

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

THE LOUP HYDROELECTRIC PROJECT
UPDATED STUDY RESULTS MEETING

SEPTEMBER 8, 2011

** **

New World Inn
Columbus, Nebraska

** **

P A R T I C I P A N T S

1
2
3 MR. FRANK ALBRECHT, NEBRASKA GAME AND PARKS
MR. JOHN BENDER,
4 NEBRASKA DEPARTMENT OF ENVIRONMENTAL QUALITY
MS. MARY BOMBERGER BROWN,
5 TERN AND PLOVER CONSERVATION PARTNERSHIP
MR. ROBERT CLAUSEN, LOUP POWER DISTRICT
6 MR. TOM ECONOPOULY, US FISH AND WILDLIFE SERVICE
MR. PAT ENGELBERT, HDR ENGINEERING, INC.
7 MR. JIM FREAR, LOUP POWER DISTRICT
MR. DENNIS GRENNAN, HDR ENGINEER, INC.
8 MR. MICHAEL GUTZMER, NEW CENTURY ENVIRONMENTAL
MR. ROBERT HARMS, US FISH AND WILDLIFE SERVICE
9 MR. RICHARD HOLLAND,
NEBRASKA GAME AND PARKS COMMISSION
10 MR. GEORGE HUNT, HDR ENGINEERING, INC.
MR. JIM JENNIGES, NEBRASKA PUBLIC POWER DISTRICT
11 MR. JOEL JORGENSEN,
NEBRASKA GAME AND PARKS COMMISSION
12 MS. MICHELLE KOCH,
NEBRASKA GAME AND PARKS COMMISSION
13 MR. TOM KUMPF, LOUP POWER DISTRICT
MR. GARY LEWIS, HDR ENGINEERING, INC.
14 MS. THERESA PETR, COLUMBUS AREA RECREATIONAL TRAILS
MR. MATT PILLARD, HDR ENGINEERING, INC.
15 MS. LISA RICHARDSON, HDR ENGINEERING, INC.
MR. JEFF RUNGE, US FISH AND WILDLIFE SERVICE
16 MR. JOHN SHADLE, NEBRASKA PUBLIC POWER DISTRICT
MR. NEAL SUESS, LOUP POWER DISTRICT
17 MS. WENDY THOMPSON, HDR
MR. DAVE TUNINK, NEBRASKA GAME AND PARKS COMMISSION
18 MR. GEORGE WALDOW, HDR ENGINEERING, INC.
MS. STEPHANIE WHITE, HDR ENGINEERING, INC.
19 MR. SHUHAI ZHENG,
NEBRASKA DEPARTMENT OF NATURAL RESOURCES
20 MR. RON ZIOLA, LOUP POWER DISTRICT

21 VIA TELEPHONE:

22 MS. JANET HUTZEL, FERC
MR. PAUL MAKOWSKI, FERC
23 MS. ISIS JOHNSON, FERC
MR. MARCUS GRANT, HDR ENGINEERING, INC.
24
25

1 (Whereupon, the following proceedings were
2 had, to-wit:)

3 NEAL SUESS: First of all, my name is
4 Neal Suess, and I'm the president and COO of Loup
5 Power District. I want to thank everybody for
6 showing up today for our updated study report
7 meeting. I think everybody got a copy or everybody
8 should have a copy or was able to access the report
9 that was put together by HDR. And, again, I want to
10 thank you for the meeting today.

11 I think the agenda Lisa Richardson will go
12 over and the rest of the HDR team as to what we are
13 going to do today. Obviously like all of our other
14 meetings, pretty free flowing and open so do not
15 hesitate to ask questions as you need to from any of
16 the entities that are here today.

17 What we will do is we will go through a
18 set of introductions from everybody that is here
19 today, and we will start with the folks on the
20 phone.

21 So will those folks on the phone introduce
22 themselves to everybody that is here.

23 STEPHANIE WHITE: So, Janet, do you
24 want to start?

25 JANET HUTZEL: I'm Janet Hutzel with

1 the Federal Energy Regulatory Commission. I guess
2 I'm filling in for --

3 COURT REPORTER: I'm sorry. I'm
4 having a hard time hearing on the phone.

5 STEPHANIE WHITE: So that was Janet
6 Hutzel from FERC. I'm going to introduce the phone
7 participants. We also have Paul Makowski and Isis
8 Johnson. Are all three of you on the phone?

9 PAUL MAKOWSKI: Paul Makowski, I am.

10 ISIS JOHNSON: And Isis Johnson is
11 here as well.

12 STEPHANIE WHITE: Great. So we have
13 three folks from FERC.

14 And then Marcus Grant, are you also on the
15 phone?

16 MARCUS GRANT: I am on the phone.
17 Good morning.

18 STEPHANIE WHITE: He's from HDR.

19 So for those of you on the phone, we are
20 going to monkey around with the phone system a
21 little bit while the rest of the folks introduce
22 themselves.

23 NEAL SUESS: Lisa, do you want to
24 start?

25 STEPHANIE WHITE: My name is

1 Stephanie White. I work for HDR, and I will
2 facilitate this meeting today.

3 LISA RICHARDSON: I'm Lisa Richardson
4 with HDR. I'm the project manager for the Nebraska
5 Relicensing for the Loup.

6 GEORGE WALDOW: I'm George Waldow,
7 HDR, relicensing consultant.

8 MICHELLE KOCH: Michelle Koch,
9 Nebraska Game and Parks Commission.

10 BOB HARMS: I'm Bob Harms with the
11 Fish and Wildlife Service.

12 JOEL JORGENSEN: Joel Jorgensen,
13 Nebraska Game and Parks.

14 SHUHAI ZHENG: Shuhai Zheng, Nebraska
15 Department of Natural Resources.

16 MARY BROWN BROWN: Mary Bomberger
17 Brown from the Tern and Plover Conservation
18 Partnership.

19 RICK HOLLAND: Rick Holland, Nebraska
20 Game and Parks Commission.

21 DAVE TUNINK: Dave Tunink, Nebraska
22 Game and Parks Commission.

23 FRANK ALBRECHT: Frank Albrecht, Game
24 and Parks.

25 DENNIS GRENNAN: Dennis Grennan with

1 HDR, Regional Power Manager.

2 MATT PILLARD: I'm Matt Pillard. I'm
3 with HDR.

4 JIM JENNIGES: Jim Jenniges with
5 Nebraska Public Power District.

6 MIKE GUTZMER: Mike Gutzmer with New
7 Century Environmental.

8 JOHN BENDER: John Bender with
9 Nebraska Department of Environmental Quality.

10 JOHN SHADLE: John Shadle, Nebraska
11 Public Power District.

12 TOM KUMPF: Tom Kumpf, Loup Power
13 District.

14 BOB CLAUSEN: Bob Clausen, Director
15 or Loup Power District.

16 GARY LEWIS: Gary Lewis, retired HDR.
17 Pine Valley Hydraulic Engineering. I'm
18 subcontracting with HDR as a specialist.

19 GEORGE HUNT: George Hunt, HDR.

20 PAT ENGELBERT: Pat Engelbert, HDR.

21 JEFF RUNGE: Jeff Runge, US Fish and
22 Wildlife Service.

23 TOM ECONOPOULY: Tom Econopouly, Fish
24 and Wildlife Service.

25 THERESA PETR: Theresa Petr, Loup

1 Power District.

2 RON ZIOLA: Ron Ziola with Loup Power
3 District.

4 JIM FREAR: Jim Frear, Loup Power.

5 NEAL SUESS: All right. I want to
6 thank everybody for being here today. With this,
7 I'm going to turn it over to Stephanie and Lisa, and
8 they are going to basically monitor and move the
9 meeting forward today. And, again, feel free to ask
10 questions as you need to. Stephanie and Lisa will
11 set up the ground rules for today, and I will turn
12 it over to them, so thanks everybody.

13 STEPHANIE WHITE: Okay. Those of you
14 on the phone, could you hear Neal?

15 MARCUS GRANT: Yes.

16 STEPHANIE WHITE: Okay. So I think I
17 will pass the microphone to those of you who want to
18 speak. This one isn't working but the one that's
19 working, I pass it around to you. If you cannot
20 hear the conversation or the discussion, your part
21 of the microphone is up near the front of the room,
22 so if you will speak up, I will ask somebody to
23 repeat their comments, or I will repeat it on their
24 behalf.

25 Okay. Lisa, if you would like to get up

1 and walk through the purpose of the meeting today
2 and the agenda.

3 We have an early dismissal. We are set to
4 adjourn at 2:30 this afternoon. So this is the last
5 stretch for this part of the relicensing process.

6 Lisa?

7 LISA RICHARDSON: All right. Again,
8 thank you all for coming. On the phone, can you
9 hear us?

10 ISIS JOHNSON: Yes.

11 LISA RICHARDSON: Excellent.

12 Okay. This is the agenda for today. You
13 should have a copy in the handout that's on your
14 table, and it was part of the packet that was on the
15 Web site. Folks on the phone, were you able to
16 download the handouts?

