on is the water quality model to tell us what the phosphorus concentrations are going to be in the completed reservoir and then we can finish the phosphorous release modeling, get the EFDC modeling done and then we can update our pathways assessment and then make a decision on additional sampling of piscivorous mammals and birds.

MR. PADULA: Thanks, Paul. Felix has some comments here.

MR. KRISTANOVICH: Felix Kristanovich from Ramboll Environ. We prepared a number of comments for 5.7 and my understanding is that our mercury expert on the phone had some trouble with the sound, an issue that -- I don't know if she still has it. She redialed in. So I'm just going to read the main comments and if anything is left, I'll let Meg fill in.

Well, we understand you guys are moving in a good direction and thanks a lot for providing mercury pathway analysis. I'll just read the main comments. Can you explain why suddenly mercury sampling was discontinued in 2014?

MR. DWORIAN: I -- we had set targets for how much mercury sampling we were going to do and we've actually met those targets. So we -- no additional sampling is planned. Do you mean for the piscivorous mammals and birds?

MR. KRISTANOVICH: Well...

MR. DWORIAN: Yeah (affirmative), because we -- I mean, we did all the water sampling and sediment and everything else was completed, and I think at that time, we looked at it and, given the challenges we were facing with that sampling, we decided to wait and see what the predictive modeling is going to tell us and whether that sampling is even necessary.

If the predictive model is saying that the, you know, concentrations of mercury in the fish are never going to exceed any kind of potential for ecological risk, you know, then we're kind of wondering what's the point of continuing of with piscivorous birds and mammals sampling, especially if, you know, we're not really finding a lot of examples of that kind of wildlife in the area right now.

One concern we've had, and this kind of came from the RSP, was, you know, that if the concentrations are very low, we don't want to take a lot of samples of a particular species that just isn't very common to begin with.

MR. KRISTANOVICH: Related to that, you said that -- okay, additional sample collection for birds and mammals are deferred until pathway analysis has been completed. Don't you need those data to complete pathway analysis?

MR. DWORIAN: Not necessarily, I mean -- you want to...

MR. PLOTNIKOFF: This is Rob. Yeah (affirmative), there are two steps in pathway analysis. We've got the aquatic environment. We have terrestrial environment. Obviously, we have background information now for terrestrial. That's good background information.

Our plan, and we'd stated this in the previous meeting, is that we want to know how much mercury, if any, will be generated into the aquatic environment that exposes aquatic life, potential for bioaccumulation. If it's -- if we don't reach a threshold -- Paul had shown some thresholds on background levels, especially those that are related to fish consumption, if we don't see them, there are not likely to pose a bioaccumulative concentration threat in the terrestrial environment, and you know, we -- we're just doing one step first at a time and Paul correctly stated that if, in fact, we see the potential for a lot of release into the different trophic levels, then certainly, that's another point at which we need to make a decision.

MR. KRISTANOVICH: You're saying so if you're going to see exceedances then you'll reconsider additional sampling?

MR. PLOTNIKOFF: That's what this slide is purported, yes.

MR. KROSTANOVICH: Okay, I get it. Okay, thank you. With respect to pathway analysis, we just feel that you need to support it with a lot of additional literature references. There was just not very well described.

MR. DWORIAN: The...

MR. KRISTANOVICH: The Pathway Analysis Report.

MR. DWORIAN: Okay.

MR. KRISTANOVICH: And maybe you can provide your specific comments. Also, in SIR report, we feel we need a table showing the inputs to the model and model outputs so the results can be reviewed and verified. For example, Harris & Hutchison model, you're presenting results, but we felt that it should be shown in its entirety so readers can also conduct and verify the analysis.

MR. DWORIAN: I think that's fine. It's -- I mean, if you look in the RSP, it's a fairly simple formula, so -- but yeah (affirmative), we can provide that.

MR. KRISTANOVICH: Okay, thank you. So with respect to the pathway...

UNIDENTIFIED SPEAKER: Hello.

MR. KRISTANOVICH: With respect to the pathway analysis, like for example, pieces that are missing, supporting information necessary to show the validity of the mercury pathway analysis would include consideration of suspended solids, more complete description of the subset of metals selected for pathway analysis and they should include a description of the concentration of metals found in the baseline sampling efforts, so just some of the pieces that were missing. Okay, these are some of the major comments.

MR. DWORIAN: Okay.

MS. MCCRACKEN: This is Betsy McCracken with Fish and Wildlife Service, and I wanted to go back to the variance that you mentioned about the deferred pathways analysis. I know you said you were looking for exceedances, but if -- my understanding that -- well, as you described in slide 15, there is already a pathway of bioaccumulation of mercury that we're aware of and that's been demonstrated and that also --

there was a lake trout sample that had very high mercury concentrations and also river otter samples. So I guess I'm not -- it's not clear to me why you deferred it.

MR. DWORIAN: It's -- you mean the pathway analysis?

MS. MCCRACKEN: It's something we -- yeah (affirmative). It's something the Fish and Wildlife Service asked for and so I'm just...

MR. DWORIAN: It's -- yeah (affirmative), I think we should be clear. We're not deferring the pathway analysis. The pathway analysis will be revisited once we finish the modeling, which isn't quite complete yet and that's -- it's only being delayed until we can get the water quality model to get us phosphorus concentrations. Then we can complete the phosphorous release model and the EFDC model and then we have a much better handle on the pathway analysis. It's not being deferred.

What's being -- what's being potentially deferred right now is additional sampling for aquatic piscivorous furbearers and piscivorous birds. That's the part that's -- we're...

MS. MCCRACKEN: A determination that says...

MR. DWORIAN: Yeah (affirmative).

MS. MCCRACKEN: So -- and we had also asked for blood and feather samples from, in particular, we're interested in birds or eagles and loons because we do have data that we can compare concentrations to.

MR. DWORIAN: Yeah (affirmative), and that's in the slide. So yeah (affirmative), that is our plan right now and that's what we're hoping to do, but like I say, you know, we're trying to get the modeling so that we can get the pathway analysis done and then we can make a final decision about how much of this additional sampling needs to be performed.

MS. MCCRACKEN: Also, I had another question on slide 14. It looks like there would be a four-fold increase in mercury or is that the...

MR. DWORIAN: Well, at these particular reservoirs, that's not necessarily -- every reservoir is going to be different. In this case, we are looking at an increase, I think -- I mean, to put this in perspective, there's an increase in probably every reservoir.