17 ISIS JOHNSON: Yes.

18 JANET HUTZEL: Yes.

19 LISA RICHARDSON: Okay. We are going
20 to be moving very quickly into the integrated
21 licensing process overview. That's going to be
22 similar to what we've talked about every other
23 meeting that we have had. And then around 9:00, a
24 little after, we will be starting on the
25 presentation of the updated study results from both

1 the sedimentation and hydrocycling studies. Then we
2 will break for a quick lunch break and have the
3 species summary for the terns and plovers after
4 lunch. And then we will go over some next steps.
5 We are hoping to get out of here about 2:30. I
6 think the original agenda had said 3:30, but we are
7 thinking it will actually be around 2:30.

8 So here are some ground rules. Stephanie,
9 I will let you cover the ground rules.

10 STEPHANIE WHITE: Sure. The first
11 one deals with those folks on the phone as well as
12 those here using the microphone. It's a little
13 unusual to be using a microphone, and I realize that
14 none of you, at least to my knowledge, are rock
15 stars so you don't do it every day, but it's close
16 up to your mouth and it's tilted a little bit.

17 For those of you on the phone, we ask that
18 you please not put us on hold. What happens is we
19 get to listen to your fine elevator music for as
20 long as you put us on hold. So if you need to step
21 away, I would just mute your phone and step away.
22 We will try to be active in letting you know when
23 our breaks are, but if you could please not put us
24 on hold that would be great.

25 We do have an alternate phone number for

1 all of the phone attendees today.

2 I would ask all of you to put your cell
3 phones on silent, if you would, please. We will
4 have plenty of breaks today, so there will be time
5 enough for you to respond to phone calls as needed.
6 But if you need to, feel free to step out.

7 And then lastly, as we have talked about
8 already, those of you on the phone, if you have a
9 hard time hearing, just speak up, and we will repeat
10 or move the microphone a little bit closer.

11 LISA RICHARDSON: Thank you,
12 Stephanie. And I will try to -- we will all try to
13 remember what slide number we are on for the folks
14 on the phone so that they can keep up with us. I'm
15 on Slide 4 now with the goals of this meeting.

16 The first goal is to present the results
17 of the updated studies that were part of the study
18 determination and then to discuss if there are any
19 additional proposals to modify studies or additional
20 things that we need to discuss in light of the study
21 results, that -- this is also an opportunity for
22 that.

23 So going to the next slide, I think that
24 everybody in this room has been to all of the
25 meetings that I have up on the board there. We have

1 had numerous meetings on this project over the last
2 three years starting back in May of 2008 when we had
3 kind of an introduction to the project and the
4 process. The FERC relicensing process is a fairly
5 long process and very involved with the agencies.

6 So we have had several discussions. The
7 most recent ones back in August of 2010 -- actually,
8 September, I should say. September of 2010 we
9 presented the initial study results for the studies
10 that were determined back in August of 2009. And
11 then in February of 2011, we presented some -- a
12 second initial study report. We had some studies
13 that had data collection activities that went past
14 the September time frame, so we did a second meeting
15 and presented those results. And now here we are
16 presenting updates to studies that were --
17 additional pieces were requested on.

18 So moving on, this is an overview of the
19 integrated licensing process. You have all seen
20 this many times from us now. We are still currently
21 in that box with the red box around it. We are very
22 much moving into the next box though, which is to
23 apply for the new license, so this is the last
24 discussion related to the studies and any issues
25 that were brought up as far as that needed to be

1 studied, so we will be putting together the license
2 application later this year.

3 So back in August of 2009, the Federal
4 Energy Regulatory Commission, FERC, had given a
5 study determination on the proposed studies that the
6 District had presented. In that determination,
7 three studies were removed, three studies were
8 approved without modification, and six studies were
9 approved with modification. Those are the first
10 studies that were presented back in September of
11 last year, including sedimentation and water
12 temperature, hydrocycling. Some of those were also
13 presented in February.

14 Moving on to Slide No. 8. This is the
15 full list of studies. Those were all presented at
16 either the first or second initial study report in
17 August/September last year or February of this year.
18 And as far as additional work, there were two
19 studies where additional work and analysis was
20 identified, and those are the two shown in red, the
21 sedimentation study and the hydrocycling study, so
22 that's what this meeting is to present, the changes
23 or additional analysis that has been completed based
24 on the study determinations.

25 So just very briefly I want to kind of

1 walk through the basics of what was requested for
2 these additional studies.

3 Study No. 1, which is sedimentation, the
4 FERC study determination after the last meetings
5 requested that we put some confidence limits on
6 sediment discharge rating curves, do an
7 aggradation/degradation analysis at North Bend,
8 Duncan, Ashland, Louisville, and Genoa. Part of
9 that was information that was included in the PAD.
10 They asked that that be added to the sedimentation
11 study and then perform a Kendall Tau test to assess
12 those aggradation/degradation trends at those gages
13 and then to do a supplemental spatial analysis of
14 the channel geomorphologic characteristics, and then
15 to do some additional statistical analysis related
16 to tern and plover nesting.

17 That additional -- the original analysis
18 was presented a year ago, and there's been some
19 additional work done, and then there were a couple
20 of reports done, the Chen, et al, and the Missouri
21 River Basin Commission report, that FERC had asked
22 that those be submitted, and those have been
23 submitted to FERC and were made available on the
24 e-Library.

25 So moving on to hydrocycling, the only

1 revision to the hydrocycling study was a request
2 that the sediment transport analysis be conducted
3 using the sediment transport module in the HEC-RAS
4 software. That has been done. Pat will be
5 presenting the results of that and also comparing it
6 to the results of the calculations that we had
7 performed for the original study.

8 And then finally there was a species
9 summary for the interior least tern and piping
10 plover was requested, something that kind of pulled
11 the studies together that related all of the results
12 in relation to the specific species habitat and
13 environment, so we will be presenting that as well.

14 Next step from here, and I will go over
15 these again at the end of the day, but today is
16 September 8th, and in 15 days the District will
17 provide a meeting summary of the ongoings at this
18 meeting. That will be September 23rd, two weeks
19 from tomorrow.

20 October 24th is when agencies will have an
21 opportunity to provide comment on that meeting
22 summary as well as to submit any requests for
23 additional analysis or new studies. Those requests
24 for additional analysis or new studies need to
25 follow the FERC process as far as meeting the

1 requirements of the seven criteria. As I think some
2 of you have had discussions with FERC prior to this
3 meeting, at this stage in the process any additional
4 requests need to have some kind of extenuating
5 circumstances as to why the request is being made,
6 new information that's available, or something to
7 that effect.

8 Then in November the District will provide
9 responses to any requests or comments that were
10 received.

11 And then in December FERC will be making a
12 determination as to any additional analysis that
13 should be completed.

14 And it's a little bit out of chronological
15 order there -- that's the process related to the
16 study meeting. And then also kind of stuck in
17 there, November 18th, the District will be filing
18 the draft license application. So we have a lot of
19 stuff going this fall.

20 And, now, I think we will turn it over to
21 Pat to talk about the sedimentation study, and we
22 are on Slide No. 12.

23 PAT ENGELBERT: All right. Thanks,
24 Lisa. Can everybody hear me okay?

25 Again, for those of you on the phone, we

1 are on Slide 12, and we are going to go into the
2 sedimentation component of the updated study report.

3 But before I get into that, I just wanted
4 to review the goals and the objectives of the
5 sedimentation study. I'm sure for most of you you
6 have seen these before but I thought it might be
7 helpful just to review them as we are in kind of the
8 third study phase here.

9 The first goal was to determine the
10 effect, if any, that project operations have on
11 stream morphology and sedimentation transport in the
12 Loup bypass reach and in the Platte River; in
13 addition, to compare the availability of sandbar
14 nesting habitat for interior least terns and piping
15 plovers to their respective populations and to
16 compare the general habitat characteristics of the
17 pallid sturgeon in multiple locations.

18 Going on to the next slide which lists
19 objectives, this is Slide 14. The first objective
20 in order to meet those goals was to characterize
21 sediment transport in the Loup River bypass reach
22 and in the lower Platte River through effective
23 discharge and other sediment transport calculations.
24 Objective No. 2, to characterize stream morphology
25 in the Loup River bypass reach and in the lower

1 Platte River by reviewing existing data and
2 literature on channel aggradation/degradation and
3 cross sectional changes over time.

4 Next slide, Slide 15. The third objective
5 is to determine if a relationship can be detected
6 between sediment transport parameters and interior
7 least tern and piping plover nest counts as provided
8 by the Game and Parks Commission and productivity
9 measures.

10 Each one of those three objectives that I
11 just spoke to we addressed in this updated sediment
12 report per FERC's study plan determination letter.
13 The fourth objective was not covered in the updated
14 study report, and that is to determine if sediment
15 transport is a limiting factor for pallid sturgeon
16 habitat in the lower Platte River below Elkhorn.

17 Okay. Moving on to the next slide, we are
18 on Slide 16, just wanted to give a little bit of
19 background on each of the study reports -- I'm
20 switching microphones.

21 A little bit of background on each of the
22 study reports that we have done to date. For
23 sedimentation, the initial study report covered all
24 of the sediment transport calculations and supply
25 and capacity calculations for the gaged locations on

1 the river, okay, for the gaged locations.

2 Once we got the survey data in, we were
3 able to perform the same set of calculations for the
4 ungaged locations, and those results went into the
5 second initial study report, so we kind of had two
6 sedimentation study reports out there. The initial
7 study report had the gaged locations on the Loup and
8 the Platte River. The second initial study report
9 had the ungaged locations or our study sites on both
10 the Loup and the Platte River.

11 So per FERC's study plan determination
12 letter, we updated the study report. The first
13 thing that they asked us to do was to combine the
14 initial study report and the second initial study
15 report so it was in one location. In addition, they
16 asked us to analyze some new things, first being
17 provide confidence limits on the sediment discharge
18 rating curves that were developed in the
19 sedimentation study, to do a supplemental spatial
20 analysis. The third thing was to do a specific gage
21 analysis and Kendall Tau on the gage locations and
22 then evaluate some bird nesting statistics.

23 On Slide 17, just a quick review of it.
24 It's a little difficult to see, I understand, but
25 the -- on the Loup River, here are the study sites

1 we will be talking about. We have ungaged Site 1,
2 which is upstream of the diversion weir, ungaged
3 Site 2, which is just downstream of the diversion
4 weir. Then we have the Loup River at Genoa gage,
5 which is located downstream of Site 2. And then the
6 last location on the Loup is the Columbus gage --
7 the Loup River at Columbus gage.

8 On the Platte River, the study sites that
9 we evaluated were the Platte at Duncan, this is
10 upstream of the confluence with the Loup. Study
11 Site 3, which is located downstream of the
12 Loup/Platte confluence but upstream on the tailrace
13 return. Study Site 4 is located just downstream of
14 the tailrace return. And then we have the Platte
15 River at North Bend gage, which is located
16 approximately 30 miles downstream of the confluence.
17 And then we have a study site, Study Site 5, which
18 is just downstream of the North Bend gage. And then
19 the remaining sites are the Platte River at Leshara,
20 Ashland, and Louisville, and those are all at gaged
21 locations.

22 So quick refresher on kind of how we got
23 here from that initial study report meeting.

24 With that I'm going to turn it over to
25 George Hunt. He's going to walk you through the

1 confidence limit development process.

2 GEORGE HUNT: Okay. I'm on Slide 18.

3 So FERC asked us to include confidence
4 limits on the sediment discharge rating curve.

5 So first I will just walk through a quick
6 history or a background of the sediment discharge
7 rating curve and the Yang unit stream power equation
8 we used to create that. I will talk about
9 confidence limits we've put on some of the
10 parameters that go into that equation, and then I
11 will show you some of the results, the results of
12 the sediment discharge rating curve with the limits
13 and regression on the USGS data.

14 So a little background, right here -- I'm
15 on Slide 19, and I'm pointing to the equation on the
16 slide. That's Yang's unit stream power equation,
17 and you can see it's -- you know, by varying flow
18 and using several different parameters we get
19 sediment discharge, and the graph shows an original
20 sediment discharge rating curve from Yang at North
21 Bend, and this is the sediment discharge rating
22 curve we used in the initial study report.

23 So confidence limits are generally put on,
24 you know, groups of data or blocks of data, and this
25 is just the result of putting parameters on

1 equations. So what we did was we expanded the
2 request by putting confidence limits on the
3 parameters that were used to create the equation,
4 parameters that we had enough data to put confidence
5 limits on.

6 And so we put confidence limits on three
7 main parameters: The velocity discharge
8 relationship, the depth discharge relationship, and
9 the D50 values we have.

10 Right here I'm showing on Slide 20 the
11 velocity discharge relationship. The black line is
12 the original equation we used originally in the
13 initial study report. The red and green lines are
14 the upper and lower 90 percent confidence limits on
15 that measure USGS data.

16 And just as an example, at around 6,000
17 the velocity ranges on the lower limit from about
18 two feet per second to between three and three and a
19 half feet per second, while the data can range
20 anywhere from nearby from two feet per second to
21 just over three feet per second.

22 Slide 21 we are showing the depth
23 discharge relationship. Again, the black line is
24 the line originally used in the initial study
25 report. The red and green lines are the upper and

1 lower confidence limits.

2 And, again, at 6,000, it can range from
3 about one and a half feet to maybe close to two and
4 a half feet while the data ranged from about that
5 same amount.

6 And the D50 values, the USGS had suspended
7 sediment discharge measurements -- I'm sorry, they
8 had measured suspended and measured beds. We had
9 combined them as described in the initial study
10 report. That still left us a group of data to
11 create confidence limits on at North Bend because
12 that's the example I've been using. Originally we
13 had used the median value of .23 millimeters. The
14 upper and lower 90 percent confidence limits ranged
15 from .2 to .26 millimeters in diameter.

16 Slide 23. So we have the Yang Unit Stream
17 Power equation. We have three variables we varied,
18 and each of the variables have three states they can
19 be in: The lower state from the lower confidence
20 interval, the origin value, and upper value. And so
21 that gives us 27 combinations to create the 27
22 different Yang Unit Stream Power curves, the -- one
23 of them being the original value that we had used.

24 So what we are showing here on Slide 23
25 are the uppermost and lowermost sediment discharge

1 rating curves. Along with the blue solid line as
2 the original and the black line is the linear
3 regression of the measured USGS suspended sediment
4 discharge. Those are the red dots.

5 And you can see that our original Yang
6 Unit Stream Power equation follows the linear
7 regression of the data well. And in our initial
8 study report, that's what we used to say that our
9 equation was well fitted and calibrated.

10 Slide 24, I'm showing upper and lower
11 confidence limits on the measured USGS suspended
12 sediment discharge data. Along with the blue lines
13 is the original calibrated Yang Unit Stream Power
14 discharge curve and the linear regression.

15 On Slide 25, we put them together to show
16 them all at once. You can see that the 90 percent
17 confidence limits on the data are on the upper and
18 lower ends of that graph. In between are the upper
19 and lowermost Yang Unit -- Yang derived Unit Stream
20 Power sediment discharge curves and the linear
21 regression and the calibrated value.

22 Any questions on that?

23 GARY LEWIS: I point out too those
24 are -- I'm sorry, Gary Lewis -- log cycles on those,
25 so -- at 1,000 CFS, there's quite a variation in the

1 sediment discharge calculation, so we have been
2 trying to point that out all along, that we think we
3 have hit the data very well. We certainly have hit
4 the regression through the data. And the confidence
5 limits are pretty broad if you look at that chart.
6 Just information that I think is important to all of
7 this.

8 PAT ENGELBERT: Any other questions
9 about the confidence limits that were developed for
10 the sediment discharge rating curves? If not, we
11 will move forward with the spatial analysis.

12 Is it okay if I just talk and not use the
13 mike? I'm cutting in and out. Can everybody hear
14 me okay? Can everybody on the phone, can you hear
15 me okay if I don't use the mike?

16 JANET HUTZEL: I can hear you.

17 PAT ENGELBERT: Okay. Per FERC's
18 study plan determination letter, they asked for an
19 additional spatial analysis on some of the stream
20 morphology, and these three bullets here on Slide 27
21 show the -- kind of the summary of what they had
22 quoted in their letter.

23 The first thing that was asked of us is to
24 relate the effective discharge at each of the
25 locations to mean velocity, flow width, flow depth,

1 and flow area. And they wanted us to do that in
2 each of the gaged and unged locations and make
3 longitudinal or spatial comparisons of all the sites
4 on the Loup River and the lower Platte River
5 starting at the upmost location and moving
6 downstream.

7 So, for example, we performed a sequential
8 comparison. We compared unged Site 1 on the Loup
9 to unged Site 2 on the Loup. Then we compared
10 unged Site 2 to the Loup to the Loup at Genoa gage
11 and so on and so on.

12 So, again, just to reiterate, the channel
13 geomorphologic characteristics that FERC asked us to
14 evaluate, and this is on Slide 28, were mean
15 velocity, flow width, flow depth, and flow area.
16 They asked us to relate those characteristics to the
17 effective discharge. We also compared them to the
18 dominant discharge that was calculated.

19 This was done at the gaged locations. And
20 if you recall from our initial and second initial
21 study reports, at the gage locations we have
22 long-term measurements from the USGS. We were able
23 to obtain those electronically from 1985 through
24 2009, so we had approximately 25 years worth of
25 measurements.

1 At the ungaged locations we developed
2 those same relationships, the depth and the width
3 and the area relationships versus discharge. At the
4 ungaged locations, we had to do that based on
5 HEC-RAS modeling, and the RAS models were developed
6 from cross-sections obtained last year -- last
7 summer, at three different points in time. I just
8 wanted to point that out. That's kind of an
9 important thing to note.