What happens is, as you fill the reservoir, the organic material that's in the fine leaf stuff and the soils, organic soils, gets flushed down into the reservoir and you've got -- so you've got this big surge of organics and mercury, which is in the organics, and that's what generates that pulse of mercury that sort of moves its way up through the food chain and when you see that sort of decline, what's happening is that mercury is slowly removed from the food chain, either the animal dies and gets buried in the sediment at the bottom of the reservoir or you're using up all that sort of extra organic material that got flushed in initially, as it 's being eaten.

So eventually, all that stuff, it all goes back down to background, but it could take 20 or 30 years. Right now, we don't know. You know, I put -- I hesitated to put this slide in here, but I did want -- whoops, I did want to clarify for everybody, this is what it's going -- it's going to look -- a curve like this, where there's going to be this -- the initial concentration should be a few years after the inundation occurs and then it should trail off over the next 10, 20 or 30 years.

MR. CHOWDHURY: This is Monir Chowdhury with FERC. I know you had issues with water quality samples. I'm just wondering if you had similar issues with sediment samples, because in the 2014 report, you reported sediment concentration much higher than what you reported (indiscernible) 2015 report.

MR. PLOTNIKOFF: This is Rob. In response to your question, there were no issues with the sediment samples collected over the two years. The only issue involving mercury was total mercury in surface water samples. Those were recollected and provided now as part of the complete dataset.

MR. CHOWDHURY: Because you can look at September 2014 report, page six, where you reported -- you said that one mercury result, which is 220 nanograms per gram from 14 sediment samples, and then you reported overall average mercury concentration for sediment samples were -- was 23.01 nanograms per gram.

MR. DWORIAN: Yeah (affirmative), I think that was just an error in that presentation.

MR. CHOWDHURY: Okay.

MR. DWORIAN: Could you state your name? You said you were with FERC?

MR. CHOWDHURY: Yes, Monir Chowdhury.

MR. DWORIAN: Thank you.

MR. PADULA: Any other questions for Paul? Yes, Felix.

MR. KRISTANOVICH: One simple one, can you go back on slide

12 and explain the legend? What color is what?

MR. DWORIAN: I'm sorry, what part? The green are samples that were from this project and the blue were samples from all the other studies that we could find in Alaska. So we just wanted to distinguish them.

MR. KRISTANOVICH: Thank you.

MR. DWORIAN: And like I say, we separated out the samples from this project, Watana Creek, Kosina Creek and Oshetna River, because that kind of had the full extent of the reservoir and I thought maybe they might look different or somebody might think they might be different, but not really.

MS. MCCRACKEN: This is Betsy with Fish and Wildlife Service. So you said this is the best available data that you have and so -- is that right, so...

MR. DWORIAN: You mean on this chart?

MS. MCCRACKEN: Well, I guess I'm a little bit surprised that it wouldn't be -- a mean concentration at age of fish, as opposed to...

MR. DWORIAN: Yeah (affirmative), I mean, a lot of studies don't age the fish. The one commonality of all of the studies we found was that they give you a weight and yeah (affirmative), it's not -- I'd rather they did length than weight and I'd rather they had age than length, but you know, you've got to go with the data you got.

MS. MCCRACKEN: And only for Arctic grayling, is that...

MR. DWORIAN: We found some other fish. Arctic grayling was the fish that was most commonly sampled, I think because it's just so widespread across Alaska that it seemed to be -- I mean, we could look at others, but we wouldn't have as many, you know, as much to show, so...

MS. MCCRACKEN: It would be great to have the age because they, of course, stop growing at different ages, so...

MR. DWORIAN: Yeah (affirmative), I know. I agree, so -- and maybe why you start seeing some of these higher concentrations in some of those high Arctic stuff because the fish are just, you know, small -- they may be really old, but really small. A question in the back.

MS. LONG: Becky Long, SRC. The one with the three reservoirs in Hydro-Quebec, that slide, so it does level off, but it looks like at the end, will some of them start going up and that green one goes up and comes down. Can you like hypothesize what's going on there? I mean, it doesn't completely level off and get less. I guess it -- there's peaks and going up and down, but...

MR. DWORIAN: Yeah (affirmative), I mean, you're going to see a lot of variability just over time. I mean, you have to imagine the process of what's happening here. It's organic material. It's flushing down into -- now it's in the reservoir.

One thing you might see is how much the elevation of the water in the reservoir is changing over time. You know, if it goes really high and then it drops really low, what happens is it tends to push organic matter down deeper into the reservoir and it actually gets buried down at the bottom and doesn't convert to mercury. So there's a lot of variability about how, you know, how a reservoir is operated that can potentially change mercury concentrations.

MR. WOOD: Mike Wood with SRC. Does that take into consideration the size of the reservoir and the type of vegetation that's being inundated? For instance, I mean, this is an extremely large reservoir and these are all old growth forests out there, including black spruce and muskeg. So I mean, we're not submerging sandstone here. We're submerging, you know, huge trees and whether it gets logged or not is probably another issue, but I'm just wondering, does that take into account the amount and type of vegetation you're submerging in your reservoir?

MR. DWORIAN: Yes, it does, actually, and the -- but the chief contributor to mercury accumulation is not trees or large chunks of wood or anything like that. It's that very fine organic material that's in the upper part of the soil column. That's really where it's originating.

The smaller it is, the easier it is, the faster it breaks down, there's a lot of variables involved in looking at this. I mean, one is temperature of the water is a variable. Phosphorus is a variable. There's all sorts of variables that play into what your ultimate concentrations will be.

However, that said, the Harris & Hutchison model, it's a surprisingly simple equation and yet, it seems to yield fairly accurate results, accurate predictions. It's been used many times as to your maximum mercury concentration. So you know, we like to -- sometimes we pretend that, you know, we think things are very complicated, and in fact, they are fairly simple and other times, you know, we think it's fairly simply and it's very complicated. So that's the answer for you.

MR. PADULA: Any further questions for Paul? Anyone on the phone with a comment or a question?

MS. PINZA: This is Meg Pinza from Ramboll Environ. Can you hear me okay?

MR. PADULA: Yes, we can.

MS. PINZA: I just wanted to make more of a comment and it's related to the fish tissue versus the whole body. I just (indiscernible) in 2005 and I know you did an adjustment of what you saw in fish tissue versus whole body, but I would say the comment in the document, can you also provide the formulas that you used there to do the whole body from what was collected and analyzed?

MR. DWORIAN: Yes. Yeah (affirmative), and for...