10 Here's an example on Slide 29. Here's an
11 example of the graph that shows depth versus
12 discharge at the gaged -- one of the gaged
13 locations, and I chose North Bend for no other
14 reason than it was closest on my computer and I
15 could dump it in quickly. But this just shows the
16 relationship between the measured data on depth
17 versus discharge at the North Bend gage.

18 The next graphic on Slide 30, this shows a
19 similar graphic, except I chose Site 4 here, of the
20 results that were developed using the HEC-RAS one
21 dimensional hydraulic model, so you get a similar
22 relationship, but one is computer generated from a
23 calibrated model, the other is based on 25 years
24 worth of measured data from the USGS.

25 Moving on to Slide 31, this is a little

1 bit of our -- the methodology that was incorporated
2 for this supplemental spatial analysis. We used the
3 sediment discharge rating curves that were developed
4 in the initial study report and the second initial
5 study report. We developed the effective and
6 dominant discharges based on those sediment
7 discharge rating curves and the hydrology that we
8 used. And from those, based on the effective
9 discharge and the dominant discharge, we went to our
10 depth discharge, width discharge, velocity
11 discharge, and flow area discharge relationships and
12 grabbed each of those for both of the effective and
13 the dominant discharge. And we used those values to
14 perform our spatial comparison.

15 The study period that we selected, at the
16 gage locations we had sediment discharge rating
17 curves developed based on data from 1985 to 2009.
18 But in order to compare those to the gaged site --
19 I'm sorry, to compare those to the ungaged sites, we
20 used data from 2003 to 2009. And reason we did that
21 is at the ungaged location we chose 2003 to 2009
22 because that's the point in time in which the
23 Eighth Street gage was put into place, which
24 measures the return flows coming out of the power
25 canal. So in order to compare the ungaged sediment

1 discharge rating curve information to the gaged
2 rating curve information, we used the hydrology from
3 2003 to 2009.

4 Okay. Moving on to Slide 33, this is the
5 graphic that we present in the report. And it's
6 very difficult to read looking at the whole system.
7 We did color code it to help folks, and we do have
8 handouts on the tables, but to make it a little
9 easier to step through the process we have created
10 another set of charts so we can walk through each
11 parameter.

12 I'm moving on to Slide 34, and we are
13 going to go through the Loup study site results
14 first.

15 On the bypass reach, we are looking at
16 ungaged Site 1, ungaged Site 2, the Loup at Genoa,
17 and then the Loup at Columbus. And this graphic
18 that's up on the screen right now on Slide 34
19 represents those.

20 Quickly to reiterate, on the -- the data
21 limitations that we had in evaluating the Loup
22 bypass reach, we had two gaged sites on the Loup
23 bypass reach, one being at Genoa and one being at
24 Columbus. The Genoa gage had measurements from
25 inception which is approximately 1950 through 2010.

1 As we stated in the initial reports, we use the data
2 from '85 to 2009 because we had that data
3 electronically. However, at Columbus that gage was
4 reinstalled -- it was taken out of service in 1978
5 and it was reinstalled in 2008, so we had very
6 little measurements for the Loup at Columbus gage.
7 The two unged sites, Site 1 and Site 2, we had the
8 2010 survey measurements.

9 What I want to point out here is out of
10 the four locations we truly only have one location
11 that had long-term measurements, and that was the
12 Loup at Genoa. We had 25 years there. At the other
13 sites, we had between one and two years. So I just
14 wanted to point out a little bit of the data
15 limitation that we have.

16 Moving on to Slide 36, this is kind of a
17 bar graph representing the mean velocity on the Loup
18 River study sites. The left side -- the Y axis,
19 that's velocity, and then we showed the mean channel
20 velocity for both the effective discharge and the
21 dominant discharge at Site 1.

22 Comparing Site 1 to Site 2, we see very
23 similar mean channel velocities between the two
24 sites for both the effective and the dominant
25 discharge.

1 Comparing Site 2 to Genoa, there's a
2 slight increase in the velocity between the study
3 Site 2 and the Loup at Genoa gage.

4 And then showing Genoa to Columbus,
5 comparing those two now, you have essentially the
6 same velocities between Genoa and Columbus.

7 All right. Moving on to the next set of
8 slides, this is flow depth at each of the study
9 sites on the Loup river. Study Site 1 compared to
10 Study Site 2, you have very similar flow depths
11 between the two study sites. Between Study Site 2
12 and Genoa, very similar flow depths between those
13 two study sites. And comparing Genoa to Columbus,
14 it looks like for effective discharge there's a
15 slight increase in depth, but the dominant is pretty
16 close there. They are really pretty close. So
17 pretty consistent flow depths between the study
18 sites on the Loup River bypass reach.

19 The next graphic that I would like to
20 show, this is flow width versus the effective and
21 dominant discharge for the Loup Rive -- the bypass
22 sites. Loup Site 1 compared to Loup Site 2, we see
23 a reduction in the flow width between Site 1 and
24 Site 2. Comparing Site 2 to Site 3, we also see a
25 reduction in the flow width.

1 Comparing Genoa to Columbus -- excuse me,
2 I think I called Genoa Site 3. That was the Genoa
3 gage. Comparing Genoa to Columbus, we have very
4 similar flow widths comparing Genoa to Columbus.

5 One interesting thing to note is the
6 effective discharge and dominant discharge at Site 1
7 when compared to Site 2. It's approximately a
8 25 percent reduction. What's interesting to note
9 here is that the flow width comparing Site 1 to
10 Site 2 is also approximately a 25 percent reduction
11 in flow width. So there's kind of a correlation
12 there between the effective discharge and the flow
13 width.

14 Moving on to Slide 39, I'm going to talk
15 about flow area now. Very similar relationship to
16 flow area that we saw in flow width. Not really
17 surprising in that for a wide shallow river the area
18 is dominated by width so you would expect the width
19 and area relationship to be similar. But we do,
20 again, see a reduction in flow area between Site 1
21 and Site 2. We see another reduction in area
22 between Site 2 and Genoa. And then comparing Genoa
23 to Columbus, we have very similar flow areas.

24 So moving on to Slide 40, this is kind of
25 a summary of the results of those bar charts. The

1 flow depth and the mean velocity between sites was
2 all relatively consistent, uniform and consistent.
3 All four characteristics--velocity, depth, width,
4 and area--were all very consistent between the Loup
5 at Genoa and the Loup at Columbus.

6 Site 2 appears to be an intermediate and
7 stable geometry between Site 1 and Genoa. It was
8 that kind of intermediate between Study Site 1 and
9 Genoa, there was a consistent trend down. And the
10 percent reduction between the effective discharge
11 for Sites 1 and 2 very closely matched the width and
12 area reduction. Again, there's about a 25 percent
13 reduction in effective discharge between Study
14 Sites 1 and 2, and we saw a very similar reduction
15 in flow width and flow area between those two
16 locations.

17 When comparing those spatial results to
18 the results that we presented in the second initial
19 study report, the percent changes in flow width and
20 flow area between 1 and 2 closely match the
21 reduction in effective discharge, and what we
22 reported earlier was we see consistent natural
23 stream flow processes in the effective discharge
24 changes as we worked our way downstream.

25 In addition, the data at Genoa and

1 Columbus, they are very consistent along all four
2 parameters, which shows that they are in that state
3 of dynamic equilibrium, which is very similar --
4 exactly the same results that we had presented in
5 both the initial and second initial study report.

6 Before I go on to the Platte River sites,
7 does anybody have any questions on the Loup sites?

8 Jeff?

9 JEFF RUNGE: Yeah, Jeff Runge, Fish
10 and Wildlife Service.

11 I guess maybe the best reference is
12 Table -- or Figure 513.

13 Looking at -- on gage Site 2 and comparing
14 that to Genoa and Columbus, when looking at the
15 effective and dominant discharges, there's really
16 not much as far as differences in effective and
17 dominant discharge. But then when you look at other
18 variables like depth, velocity, and I think most
19 noticeably width and area, that you see
20 differences -- slight differences when comparing on
21 gage Site 2 to those numbers on Genoa and Columbus.
22 To me it doesn't explain -- or dominant or effective
23 discharge doesn't explain these differences. I
24 don't know if you had any insight as to what else
25 may cause these differences.

1 PAT ENGELBERT: I have transitioned
2 back to Slide 38 which shows the flow width for the
3 study sites as an example. And what Jeff had asked
4 is the Loup Site 2, the Genoa, and the Columbus
5 sites all have very similar effective and dominant
6 discharges. Is that right?

7 JEFF RUNGE: That's right.

8 PAT ENGELBERT: That's part of your
9 question? And then the question was, Genoa and
10 Columbus have very similar widths, but yet Site 2
11 has higher widths. And because we are relating
12 dominant and effective discharge back to those
13 widths, why -- is there a reason why the Loup --
14 Study Site 2 is so much different than Columbus and
15 Genoa.

16 We looked at that as well, Jeff. One of
17 the things is that the difference in data. At the
18 Genoa site we had very long-term data. At the Loup
19 site, we had just essentially the one surveyed
20 cross-section. And it seems to be an intermediate
21 site between the two.

22 We evaluated the variability between
23 effective and dominant discharges when you are using
24 a short window for the analysis. In this particular
25 case we are looking at 2003 to 2009, which is a

1 fairly short window. That may explain some of the
2 variability that we are seeing at those sites.

3 Gary, is there anything that you would
4 like to add on that particular point? You talked
5 about it a little yesterday.

6 GARY LEWIS: Yeah, we expected this
7 question because we puzzled over the same question.
8 And I think Jeff has really raised a very important
9 question here. Why -- with the same effective
10 discharges at Site 2, Genoa, and Columbus -- they
11 are between 100 CFS of each other. Effective
12 discharge is that discharge that represents what
13 flows transport the greatest amount of sediment, and
14 what we are looking for and the reason that FERC
15 asked for this graph is that there have been many
16 research studies that show that there is a
17 relationship between the effective discharge and the
18 channel width. Area and depth are not reported as
19 much in the literature -- or velocity and depth.
20 And area, as Pat mentioned, is made up mostly of
21 width. With a very wide width, you take that times
22 the shallow depth, you don't see much difference in
23 the graphs.

24 And I think Pat answered the question
25 fairly well. Probably one thing I would add to

1 that, at -- comparing now Site 2 with Genoa, so
2 Jeff's question, if you didn't understand it, is why
3 are the widths and areas -- and I believe velocities
4 and depths -- different at Site 2 than they are at
5 Genoa and Columbus if you have the same effective
6 discharges.

7 So trying to rationalize that, one of the
8 things that we came up with is the fact that for
9 Loup Site 2 all we have is a single one set in time
10 set of cross-sections. HEC-RAS requires that you
11 model that cross-section at the -- assuming a fixed
12 bed.

13 So in addition to what Pat said in terms
14 of the limited data that we have compared to Genoa,
15 Genoa may have many, many years of data that we used
16 for this. When you use a rigid bedded model, for
17 example, we surveyed that cross-section or those
18 cross-sections, we averaged them for this model
19 study. When you look at those surveyed cross
20 sections and the flow rate that existed at the time,
21 that flow rate was not equal to the effective
22 discharge. That just defines the width of the water
23 surface.

24 But probably part of the answer, Jeff, and
25 I think what we are really saying here is I don't

1 have an, and I don't think Pat has, a full
2 explanation for what we are looking at here, and all
3 we can allude to is the difference in the data sets
4 and the assumption in HEC-RAS of rigid boundaries.
5 So when -- effective discharge, for example, at
6 about 1700 for Loup, Genoa, and Columbus, if the
7 cross-section that we measured on the days that we
8 did it was formed by flows that were leading up to
9 those dates. They weren't formed by the flow that
10 day, but if they were formed by the flows leading up
11 to that day and if that flow was not something close
12 to the effective discharge, you are going to get a
13 weird reading because -- remember the cross-sections
14 we took showed huge variation in the bed, where the
15 deep channels were, a lot of variation over the two
16 or three months that we took these measurements. So
17 the bed changes constantly and the width adjusts
18 itself with those changes.

19 So that's part of the answer, Jeff. We
20 think that the rigid bed assumption in HEC-RAS. We
21 developed, for example, the width versus discharge
22 relationship. And if that -- at the effective
23 discharge, if that width would have been quite
24 different we wouldn't get a reading on that. We are
25 only getting the width that existed on the days that

1 we measured the cross-section.

2 So we have puzzled over the same thing. I
3 don't believe we have a full answer to it. And what
4 we concluded is that Site 2 is an intermediate
5 morphology between Site 1 upstream of the diversion
6 and between that of Genoa and Columbus, where Genoa
7 and Columbus are so equal to each other, that
8 there's an immediate -- I don't think it's
9 transitional. I think it's just an intermediate
10 morphology.

11 If there is a difference in morphology,
12 more likely it was a difference in the data we had
13 and the methods that we had to use to develop this
14 relationship. If we had long-term data at Site 2,
15 you might find something much more similar to Genoa
16 and Columbus because they are all receiving about
17 the same flow, they are receiving about the same
18 sediment.

19 One other point I will make too, because
20 we did use 2003 to 2009, if you look at older graphs
21 in the initial study report where we plotted the
22 effective discharge each year from -- at Genoa from
23 1985 clear up to 2009. If we look at that 2003 to
24 2009, you see the effective discharge varies between
25 1,500 CFS and 3,000 CFS during that seven-year

1 period, so those would have an effect on the
2 morphology. That effective discharge is what's
3 changing the width and the depth and the area. That
4 rate is an indicator of what's changing that.

5 We have very high fluctuations at that
6 Genoa station over a very wide range, so when we
7 went out there in 2010, who knows what you have.
8 What you are measuring in 2010 may not be the
9 equilibrium morphology. It's probably in transition
10 from what it is that year to this long-term
11 equilibrium that was established for the gage sites
12 and we reported in the initial study report.

13 So, Jeff, that's about all we could come
14 up with.

15 JEFF RUNGE: Just one follow-up
16 question then.

17 Thank you for the explanation. With that,
18 it seems as if your boundary conditions like channel
19 width is not a static condition but pretty highly
20 variable based on the flow events that pass through
21 there.

22 PAT ENGELBERT: The width I think
23 would be probably more consistent in that once you
24 kind of get up close to those vertical banks, if you
25 look at cross-sections, once you reach a certain

1 discharge, it should maintain pretty well. Getting
2 on the lower stages, that -- you see some
3 variability of width due to the presence of sandbars
4 and things. The depth and the area I would say are
5 probably pretty similar in relationship as well.

6 JEFF RUNGE: Okay. So what you are
7 talking about is the active channel width stays
8 similar but the flow width may vary based on flow
9 conditions.

10 PAT ENGELBERT: Yes.

11 JEFF RUNGE: Okay.

12 PAT ENGELBERT: Particularly at those
13 lower flows when it's kind of going between sandbar
14 formations.

15 GARY LEWIS: If you remember the
16 cross-section from over those few months that we
17 measured, the geometry, you saw huge changes in the
18 width between -- across the surface among those
19 three cross-sections. So we say the flow is 1700
20 and go to the graph and try to pick out what the
21 width would be, it's kind of an estimate at best.

22 JEFF RUNGE: Okay.

23 PAT ENGELBERT: Any other questions
24 on the Loup bypass reach, the supplemental spatial
25 analysis?

1 If not, I will go ahead and move forward
2 toward the Platte River results.

3 For those of you on the phone, I'm now on
4 Slide 42.

5 And, again, this is just the graphic
6 showing the location of both the gaged and the
7 ungaged sites that we have evaluated on the Platte
8 River starting at Duncan and working our way down to
9 Louisville.

10 Again, just wanted to reiterate the
11 difference in data that we had. The gage locations,
12 again, we had longer term records, particularly at
13 Duncan and North Bend and Louisville, we had the
14 full 25 years. At Ashland and Leshara we had
15 shorter periods there. I believe Ashland -- one of
16 them started in '94 and the other one started in --
17 I'm sorry. Ashland began in 1989, and Leshara began
18 in '95, so we did have slightly shorter periods for
19 those two particular gages. And then at the ungaged
20 locations, the surveyed information that we had in
21 2010.

22 Moving on to Slide 44, here's a
23 relationship of the mean velocity for the Platte
24 River sites. Starting at Duncan, we see a slight
25 increasing trend between Duncan as compared to

1 Site 3, and then Site 3 as compared to Site 4. So
2 there is a slight increasing trend when we compare
3 those sites.

4 From Site 4 down to Leshara, we have very
5 consistent mean velocity relationships there,
6 between those sites. Then between Leshara and
7 Ashland, we have a step up again, a slight increase
8 in velocity, and then that is fairly consistent as
9 we move down to Louisville.

10 Looking at flow depth at those sites, we
11 see a very similar relationship with what we saw in
12 the velocity. We saw an increase between Duncan and
13 Site 3, and then again between Site 3 and Site 4.
14 At Site 4 -- from Site 4 to Leshara again, we see
15 consistent -- pretty consistent flow depths between
16 each of those location. And then again we see a
17 slight step up between Leshara and Ashland, and then
18 a leveling off again between Ashland and Louisville.

19 Moving on to Slide 46, we evaluate the
20 flow width of the study sites. And at this
21 particular study site, we see fairly consistent
22 widths between -- from Duncan all of the way down to
23 Louisville in about that 1,000 foot range. A slight
24 increase as we work our way downstream with the one
25 anomaly being that Site 3 is a little bit lower than

1 all of the other sites. It's a little bit lower.

2 Going on to flow area at each of those
3 sites, and I am now on Slide 47, again we see a
4 slight increase between Duncan and Site 3 and then
5 comparing Site 3 to Site 4, a slight increase again.
6 And then that -- kind of that leveling off between
7 Site 4 and Leshara, and then a leveling off between
8 Ashland and Louisville.