MS. PINZA: Great, that's kind of -- that's just kind of a general comment walking through the document from someone who doesn't -- I haven't read all of the countless documents that are on the website. If you could just have the -- your document be a little bit more standalone so that it can be kind of verified as we go through and read. I think that would be a general comment.

MR. DWORIAN: Okay, yeah (affirmative).

MR. PADULA: Okay, unless anyone has anything further, we're going to take a 15-minute break. We'll try to start up about 3:20 Alaska Time and we'll finish out the day with the Groundwater Study.

3:06:51

(Off record)

(On record)

3:23:29

GROUNDWATER STUDY (Study 7.5)

MR. PADULA: Hey, folks, let's get started. Dan, the phone's on, awesome. Thank you. The last study summary for today is groundwater and Dudley Reiser is going to lead that discussion for us. Dudley, it's all yours.

MR. REISER: All right, Steve. Thank you. So we're going to finish up this afternoon with the Study 7.5 Groundwater discussion and I want to check first, because we've got -- going to play a little bit of tag-team with this presentation. We've got Michael Lilly, who's on the phone. Michael, are you there?

MR. LILLY: Yes, Dudley.

MR. REISER: Could you repeat that? It came in a little bit garbled.

MR. LILLY: Yes, Dudley, this is Michael.

MR. REISER: And then we have Steve Swope from Pacific Groundwater Group. The PGG group has joined the groundwater team and roughly around August of 20 -- 1915, right, 2015. I'm not that old.

All right, so we're going to -- similar to the other studies, we're going to go through these introductory ones fairly quickly. Just like the other studies, 7.5 status, ISR documents, Part A, B, C, additional technical memos, we'll talk very briefly about those, that were delivered in September 30th, 2014.

In the SIR, in November 2015, we produced a number of other appendices associated with that, including the preliminary water table maps and some MODFLOW, three dimensional groundwater model for FA-128, and there was also a summary, a document presenting a summary of information that had been compiled and reviewed from the 1980 studies and then there was a technical team meeting held in December of 2014 in the meeting notes and presentation materials were part of that.

As far as the status goes, the -- we've completed intensive data collection on four focus areas and wells that are associated with the riparian transects and other study sites, in particular, those associated with the fish and aquatics instream flow.

I've already mentioned the three dimensional MODFLOW groundwater model for FA-128. Steve will talk just briefly about that. We completed a series of time -- time series maps, water table maps for 104, 115, 138, and 128, and this existing synthesis I just mentioned, continued working on the upwelling and springs broad-scale mapping task. We talked a little bit about that, and then these two memos I mentioned before on September 30, 2014.

Just for the record, the objectives of the study, as you all have seen before, so I'm not going to go through these. Components actually mirror the same objectives in a way, just broken down in the shorter snippets here, so you can see them, and then variances, that's something to consider.

Most all of the variances associated with the groundwater study were tied in with schedule and so there was a schedule for objective one that was to be completed. Well, it was completed now in 2015. So that particular objective has been met.

Objective 2, the schedule for the mapping, geohydrologic units, that one is yet to be completed, but will be once we get all the necessary information together for that.

Objective 5, 6, and 7, the groundwater flow models, I mentioned that we've got the preliminary MODFLOW models. So the MODFLOW modeling piece of this is being initiated and is underway.

Under the water quality data, that was also a scheduling issue. In the meantime, there's been a lot of other water quality data that has come into play. Rob mentioned the baseline water quality completion report, the modeling that's being done.

As part of the instream flow work, we did an evaluation of microhabitat parameters that included water quality and that was submitted and completed in 2014.

Now summary of results, Michael, you could jump in here, if you could for a second, and maybe describe very briefly the summary of results on Objectives 5 and 6 for these initial two TMs that were generated in 2014.

MR. LILLY: Hey, Dudley. There were two technical memos, as Dudley mentioned, for this in 2014. There was a follow up meeting to discuss those technical memos on December 5th, 2014, and the objectives of this, of both memos, were to look at the data that had been collected to date and look at how -- and look at the interactions between groundwater and surface water and how that information would be used to help understand the natural system and lead into how project effects would be evaluated and that's discussed in both the two technical memos and was discussed in that December meeting. Dudley, you want to move onto the next slide?

MR. REISER: You bet, yeah (affirmative), there you go, Michael, under the continuation of data collection.

MR. LILLY: So the data collection is still ongoing out in the field. There was a field trip in the fall of 2015 to go out and service all of the sites in each of the focus areas and maintenance were done at a whole number of the sites.

Some sites were moved due to damage associated with either ice processes or bears. Sites on the Lower River were removed and it was a feeling that there was enough data collection to complete the Lower River analysis that was part of task five. So the...

MR. REISER: Yeah (affirmative).

MR. LILLY: So the monitoring is continuing, as we said, continuing now and Dudley, do you want to mention what is being done on the (indiscernible) on the intergravel water temperature...

MR. REISER: Right, yes. Yeah (affirmative), that's great, Michael. The one bullet here, intergravel water temperature and dissolved oxygen monitoring, that's also underway or continuing, I should say. We got recorders that are in FA-144 and FA-128 that are continuously monitoring dissolved oxygen, temperature, as well as a number of other pressure transducers that are out in those systems that are continuing to collect both temperature and stage in those areas. Also, quality control checks of the data have continued and are being processed for use in the modeling aspect.

Steve, you've got a couple of slides here, if you want to step through these real quick on the different TMs?

MR. SWOPE: Thanks, Dudley. So I'm just going to go briefly through the three TMs that we completed. The first one was a synthesis of hydrogeologic data that had been collected on the subject area to date.

Most of this was collected during the 1980s. We downloaded almost 300 documents from ARLIS. Twelve of them contained specific data regarding the subject area and out of those, we were able to glean a lot of aquifer-specific data, not all of it is close to our FAs as we would like, but we were able to get information, such as aquifer thickness, aquifer properties, gradients, flow directions, that sort of thing, and that was all tabulated.

We also completed some water table maps. This was not actually from the initial study plan, but was agreed upon in a meeting in December of 2014. We did up to six maps, between two and six maps, for each of the FAs, depending on, you know, how much data was available. They were constructed for specific time periods based on open-water flow, summer periods, pre-break-up, post-break-up, and a number of other periods.

The model that we completed was a MODFLOW model. Inputs to this included the OW, open-water, model and the SRH 2-D model. Those were the two surface water inputs. The model cells were approximately -- ranged between about 50 feet out to 450 feet, depending on the location.

The smaller cells were in the area of interest and we used telescopic mesh refinement to slowly decrease the size of the -- or increase the size of the cells away from the area of interest, so that we could reduce the number of cells and speed up the model.

We did two different calibrations. One was a steady state calibration, which was calibrating to a period of fairly stable water conditions to get long-term ground -- just simply looking at groundwater baseflow.

We also did a transient calibration, looking at a time of peak water flow to see if the model could respond accurately to that event. The resulting properties, for instance, hydraulic conductivity was within the range that we identified in the literature review.

We will actually -- there will be some additional work this summer, I believe, refining that number and getting some point estimates of hydraulic conductivity throughout some of the FAs.

The resulting -- one of the calibration standards that we looked at for steady state, the root mean square was about 9% for the model. Calibration for the transient is still ongoing and that's why we don't have any validation for the statistics. Thanks.

MR. REISER: Great, thanks, Steve. So then moving on with Objective 7, which had to do with the water quality piece, I mentioned this particular tech memo here, the evaluation of relationship between fish abundance and microhabitat variables, which included some water quality parameters that we looked at and tried to tease out whether there were any relationships between those water quality parameters, of which, VHG or the upwelling component was part of that, turbidity was part of that.

So some of these things related to the groundwater side of the equation, in terms of water quality, coupled with the, you know, the water quality data that's been collected in these other studies, the adjoining areas, the groundwater wells, the baseline water quality study, AEA, we've concluded that the surface water quality characteristics have been sufficiently characterized to be able to continue to evaluate them, the project operational effects on water quality within these -- within the groundwater areas.

In terms of proposed modifications, AEA is not proposing any modification to the methods to complete this study. There are a number of steps, yet, that remain specific to different objectives. As I mentioned, Objective 1, that has been completed and it's in SIR Appendix C.

The geologic -- geohydrologic process domains, Study Objective 2, that's -- there's going to need to be additional work done to define these regional scale relationships and see if we can't use that process in expanding some of the analysis to other areas. That's the goal of this, but we'll -- that -- so there's work that needs to be done on that one.

The Watana Dam reservoir, Study Objective 3, that relates to the engineering feasibility studies and geotechnical investigations that are continuing and those efforts will be coordinated as necessary to complete that.

The upwelling springs broad-scale mapping, Study Objective 4, the mapping analysis, this is ongoing. It does bring in the TIR, the thermal infrared imagery, into the process. So that is something that is ongoing right now and will need to be completed.

There's a number of steps, both of these next two slides, the riparian vegetation and the FA, the fish and aquatics instream flow component share a lot of the same steps here. So I'll go through this one for the riparian and I won't repeat it for the instream flow, since there's -- except for right at the very end, there's a bullet right at the end.

So basically, we've got -- in order to finish this up, and Kevin Fetherston will be on the phone tomorrow to discuss the riparian, but we need to analyze the rest of the groundwater and surface water data. We've started, Steve mentioned, we've got a preliminary calibrated MODFLOW model for FA-128.

We would need to develop additional MODFLOW models with, I should say, the resolution of those models would vary, depending upon the data that are available. So they're not all going to be held at the same level as, for example, FA-128 is right now.

We would need to run the open-water flow routing model and the SRH 2-D models to get the focus area interpretations of what those models and putting out and then the same thing, Jon will talk a little bit, Jon Zufelt will talk a little bit about the ice processes modeling.

We would need to couple those together with the MODFLOW models and through that process, we should be able to get an understanding, then, of project operational effects, you know, running the models through the open-water flow routing model and the rest -- and these other models and the MODFLOW models, to get a sense of what the groundwater effects are going to be, due to project operations. So there's -- I would say, if you look at this, there's a number of steps that are -- that remain in order to complete this.

The same thing, then, without going through this, but moving down to -- we'll talk a little bit about this tomorrow, this last bullet, provision of MODFLOW outputs and groundwater/surface water data for input into the habitat models, and so a key thing that we'll mention tomorrow, and it's been brought up before, effective spawning habitat, looking to the MODFLOW models to be able to provide some input into those models, in terms of, you know, upwelling areas, perhaps better defining areas of upwelling within the focus areas, and then we're also exploring, Steve's exploring, and the idea of somehow bringing in temperature into the MODFLOW equation, as well, and that way, we can bring temperature into an effective habitat analysis, in terms of egg incubation, and the effects of project operations on what that might do to egg incubation and fry development in the wintertime. So those are a couple of outstanding things that need to be followed through on, in order to complete these aspects.

Water quality, the same thing, we would pull these different groundwater/surface water data and integrate the MODFLOW results into the mod -- into the water quality models as part of that.

The model -- the Study Objective 8, the development -- we've collected quite a bit of information on the winter time periods. As I mentioned, we got these recorders that have been continuing to gather data over the wintertime. That information will be brought in. develop -- if we're able to develop MODFLOW models for each of the sites, we can bring that into the ice processes modeling and get some sense of what happens in the wintertime when you change -- project operations change and how does that affect the wintertime conditions with groundwater? That's the intent.

Then shallow groundwater users, Study Objective 9, there's been ongoing monitoring conducted in four private home owner wells, one of which is in the -- I think is in the room, Mike Wood is in the back, and so part of the completion of this study would be to gather that information, begin analyzing it and see if we can use that information to understand how project operations might actually influence the private well conditions, and I think that's it, not only think it is, that is it. Questions?

MR. PADULA: Comments and questions coming.

MR. AUBLE: This is Greg Auble with USGS.

MR. PADULA: Yes, Greg, go ahead.

MR. AUBLE: In the sort of the first MODFLOW model development that you've done, what about this RIP-ET module of MODFLOW, because the riparian study has spent a massive amount of time and money trying to calibrate that module, presuming that it's going to be needed for MODFLOW, and I've been skeptical about that and I just wondered what -- do you -- is that -- are you going to need that?

MR. SWOPE: I'm not familiar with that module.

MR. REISER: Greg, I would say that might...

MR. AUBLE: This is the mod that drives transpiration based on rooting depth and soil moisture and variation in plant cover. It was primarily developed for the Southeastern or Southwestern United States where you're going from leaf area indexes of three or four to basically bare ground and so it actually does a patch-based estimate of evaporation and transpiration, but you're not -- yeah (affirmative).