9 So moving on to Slide 48, kind of a
10 summary of the results of those particular graphics
11 of the channel geomorphologic characteristics we
12 were asked to evaluate, for flow depth, mean
13 velocity, and flow area. Duncan to Site 4 showed a
14 gradual increase. From Site 4 to Leshara, there was
15 essentially no change, maybe a slight increase.
16 From Leshara to Ashland we had a step up. And then
17 again from Ashland to Louisville there was no
18 change.

19 These changes were consistent -- the
20 increases were consistent with the increases that we
21 see between Duncan, Site 3, and Site 4, the
22 differences in effective discharges that we see
23 there. From Site 4 down to Leshara, it has
24 essentially the same effect of dominant discharges.
25 And then we see a step up with additional tribs

1 coming in for the effective and dominant discharge.

2 Now, in looking at the flow width, Gary
3 had mentioned that some of the work -- prior work
4 done by the USGS, Kircher in particular, noted a
5 relationship on the river between the effective
6 discharge and the flow width. I think we have seen
7 that same -- we have confirmed that relationship
8 that he wrote about in his paper. And, again,
9 Duncan to Louisville, there was a -- just a very
10 gradual increase in that width with the exception of
11 Site 3.

12 Okay. So that's kind of a summary of the
13 results of this spatial analysis. But we wanted to
14 go one step further in evaluating that relationship
15 between effective discharge and flow width and the
16 effective discharge and flow area. And we thought
17 we would represent it using a line chart, and this
18 is on Slide 50, kind of showing that spatial
19 longitudinal relationship.

20 We see that when we plot flow width versus
21 discharge and that just gradual slight increase that
22 we saw, the sites fall pretty much -- very close to
23 the line, which tells us that there's a strong
24 relationship between flow width and flow -- and the
25 effective discharge.

1 Similarly the flow area even has a
2 stronger relationship on the Platte. And recall
3 that in a wide system the area is very much
4 dominated by the flow width itself. So when we look
5 at flow area versus effective discharge, we see a
6 very good relationship between those two parameters
7 at all of the gaged sites which tells us that as
8 effective discharge increases your flow area will
9 increase and then similarly your width.

10 In summary, there was a strong
11 relationship between effective discharge and the
12 width and a similarly strong relationship between
13 effective discharge and the flow area. Again, the
14 area in a braided river is predominantly governed by
15 the width. It's very wide and shallow. The results
16 indicate that a percent change in effective
17 discharge was corresponding to a proportionate
18 change in width and area, the one exception being
19 Site 3.

20 So in summary, it's, again, consistent
21 with the results that we showed in the prior spatial
22 analysis that we see, an increase in the effective
23 discharges as we move downstream. We are seeing,
24 you know, similar changes in the four channel
25 geomorphologic characteristics that we were

1 evaluating. And, again, probably one of the biggest
2 things that we found is that it really shows what
3 Kircher had found, that there is a strong
4 relationship between the effective discharge and
5 flow width on the Platte River.

6 So that kind of concludes the supplemental
7 spatial analysis that we did on the Platte as well
8 as the Loup. I would now open it up for any
9 questions that you guys may have on the
10 relationships that we saw on the Platte River. And
11 if you thought of something that you want to cover
12 on the Loup, we can hit that one again.

13 PAUL MAKOWSKI: Pat, this is Paul
14 Makowski from FERC.

15 PAT ENGELBERT: Yes, Paul.

16 PAUL MAKOWSKI: What you see on Slide
17 50 and 51, did you do that for the Loup on that?

18 PAT ENGELBERT: We plotted those for
19 the Loup, Paul, but had very -- it didn't look good
20 at all. The relationship just didn't -- it didn't
21 look good.

22 PAUL MAKOWSKI: Okay.

23 PAT ENGELBERT: And I think we
24 attributed that to the four areas that we were
25 looking at, truly only one of them had long-term

1 data. The others were very short and limited data
2 sets on that.

3 Paul, Gary Lewis would like to respond as
4 well.

5 Can you hear us okay?

6 GARY LEWIS: Very good question.

7 Recall on the Loup that three of the four
8 locations all had the same effective discharge, and
9 then Site 1 had a higher effective discharge, I
10 think around 2300, so we only had a few data points.
11 So if we plotted them, you would see the same
12 relationship. We would see -- because the three
13 data points for Sites 2, Genoa, and Columbus would
14 all fall on the same discharge, that basically,
15 essentially, is one data point cluster, and then the
16 other data point would be at Site 1.

17 And as Pat pointed out, there is
18 definitely a change in width area -- I'm sorry, at
19 least in width and area with the effective discharge
20 between Sites 1 and 2 and 1 and 3 -- or, I'm sorry,
21 1 and Genoa and 1 and Columbus. So it's essentially
22 two data points, and two data points don't make a
23 good graph.

24 PAUL MAKOWSKI: Okay.

25 PAT ENGELBERT: Thanks, Gary. That

1 sounded a lot better than it didn't look good.

2 JEFF RUNGE: But based on what was
3 said earlier, you see a relationship, but that
4 relationship can't be overlaid with the data from
5 the Platte? I mean, are these relationships
6 generalized to the point to where it doesn't matter
7 which river you use, these relationships will have a
8 similar -- similar linear form to them, or are they
9 completely different? Since it's in a different
10 system using different inputs, you can't overlay the
11 Loup data with the Platte data.

12 PAT ENGELBERT: I think it goes to
13 just the natural river processes as you work your
14 way upstream to downstream.

15 And I see Gary grabbed a microphone.

16 GARY LEWIS: Yeah. Another very good
17 question.

18 First of all, we saw a steeper slope on
19 the graph between Site 1 and Site 2. If you look at
20 this graph, it's not a 45 degree line. It's much
21 flatter on the Platte.

22 In the professional paper 1277, USGS
23 looked at three different ways of trying to match
24 width with discharge, with effective width, some
25 governing discharge. It wasn't always effective.

1 But they found in the upper part of the Platte that
2 that relationship existed and they applied power
3 equations and others some of you are familiar with.

4 The effective discharge/width relationship
5 is a defining relationship in a truly unconstrained
6 natural river. Do we have that in either of the
7 Loup or the Platte? No. The Platte River,
8 especially in the lower Platte, and that's reflected
9 I think in the slope of this line that we have up
10 here in Slide 50 is reflected somewhat in the
11 lateral constraints. Yeah, that's flow width versus
12 effective discharge. The surveys that have been
13 done by the Corps of Engineers has looked at the
14 effects on the environment of those I think is
15 impacting that, we think.

16 Paul and Jeff, part of the explanation of
17 Site 3 is that. If you look at the surveys that
18 were done on Site 3, it shows lateral restraints on
19 both sides of the river at Site 3. And if you look
20 upstream and downstream on those same surveys, we
21 see the lateral constraints on one or neither side.
22 So that's one possible explanation for Site 3.

23 If the river was completely unconstrained,
24 I would expect these data points to fall right on
25 that line, Paul and Jeff, because that is the

1 relationship between the flow that's shaping the
2 river and the shape of the river. That's how we
3 define effective discharge.

4 So any deviation from this graph -- and we
5 were surprised. We hadn't seen this done. I would
6 like to see someone do it for the Central Platte,
7 plot these widths and depths and areas and so forth
8 and have the effective discharge rates.

9 So part of the question I guess is can we
10 apply what's happening on the Loup to this river,
11 they are two different rivers, they are both
12 braided. If you plotted the Loup data on this, the
13 effective discharges were down around 1700. And we
14 don't see the widths on the Loup that we had here.
15 If you recall on the graphs that we showed for the
16 Loup, the widths were quite a bit less.

17 So the answer is, no, we can't really
18 translate from one river to another, but you can
19 look -- we make that point in our write-up, that if
20 we have enough gages on the same river, you can get
21 a very morphology defining relationship by creating
22 these graphs. So if for some reason at Leshara
23 somebody wanted to change the effective discharge
24 reducing it 40 percent for whatever reason, I think
25 you can estimate what that width would be by just

1 moving down this line. I think this line defines
2 the morphology of the river based on the whole
3 principle of effective discharge.

4 That's a long answer, but hopefully that
5 adds something to it.

6 JEFF RUNGE: That's helpful. Thank
7 you.

8 PAT ENGELBERT: Any other questions
9 on the supplemental analysis either on the Loup or
10 the Platte River?

11 If not, I'm going to go ahead and turn it
12 back over to George Hunt who will talk on the
13 specific gage analysis, moving on to Slide 54.

14 GEORGE HUNT: So we originally
15 presented specific gage analysis in the PAD. FERC
16 asked us to include that in this updated study
17 report, and they also asked us to do a Kendall Tau
18 analysis on that data -- sorry, they also asked us
19 to include Genoa in that -- in the analysis.