MR. LILLY: Hello, this is Michael, if I can add a comment? The work associated with that MODFLOW module is a cross-over with work that Kevin was leading in particularly the ET study that was being done as part of his effort and to answer this question, I think it'd be good to bring that up tomorrow when Dudley, and I think, Steve will also be there and Kevin will be online, because it's got to have everybody at the table to address that.

MR. AUBLE: Yeah (affirmative), okay, okay. I just wanted -- from the MODFLOW modelers' perspective though, I think in entering that discussion, it -- yeah (affirmative), if you didn't even know about it, then you didn't desperately need it, but -- because a big part of the motivation for doing that work was that it was going to be needed by MODFLOW and my guess is it isn't, but anyway, okay, we can talk about that tomorrow.

MR. SWOPE: Well, it...

MS. CHAPEL: I just want to chime in here. This is Dawn, who is involved in developing the MODFLOW model and we can incorporate that package. This preliminary does not include evapotranspiration, nor does it include recharge right now, but those packages certainly can be added if the datasets are there.

MR. SWOPE: At this point, we just included a constant recharge. It's 12 inches per year, but I think -- had we -- if we had access to that data, we certainly could have used it and it would have improved the accuracy.

MR. MUNTER: Okay, this is...

MR. AUBLE: Okay.

MR. MUNTER: Thanks, Greg. This is Jim Munter, contractor for NMFS, and I was -- I want to say first of all, I was very happy to see all the water table maps. We discussed that at great length a little over a year ago and the 3-D MODFLOW model and also the literature review, I think are all -- work toward advancing the ball down the court, but there's still some complications here that we need to address, I think.

One of them is on the model, you know, you've got a steady state calibration, but your transient calibration, as you said, really hasn't come together yet, and I guess the way I think of it, the model doesn't really work yet.

It's hard to diagnose exactly why it doesn't work yet, but one of the features that is not a calibration feature, but it's a structure of the model feature and a process feature is that you calibrated for your transient runs, you looked at the snow melt period, late April or early May, and in a pulse of the river as driving changes in groundwater level and what happens in the spring is the snow pack melts and we get a lot of our groundwater recharge during that same period and there was no reference in the write-up to that process, how much snow there might have been, when it might have melted, how much of it hit the groundwater system and what impact it may have had on the water levels in the wells.

So the concern here is that you're trying to use the river pulse to drive water level state changes inland that are driven by something else and related to that is, you ended up coming up with a very small value for storage coefficient that is more assigned to semi-confined aquifers and so that -- the effect of that is you tend to drive changes further inland than you would with a higher number for water tables and those two might be related. So I guess I wanted to have you comment here on where we're at and where we're going.

MR. SWOPE: Well, I think the -- I think that's a good point. The recharge that we used, as I said, was constant. We did not have a variable recharge at this point. That's the level of technology at this point. I think it would be helpful to have a dynamic recharge occurring and that's something we should look into. Dawn, did you have a comment on that?

MR. CHAPEL: Yeah (affirmative), I agree. I mean that's one of the recommendations of many that were made in the report for refinements. We just, honestly, ran out of time to take the transient calibration any further and look at, you know, those additional processes that we can include into the model.

MR. MUNTER: Okay, one of the other things that I would encourage you to look at is maybe the selection of the time. It might be that doing a simulation of transient stuff during a snow-melt period might not be the best time of the year. It might be easier to look at a rainfall event or something later in the year.

The other thing I think important is that there has been a lot of data collected on discharges to sloughs that do not have headwater connections to the river. So you get real physical measurements for how much groundwater is coming out of a slough and the steady state model you have doesn't really have a lot of flux data with which it was calibrated and that's a pretty important thing to assure that you've got your hydraulic connectivities where they should be and potentially, a symptom of the problem here is that the studies from the '80s came up with a value of regional groundwater flow toward the Susitna River bottomland that was about 10 times the number that was used in the steady state model and I understand all those numbers are estimates and they could be off by, you know, factors, but a factor of 10 is a pretty large factor and it's maybe an indication that the flux of water moving through the system needs to be looked at and calibrated against data that may actually be available. So I toss that out.

MR. REISER: Okay, that's something we can look into.

MR. MUNTER: I'm looking forward to three dimensional models for the other areas. One of the things that pops out on the water table maps is that they have large gaps where there's no data and it's going to present a challenge, and Dudley, you mentioned that because of the data availability, there could be some accuracy given up on simulation results and that -- I don't have a magic answer to that, because it's hard to go back and fill in those and collect all that data, but it -- it could be an issue and one of the problems that we've got here is that -- it stems back from a discussion that never really got resolved, that I think merits more analysis, and that is whether 2-D models are appropriate or 3-D models.

Michael and I -- I'm sure Michael recalls that we had a spirited back and forth in December and never really resolved it. The clock ran out and we moved on, but -- and it's not addressed. So the current study plan calls for 2-D models and I'm still convinced that that's not going to work, because there's too much flow in the third dimension.

You know, you have to have giant fudge factors for water coming in and going out some place that you're not simulating, essentially, to make it work and so going forward, you've got a problem with the 2-D model. You also have a problem with a 3-D model of data coverage and the ability to really calibrate those things and I don't have a magic answer to that, but a little technical write-up on the problem would be a good start.

MR. PADULA: Okay.

MR. REISER: And Jim, just to be clear, you'll have your comments, I mean specific comments on that, that particular point.

MR. MUNTER: Maybe I'll -- somebody else might have questions here.

MR. AUBLE: This is Greg again, from USGS. I just want to throw one other thing in here, which is the rest of the aquatic habitat evaluation, both of the fish and the riparian vegetation, is really dependent upon what kind of information you're going to be able to generate from these groundwater models, especially simulating post-project conditions, and you know, six-foot intra-daily stage variation and under ice and all of that, and we're -- it's been sort of uncertain.

There's been, okay, there's been a lot of variation in those other -- the thinking in those other studies about how much detail they've got to be able to get out of the groundwater modeling and I'm worried that if we actually were going to try to finish this thing in one more year, that they're going to go out and finish most of the field work in those other studies, still not really understanding what they're reliably going to get from the groundwater study.

So anything you can -- that the groundwater study can do to communicate what's really going to happen, because I look at the amount of work -- I mean, we're talking about some pretty complex groundwater models that are moving, you know, in and out of an iced condition, and yeah (affirmative), it just seems to me to be very complicated modeling and the sooner that information can be shared with those people that are planning impact assessments, counting on having groundwater inputs -- that's it.

MR. PADULA: Thanks, Greg. Jim, back to you.

MR. MUNTER: I did think of another one. This is Jim again. You know, I really enjoyed reading your literature review of the studies from the '80s. I thought that was nicely done and there was a finding that popped out from those studies that sort of surprised me, and that is, you know, they had gone to some of these same sloughs and put in monitoring wells and studied the flow systems and essentially, what they concluded is that most of these sloughs are unique and they have different characteristics with discharge and temperature and connections to the headwater and physical geometry and all these different things, and the idea of making a groundwater flow model that broadly applies to different sloughs is probably not going to work.

You pretty much have to go out and collect data for each field site and do an independent model, and what this leads to is the whole problem of upscaling or expanding beyond our focus areas into the -- assessing impacts in the general, mainly the Middle River area, and it's quite different than the current approach, which is to map the geohydrologic process domains and do a model, and then, you know, kind of copy it or at least copy what you've learned from it in some way up to the bigger basin and the impact -- and I've always wondered how that's going to happen and I still don't have clarity and I guess seeing that study from R&M and Woodward-Clyde makes me somewhat doubtful that this is going to work, basically, I mean it -- it's a different approach and they said, you know, this isn't going to work and they had full knowledge of this technology, this model -- MODFLOW, you know, was published in 1984 and they knew about it and I guess, can you shed any light on your response, and I guess in particular, there should be a reconciliation between what those prior findings were and how we're maybe going off in a little different direction here.

MR. SWOPE: I agree they had full knowledge of the technology, but they hadn't tried to apply it yet, though. So I think we've got a more robust and thorough dataset and we've got -- and that was 30 years ago. We've got a more sophisticated approach to using that data. We have actually a broader set of tools. We haven't applied those tools yet and so I can't say whether they're going to be successful or not, but I am confident that we can bring those to bear (indiscernible - voice lowered).

UNIDENTIFIED SPEAKER: Can you repeat that?

MR. SWOPE: I'm just saying that, you know, we've got a broader set of tools and a larger dataset, more robust dataset.

MR. MUNTER: Well, one of the key pieces of seeing how this works is mapping these geohydrologic process domains and one of the variances is, as you said, that is still underway, and one of the things we've kicked around is the viability of doing a little pilot project.

You know, before you tackle the whole basin at once, if you can show that the methods that have been proposed actually work for a complete evaluation assessment at a site and another site, maybe not the whole river, but you know, if we could have a sample for exactly what this result is going to demonstrate, that would be really helpful.

MR. SWOPE: Yeah (affirmative), and I think that is the intent for the long-term.

MR. EAGAN: Hi, this is Sean, National Marine Fisheries Service. I've put in piezometers and I've tried to make pressure transducers work over the winter and I realize it's a huge task, but I look at the data at 128, which is the biggest piece of groundwater data that we have for the focus areas and I know you started with about 20 piezometers and there were some failure of pressure transducers, so we're down to about 15 for the grid.

There's a few that looked like they got -- I know there's been a Q3, quality process applied to them. There's still a few that look a little bit suspicious, like they were ice-jacked up or something.

So given the amount of constraints there are on our very best focus area, and there's quite a few less wells, more like 10 or eight or seven, that are working in some of the other areas, to me, it doesn't look like there's enough data at the other focus areas to move forward with this same method and one indication of that is, with your groundwater maps, there's one or two lines that are continuous and there's lots that have a line and they have dot, dot, dot, dot, dot.

So I'm wondering how you're going to move this technique to other focus areas with such limited numbers of wells and working pressure transducers?

MR. SWOPE: I agree that is an issue. One of the other FAs, I don't remember which number it is, but it has -- basically it's a transect of wells and -- 115. Our intention for that focus area is probably to do a slice model, as opposed to an aerial model, so looking more vertically than horizontally, just because that's the orientation of the wells that we have, but you're right, for the other two, there really is not a whole lot of data and we're going to address whether we can actually model those or not.

MR. MUNTER: It's good to have other people ask questions, because it gives me time to think of my next one here. One of the things that commonly is done in modeling reports is a conceptual model at the get-go, which kind of lays out what you know about the stratigraphy, the aquifers, the recharge and those basic processes that are there and this is -- I don't remember seeing that in the write-up and where it comes home to bear on this is on the storage coefficient, and you know, the number, as I said earlier, that you use really reflects a semi-confined aquifer, but there's no evidence that there's really a semi-confining layer.

I mean, we all have been treating this like a nice water table, you know, lots of gravel, lots of sand. It rains, the river goes up, stuff changes. So that really needs to be -- whatever numbers you end up with need to be reconciled with a plausible physical model that's supported by the physical data and even going back to the '80s, because the geology actually hasn't changed since then.

There's another key point however, there was no question there. That was -- I'm sorry, I'm running on, but in the document, the project discusses how the river will affect flow on a seasonal, daily, and hourly basis, and in your modeling report, there's a brief reference to water called short duration temporal variations, which, you know, ice jam flooding is the classic thing, right. So if something happens, the water levels go up immediately.

Your time units were 12 hours and you averaged data over 12-hour intervals and I think this is an important parameter to evaluate in going forward to plug these results into the other models because a 12-hour time step may not really give you useful results for the other habitat models, particularly on the hourly flow fluctuations and impacts to water resources and so I understand why you did 12 hours.

I mean, you've got to get a grip on this thing somehow, but because the project is planned to create these very short duration things, there needs to be some energy put into how to evaluate that and incorporate it robustly into the analysis. So there's a little additional work on conceptualizing how to do that, I think, at this point.

MR. SWOPE: Yeah (affirmative), that's correct. You know, this was more of a proof of concept model and the intent is to upscale that time step for actual simulations. It will probably need additional calibration at a tighter time step.

MS. PADULA: Thanks, Jim. I want to check the room here, see if anyone else has any comments or questions. Way in the back.

MS. HILL: Hi, Melissa Hill, DNR.

MR. PADULA: Closer -- closer in.

UNIDENTIFIED SPEAKER: We still can't hear you.

MR. PADULA: Maybe try a different mic.

MS. HILL: Hello, can you -- yeah (affirmative), okay, so I heard several comments, pretty good comments, and I know that Mike and I, at some of the previous meetings, we've talked about that too, some of the different things with the modeling, the quantitative data, the discharge, and I heard some good comments about the stress periods.

Being a modeler, I totally understand the amount of data that's going to have be on anything three dimensional. I also know that we don't want to really be relying too heavily on recharge as constant and transient models. I've seen that up here. I don't usually like the results when I see that.