20 Bringing the data and the graphs forward
21 from the PAD to the updated study report, we added
22 two more years of data since the PAD was written,
23 2009 and 2010.

24 Slide 55. So the specific gage analysis,
25 this is the exact graph plus two years that was in

1 the PAD, and what we are showing here is North Bend
2 at several different flow rates -- 500, 1,000,
3 5,000, 10,000, 15,000, and 30,000 CFS.

4 Slide 56 is the Genoa, so this is new,
5 and, again, 5,000 through 30,000 CFS.

6 And then just like in the PAD, on Slide
7 57, we put the -- we rearranged the data to show all
8 of the sites that we are looking at on a single
9 graph, and we have here -- we also included Grand
10 Island, but we have Duncan, North Bend, Ashland,
11 Louisville, and now Genoa. For -- and this is
12 specifically the 1,000 CFS flow rate.

13 On Page 58 -- sorry, on Slide 58 we --
14 this is a summary of the Kendall Tau analysis. The
15 Kendall Tau analysis showed no trend at Genoa,
16 Duncan or Ashland. There was a trend for the 1,000
17 CFS flow rate at North Bend.

18 And I'm going to go back to Slide 55.
19 That would be this kind of pink line, the 1,000 CFS
20 line, showed a slight degradational trend.

21 And I'm back on Slide 58. There was a
22 trend at the highest flow rate for Louisville, but
23 overall no aggradational or degradational trend were
24 found using this analysis, which, you know, meshes
25 well with what we had said qualitatively in the PAD

1 originally.

2 Any questions?

3 Hearing none, moving on.

4 LISA RICHARDSON: We are going to get
5 done early if you guys don't start asking questions.

6 Okay. The next piece that we are going to
7 talk about is this statistical analysis of the bird
8 data that we did. Can you guys hear me on the phone
9 without the microphone?

10 ISIS JOHNSON: Yes.

11 LISA RICHARDSON: Okay. Starting out
12 I'm going to just indicate that we had done some
13 statistical analysis in the initial study report.
14 As part of the study determination, we were asked to
15 do some additional analysis. And as part of that,
16 we recruited one of the folks in our Denver office
17 to do that statistical analysis. Marcus Grant is on
18 the phone. I'm going to be presenting a lot of the
19 data that's on the slides. Marcus did the analysis
20 and can answer any questions. He will correct me if
21 I say anything that is not accurate. So with that,
22 Marcus, can you chime in just real quick?

23 MARCUS GRANT: Yeah. I would be glad
24 to answer any questions anybody has, and I will just
25 let you go ahead with it, and, if I need to chime

1 in, I will.

2 Are you okay with that?

3 STEPHANIE WHITE: Marcus, are you on
4 speakerphone, or are you talking directly into the
5 receiver?

6 MARCUS GRANT: I'm on speakerphone.
7 Is that a problem?

8 STEPHANIE WHITE: It would be -- I
9 think we could hear you better if you pick up the
10 receiver for this part.

11 MARCUS GRANT: Okay. Is this better?

12 STEPHANIE WHITE: Try it again and
13 speak up.

14 MARCUS GRANT: I'm speaking directly
15 into the phone.

16 MATT PILLARD: It's a little quiet.

17 STEPHANIE WHITE: If you can speak as
18 loud as you can, even though it will feel strange to
19 you. Your voice is projecting about 35 feet.

20 MARCUS GRANT: Okay.

21 STEPHANIE WHITE: Okay.

22 LISA RICHARDSON: Okay. We will get
23 started then. And if we can't hear Marcus, we will
24 try to repeat what he says. I can hear him down
25 here.

1 As Pat mentioned, there were several
2 objectives with the sedimentation study. The one
3 that applies to this analysis is Objective No. 3,
4 which was to determine if a relationship can be
5 detected between sediment transport parameters and
6 interior least tern and piping plover nest counts.

7 As I mentioned, we did some initial
8 analysis. What I wanted to make note of here is
9 that we did that initial analysis on nest count data
10 that was available from Game and Parks. There was
11 some portion of that objective that indicated trying
12 to use productivity measures. There really wasn't
13 enough fledge ratio information to be able to do
14 that, so the best data that we had was the nest
15 count data. There was quite of bit of adult count
16 data, but there was some concern about the accuracy
17 of that, which we see -- in a count on the river,
18 would you see the same bird be counted two or three
19 times as they flew up and down the river.

20 So we were using the nest count data.
21 That initial analysis was conducted at really a very
22 coarse geographic scale. We did the analysis from
23 the tailrace all of the way down to Louisville by
24 hydrologic river segment. So it was broken down
25 basically by the gage locations, which put 30 or

1 more miles in each segment.

2 And then we did some linear regression on
3 14 different hydrologic variables. That analysis
4 showed that there was no evidence of a relationship.
5 But we were asked to do some additional analysis,
6 maybe look at fewer parameters, but do some
7 additional statistical analysis.

8 So for the supplemental analysis, the
9 first thing that we did is look at hydrologic data
10 correlation and see out of those 14 variables that
11 we looked at initially how much of those were
12 collinear. We also did a normality assessment and a
13 factor analysis kind of determining which were the
14 variables that we should be continuing to look at
15 that weren't related to each other.

16 So in this analysis, the variables that
17 remained were river mile, year, adult counts, peak
18 mean daily flow, wetted width, and the annual
19 percent diverted flow. So we really ended up with
20 three hydrologic variables and then the other
21 variables, and all of that was being related to nest
22 counts.

23 Back in March, we did have a meeting with
24 Joel Jorgensen and Mary Brown from the Game and
25 Parks and the Tern and Plover Conservation

1 Partnership to discuss the data, the types of
2 analysis that they thought would be appropriate for
3 the data that we had, and how we could continue to
4 further the analysis.

5 One of the things that we talked about
6 very much in depth was the bird data that -- that
7 the data has been collected by the Game and Parks
8 since about 1982, I believe, through 2010. Over
9 that time period, there have been a lot of changes
10 that's been made to the data collection methods. We
11 all understand that the data was not collected based
12 on a specific research design for this purpose, so
13 there is some uncertainty about the data and its
14 applicability for this use.

15 We agreed that there was much more
16 interior least tern nesting data than there was
17 piping plovers, so we only did the initial analysis
18 on the tern data. There really wasn't enough plover
19 data to make a useful analysis.

20 A couple of other things about the
21 populations: One, that the birds themselves are
22 very -- they cover a very large area. There may be
23 nesting populations on the Missouri River, on the
24 Niobrara River, on the Platte River, and there's
25 interchange between those groups for various reason

1 that are mostly unknown throughout time. Another
2 factor in the analysis is that the interior least
3 terns are colonial nesters. They don't necessarily
4 all identify their own specific best place to nest.
5 They like to kind of nest together. So once one of
6 them decides to nest, you may see a group of them
7 nesting in that same area.

8 And as I said, we all agreed that this was
9 the best available data but that it wasn't gathered
10 specifically for this purpose, and so there's
11 uncertainty about how it's used.

12 Additionally at that meeting we talked
13 about how were we going to do the analysis. And,
14 first of all, we talked about a refined spatial
15 scale. As I said before, it was a very coarse
16 geographic scale by hydrologic river segment. We
17 determined that we would go ahead and try to do this
18 analysis by river mile so you are only looking at
19 one mile of data at a time. And then we also
20 limited the analysis to the area immediately
21 downstream of the tailrace. That's the area
22 basically between the tailrace and North Bend.

23 We could identify the hydrologic
24 parameters that were going to continue to evaluate
25 and then -- but we would not have as much influence

1 from other outside flows. As you move downstream,
2 you get a lot more inflows and a lot more changes
3 that are not related to the project.

4 So as far as the types of statistical
5 analysis that we agreed to do, one was to look at
6 just a pretty basic presence/absence analysis. We
7 looked at log transformed nest counts for
8 normalization, and then did some logistic regression
9 and ANOVA for the additional statistical analysis.

10 And feel free to ask a question in the
11 middle here.

12 This is the study area that we did the
13 analysis on. Basically from the tailrace canal
14 right here, that is approximately River Mile 102,
15 and then all of the way down to North Bend, which is
16 approximately River Mile 72, so we looked at the
17 analysis on data for about a 30-mile stretch. And a
18 lot of the following slides talk about river mile,
19 so 102 is at the tailrace, 72 is downstream at North
20 Bend.

21 The first analysis that we did was to look
22 at relationship of nest counts to the actual data
23 collection visits. As I mentioned, the data was
24 collected over a variety of years. The methods of
25 collection maybe have changed a little bit. There

1 have been cycles of volunteers doing the collection,
2 Game and Parks employees doing the collection.
3 There was a lot of differences in the data.

4 So we looked at all of the data that was
5 in the database from the mouth of the Platte at the
6 Missouri, which is River Mile 0, all of the way up
7 to the confluence with the Loup, which is River
8 Mile 106. We looked at only the on-river data and
9 found that there was a very slight correlation
10 between the number of times that nests were counted
11 and the numbers of nests that were counted.