So my comment was going to kind of be, if -- I mean, the whole thing for modeling, from my understanding, was that this was to look at the conceptualizations, kind of proof of concepts, like you said. If we're going to go through that level of detail, we're definitely going to want the discharge and the recharge to be at the same time scales and I'm not sure that we have that data at that level.

I haven't looked at it. Maybe you know if we do, because that's the thing, if we can't get the recharge and the discharge and the time steps to all line up, I'm not sure the results are going to be very meaningful for the simulations, so...

MR. SWOPE: I think it depends on sort of what scale output variables you're looking at and I think the intent of this model is to look at the small scale surface water/groundwater relationships, so changes in gradient between the river and surface water. That's a result of surface water events.

So in general, groundwater is going to be flowing from the aquifer into the river. There will be some sort of surface water event. The surface water stage rises. Water's pushed back into the aquifer. It recedes and then the gradient reverses, and so the intent of the model is to really look at those relationships, which is a pretty small scale close to the river itself and look at the effects of those gradient reversals on temperature and so, I think you're right.

I can't imagine we're going to have recharge that's on an hourly basis. I'm thinking, in general, because groundwater responds so much more slowly than surface water, it tends to average itself out and we may not need it quite on that scale, but we'll probably need it on, at least a weeklytype scale and at this point, you know, what we've got is an annual. So that will need to be refined.

MS. HILL: Follow up on that, so are you going to be able to use any of the -- I think you mentioned you're doing some mapping, right, thermal mapping?

MR. SWOPE: Yeah (affirmative).

MS. HILL: And upwelling, so are you going to at least be able to do, because it sounds like it's probably not going to be really a good statistical calibration, but maybe more of a qualitative calibration, given the data constraints.

So I'm thinking, are you going to be able to do any kind of a qualitative comparison between what the model -- if it can match any kind of a, you know, the signature that you're getting from any thermal upwelling or is that going to not be something you can do with that scale?

MR. SWOPE: It depends. We'd really need aquifer properties to that scale also, because if -- you know, the upwelling is most likely a function of higher permeability (indiscernible) materials in that area. So to get to the scale of being able to look at, you know, open-water leads and that type of thing, we will have those maps and we will be using that as input, but I don't think we'd have a second dataset to validate that against. So you're right. That will be more qualitative.

I'm optimistic, though, that we will be able to do some sort of statistical calibration because of the density of temperature data that we have.

MS. HILL: So then I guess, like what would your targets be? Would it be temperature and any groundwater levels in the wells that you have?

MR. SWOPE: Initially, it's going to be gradient direction, direction and magnitude between the river and groundwater.

MS. HILL: Okay.

MR. SWOPE: Once we get that nailed, then we can start looking at temperature and mixing a model between the two at the various different temperatures.

MS. PADULA: Thank you. Mike.

MR. WOOD: Yeah (affirmative), Mike Wood, SRC. I just -- I'm going to sound like a broken record, but I want to bring this up every day, that for baseline studies, we've had two really huge flooding events and the latest break-up ever during this period of study and I don't think that can be overlooked every day, and that probably has some effect on what's happening in these wells.

I just also want to talk a little bit about the impacts of ice and I know Jon's going to go into this tomorrow, but I look at the actual river as just a tip of the iceberg and what's happening under, in the ground is phenomenal and I witness this every year in my -- in the well that I dug by hand and when we run out of water in November and we don't have any water until the river jams and then there's a total influx from the river center out into the -- either side of the -- into the woods and then we have water again, and then the same also happens in the spring when we get the jams and then the water's almost coming out of my well.

So I just -- I just think it's -- when you talk about 12-hour variations and the timing on things, it is a wicked complicated model because the water is definitely not just going one way and it's also going uphill, too. I've -- we've watched the Talkeetna River flow backwards. The Susitna flows backwards. Everything goes backwards and so I just want to make a note of that. It's complicated.

MR. PADULA: Thank you. Anyone else? Chris.

MR. HOLMQUIST-JOHNSON: I just had a general question and you may address this tomorrow, Dudley, with the instream flow work, and you know, in Focus Area 128 and Slough 8A, you guys did some work there where at certain flows, you know, that slough was dry, essentially, based on the hydraulic model and you put some sort of point inflows, you know, to be able to account for there is actually is water there based -- from kind of the groundwater interactions.

Is that something that results from this 3-D groundwater might be able to help and are you hoping that any of that might tie in to help drive that information, as well, in kind of future post-project conditions or is that outside of any scope with the groundwater monitoring that this is addressing.

MR. REISER: I'll speak for Steve, yes. It definitely is something that we would like to be able to use the modeling output, model output to help inform that, you know, and put water where water should be, where we know it is, which is the source of groundwater. The SRH2D that Lyle developed, we -- and Phil can talk about this tomorrow, as well, if we need to, but you know, it does a nice job of surface water, but it doesn't connect with the groundwater very well.

So we were without a model, without a groundwater model in place, we did some empirical evaluations and then we had some actual field measurements that we went out and tried to inform that, as well, but I'm hoping we can utilize the MODFLOW and helping with that answer to your question.

MR. HOLMQUIST-JOHNSON: Yeah (affirmative), that's what I was curious about, because was one thing. It was great to see some of that info on the modeling that you guys did do and knowing from the field experience, you know, needing to add that in, but that's something that can be, you know, and again, similar to Mike there, I might be a broken record with the pilot studies and how all that gets integrated in, but you know, this is -- the 3-D component is newer information and it's great to see that capability and how that would be applied would be very good input, as well.

MR. RUGA: Hi, Tim Ruga, AKRF contractor with FERC. I just have a few questions. The first one would be, I think in the report it says on page 13 that you have the data that's in your table all on the website, the (indiscernible) website and I did, indeed, find a lot of it there, but it appears to me that not all of it is there and I'm wondering if you can just check that.

The particular two that I can think of off-hand would be Focus Area 128 Well 6 and Well 7. If you could just check that, it would be helpful.

MR. SWOPE: Sure.

MR. RUGA: And the next comment that I have or question, really, is that the report states that the model simulates groundwater processes and the alluvial aquifer was assumed to be uniformly 100 feet thick throughout the model area, and then you subdivided that into two layers.

So my understanding of your model is that what you have is an incredibly detailed model on the surface, but beneath that, it's essentially a black box. We don't know where the bedrock is. We don't know where silt, clay, any layers are below that and this goes a little bit to the conceptual model that Jim was talking about and I guess I have to say I haven't seen that before and I'm doubtful as how useful a model like that can be.

My question is, I'm wondering if there's any way you can get additional information to describe some of those things, perhaps geophysical information, resistivity, I don't know. It's a question, really.

MR. SWOPE: Yeah (affirmative), it's -- we, you know, as you've heard on some of the other presentations today, we had to go with the data that we had. There aren't a lot of deep borings out there or any deep borings. So we went with the information that we were able to find in the literature.

That being said, as I mentioned before, we are looking at processes that are fairly close to the river itself and some of these deeper processes can be considered far-field at a similar way to the upgradient and downgradient parts of the model, you know, the further away you are from the area of interest, the less impact it will have.

MR. RUGA: Maybe, we'll see. Can you go to your slide number 12 for my next question? Okay, in the report, you state that despite the poor match to groundwater elevation changes at some stations, the calibration statistics for the transient model were relatively good. Could you refer to Table 5-1. It's a little hard to see on your figure, but when I went back and looked at these data, and by the way, you did a very nice job of presenting that transient data and the very last figures of the appendix. I think there were 15 wells on Focus Area 128 that you presented data for, but the point I want to make is if you go and look at those wells, just as a whole group of wells, I could almost believe what this sentence says, that the calibration wasn't bad in some and others, it was, well, not as good, but in fact, when you separate where those data were plotted and you separate it by where the wells are located, then a very different picture emerges.

The wells for which observed data tracks (indiscernible) data very closely, all occur right next to water bodies. They occur immediately adjacent to the value condition that drives the response in those wells, with almost no effect from the aquifer at all and all of the wells that are in the interior of your islands on Focus Area 128 had -- I'd characterize it and I would say terrible calibrations. They just didn't really match at all and I'm just wondering if, in the future, you're going to separate those wells and not include a whole dataset? I'm not quite sure how you came up with the target calibration parameter that you refer to in the text, but certainly, looking at the plots, I think it looks differently and I'm wondering how you're going to address that in the future?

MR. SWOPE: I think the intent, you know, has been mentioned a couple of different times. The model calibration is not complete and I think we mentioned in the recommendations, in fact, that the intent is to calibrate those wells further away and spend more time looking at the (indiscernible) properties in those areas and vary them, instead of using single variables for connectivity, depth and storage coefficient throughout the entire model, but vary those geographically and I think that would be the first step in looking at getting better calibrations in those areas.

MR. RUGA: Okay, I think that would be very helpful and also to describe the success of your calibration differently than how you have in this report. I would just point out the fact that the model predicts a response that's very, very small when you get around -- 800 to 1,000 feet away from the river. That's the current prediction, according to those plots, and in fact, the observed data shows response of maybe one to two feet from that wave, the break-up flood wave in the river. So the model would be, at this point, dramatically under-predicting project effects and I think that's a real concern.

The other final comment I have is: is there any chance that your transient calibration event had an overtopping on the bank of the Susitna? Again, it's hard to see the figures. They're plotted pretty small up there, but it appeared to me like it could have been, not just recharged from precipitation, but possibly also recharged from an overtopping event of the river during your calibration period that could have introduced quite a bit of flow onto those islands, which then infiltrated down to the wells.

I'm not sure if that's the case, but I wasn't able to find data that could inform me further on it. It looks like the river stages that you present in the report put the river at approximately the same height as the edge of those islands on the riverbank of the Susitna during the peak of the plotting. I'm wondering if you can check that?

MR. SWOPE: That's a good point.

MR. RUGA: Okay, but just to follow up on that, if it is true, then, you may need another calibration of that, because of what's already been mentioned here a few times, the complexity of that ice break up and how the water backed up, I'm questioning whether that event is even useful.

MR. SWOPE: Yeah (affirmative), I'm optimistic that we haven't actually looked at the data collected during 2015, but I'm hopeful that there are better calibration events during that data measurement period.

MR. RUGA: Okay, and then as a final comment, I would suggest that if you don't find a good calibration and verification event in those data, then I personally would have a concern with what we heard yesterday, that the hydrologic instruments are scheduled to be taken out this summer. So that's the final point I wanted to make.

MR. SWOPE: Okay, thank you.

MR. MUNTER: I have a relatively short one. It goes back to one of those questions about the calibration statistics...

MR. PADULA: This is Jim.

MR. MUNTER: This is Jim Munter, sorry, on the transient run and what happens is you have a quiet period where nothing's happening and then you have a pulse and the water level goes up and goes down, and then another quiet period, typically, and my understanding of your calibration statistic procedure is that you look at all those data points and roll them into the statistics, but when you're -- have long tails, it can skew the calibration results and so even though you're just trying to get that pulse, it can be way off, but it can be skewed by lots of data points that are sort of non-events.

You know, the model's chugging along. The groundwater's chugging along. Nothing's happening, but to include those numbers in the data points gets you closer to that 10% goal. So I would encourage you to look at calibration statistics that really reflect the pulse that you're trying to simulate, because that's where the meat and potatoes are.

MR. SWOPE: Yeah (affirmative), good point. The calibration statistic that we quoted was actually just for the steady state model and then we presented some plots for the transient, but we didn't quote any statistic.

MR. MUNTER: That's a good point.

MR. EAGAN: This is Sean, National Marine Fisheries. The whole thing is a huge document. So maybe this is someplace that I didn't see it, but on Study Objective 3, potential effects of Watana Dam on the groundwater right around the dam, what's been done on that or is that something for the future?

MR. SWOPE: Yeah (affirmative), I would -- is Bryan -- Bryan, you're in the -- or Doug, on terms of the geotechnical and the Watana Dam site?

MR. CAREY: At this time, we haven't drilled anything around the dam site. We haven't been taking samples around the dam site at this point.

UNIDENTIFIED SPEAKER: Hello.

UNIDENTIFIED SPEAKER: Okay, yeah (affirmative).

MR. CAREY: No, we don't have that information too much. I mean, there is a little bit from the wells that we have drilled right at the dam site. So we do have groundwater information on the wells right at the ground at the dam itself.

MR. PADULA: Any other comments or questions, either in the room or anyone on the phone?

NEXT STEPS AND ADJOURN

MR. PADULA: Great, well, thank you, everyone, for another very productive day. I appreciate, again, all of the input and interaction.

For those who are ready for day three, we'll start again tomorrow morning at 8:30 and you don't want to miss Mr. Zufelt talking about ice. So be here promptly. Thank you very much.

4:25:37

(Off record)

SESSION RECESSED