12 So basically what we were trying to
13 determine is when there was a year that there were a
14 lot of visits made, sometimes you would see folks
15 would be out about once a month for three or four
16 months versus a year when there was only one or
17 maybe two visits made, was that affecting the number
18 of nests that were counted. So basically that
19 analysis showed that about 4 percent of that
20 difference could be associated with the number of
21 visits.

22 That was further reduced though when we
23 looked at adding in adult nests -- or, excuse me,
24 adult counts into the analysis. Then this is pretty
25 obvious, the more birds you see, the more nests you

1 tend to see. It was really determined that the
2 number of data collection visits that occurred was
3 really insignificant in the number of nests that
4 were counted.

5 JOEL JORGENSEN: I have a question
6 about that.

7 LISA RICHARDSON: Go ahead, Joel.

8 JOEL JORGENSEN: So you are telling
9 me that increased effort does not significantly
10 increase the number of nests detected. I guess I
11 see -- when I see that you say that there's -- the
12 relationship between the number of visits and the
13 number of nests counted, I guess if there's a period
14 of time that is between those visits you may have
15 the same number of nests but they could be all
16 different nests.

17 LISA RICHARDSON: And that's
18 something that we -- you know, you can't tell
19 exactly. Nowadays when you are counting the nests,
20 you are getting the GPS coordinates.

21 JOEL JORGENSEN: That's right.

22 LISA RICHARDSON: So you can
23 know which -- when you have the same numbers -- when
24 you are counting the same nest.

25 JOEL JORGENSEN: Right.

1 LISA RICHARDSON: Historically in the
2 data that wasn't available. So we had to make an
3 assumption. You are right that you could go out two
4 different times and come up with the same number of
5 nests, none of which are the same or all of which
6 are the same or some combination, somewhere in
7 between. We didn't know what was what there, so we
8 had to make an assumption.

9 JOEL JORGENSEN: So what did you use?
10 I guess my question is, did you use the data from
11 both visits, or should I wait until you sort of get
12 down the line a little bit?

13 LISA RICHARDSON: And maybe Marcus
14 will chime in, but when we were just looking at the
15 number of data collection visits versus the number
16 of nests counted, we looked at all of the data.
17 Every time -- every piece of information that was in
18 there.

19 JOEL JORGENSEN: So this wasn't used
20 in the analysis?

21 LISA RICHARDSON: Right. What we
22 did, in the analysis we looked at each year and each
23 river mile and said, Okay, was there -- as an
24 example, at River Mile 72.2, it was noted in the
25 database that that location was counted four times

1 in 1987.

2 JOEL JORGENSEN: So what you are
3 presenting here is talking about what you did to
4 sort of assess the data before it was applied to the
5 analysis.

6 LISA RICHARDSON: Yes.

7 JOEL JORGENSEN: I guess bottom line
8 this for me then. Did you adjust the data in any
9 way to account for effort intensity, or is it just
10 looking at data and we looked at it and now we are
11 moving on, or did you actually make any changes as
12 to how you applied the data?

13 LISA RICHARDSON: When we did the
14 analysis -- the statistical analysis, we only looked
15 at the highest nest count at a specific location.

16 JOEL JORGENSEN: During a year?

17 LISA RICHARDSON: During a specific
18 year.

19 JOEL JORGENSEN: Okay.

20 LISA RICHARDSON: Now, there might
21 have been -- as I mentioned, we are looking at this
22 by river mile. So as an example, there would have
23 been three counts at 72.2, one count at 70, and one
24 count at 72.8. So we would have looked at what was
25 the height at that specific location. We only took

1 the maximum number.

2 So at 72.2 where there were three counts,
3 we looked at which one of those counts had the
4 highest number. That's the piece of information
5 that went into the analysis.

6 JOEL JORGENSEN: Okay.

7 LISA RICHARDSON: In addition to the
8 counts at 72.0 and 72.8, so -- because those were
9 considered to be separate locations, not potentially
10 the same nests, so when we looked at a river mile,
11 there would have been three counts in that river
12 mile.

13 JOEL JORGENSEN: Okay. Well -- and
14 just to clarify again, I come back to my initial
15 statement. If the nests were individually marked, I
16 think you would find a much stronger relationship
17 between the number of visits and the number of nests
18 counting. It's counter-intuitive to say that the
19 effort does not affect the number of nests present
20 in the environment over the course of a year. I
21 mean, I know that's not specifically what you are
22 saying there, but it's sort of what's being implied.

23 LISA RICHARDSON: Right.

24 JOEL JORGENSEN: And that doesn't
25 make any sense. So -- and I guess given the amount

1 of variation in timing and effort on the surveys in
2 any one year, the amount of variation may by that
3 very fact lead to a nonsignificant relationship. If
4 you had a controlled period where you were making
5 weekly visits or something, if you were controlling
6 for those things, a significant relationship may be
7 much more obvious. I mean, it's not a surprise
8 there's not a significant relationship.

9 LISA RICHARDSON: Right.

10 JEFF RUNGE: I guess since we are
11 stopped here, just one quick question. The R
12 squared values, does that, for example, for the
13 number of visits and number of nests, is that .04R
14 squared?

15 MARCUS GRANT: The R squared for the
16 correlation for the number of visits and number of
17 nests is 0.038.

18 JEFF RUNGE: Okay. .038.

19 MARCUS GRANT: So we made that an
20 approximation on the slide.

21 And then when we included adult tern
22 counts, the semi-partial R square for number of
23 visits reduces to .02.

24 JEFF RUNGE: Okay.

25 MARCUS GRANT: So that removing all

1 of the shared variance and looking at just the
2 contribution of the number of nest counts to -- or,
3 excuse me, number of data collection visits to
4 number of nest counts.

5 LISA RICHARDSON: Mary, did you have
6 a question?

7 MARY BROWN BROWN: I'm wondering what
8 statistics we are actually looking at because
9 correlation is R and R squared is regression. I'm
10 wondering actually what test statistics we are
11 seeing and are the actual test statistics values
12 available, Marcus, that we can see? Or am I
13 misunderstanding what I'm reading on the chart?
14 Correlation is R and regression is R squared?

15 MARCUS GRANT: R squared is
16 proportion of variance of the independent variable
17 that's accounted for by knowledge of the -- I'm
18 sorry. The dependent variable --

19 COURT REPORTER: I'm sorry. Can you
20 speak --

21 MARCUS GRANT: It's called the
22 coefficient of determination.

23 STEPHANIE WHITE: Marcus, can you
24 speak up a little bit, please?

25 MARCUS GRANT: Okay. I'm trying to.

1 R squared is the coefficient of
2 determination. It's the proportion of variance in
3 the dependent variable that's accounted for by
4 the -- by knowledge of the independent variable, in
5 this case number of nest count visits or number of
6 least tern adult counts.

7 JOEL JORGENSEN: So I guess the
8 question is, did you conduct a correlation analysis
9 or a regression analysis here?

10 MARCUS GRANT: This was a regression
11 analysis. This was a multiple regression using the
12 two independent variables.

13 LISA RICHARDSON: More questions on
14 this slide. I thought this one would be the easy
15 one.

16 Okay. We will move on to Slide 67 for
17 those folks on the phone.

18 So now this is actually getting into the
19 analysis that we did to try to look at project
20 effects.

21 One of the analyses we did was to look at
22 the relationship of nest counts to distance from the
23 tailrace return. So basically were you seeing more
24 nests further way, closer, or did it not seem to
25 matter in relation to the tailrace. The data that

1 was used was from 1987 to 2010. That was when we
2 had the flow data and the nesting data. And, again,
3 as I mentioned, we were analyzing River Miles 102 to
4 72.

5 And then one of the things -- one, we did
6 not see a statistically significant relationship
7 between distance from the tailrace and the number of
8 nests that were counted.

9 We did identify a post-1995 and pre-1995
10 kind of dichotomy in the data, that the -- in this
11 particular river segment, counts after 1995 were
12 pretty steady but significantly lower than counts
13 before 1995.

14 And then, Marcus, I will let you talk a
15 little bit about the tests that you did on that, the
16 T-test and then the Mann-Whitney U and the Kendall
17 Tau.

18 MARCUS GRANT: Sure.

19 We basically visually saw that potential
20 dichotomy between nest counts prior to 1995 and
21 after 1995 on that portion of the river. And you
22 can see it in that box plot in the slide of 69.

23 And we did the T-test of the difference in
24 means all of the years prior to 1995 and all of the
25 years after 1995 for that stretch of the river and

1 got a significant result -- a significant
2 difference. After discussing with one of our senior
3 biometricians, he suggested, Well, why don't we do a
4 non-parametric test on that because it's a more
5 conservative test and it's going to cover your bases
6 good. So we did a Mann-Whitney U test, which is a
7 non-parametric version of T-test that looks at the
8 rank compared observations, and we got a
9 Mann-Whitney U T value of 0.71 -- .071, excuse me,
10 so a trend towards significance there, but not
11 hitting the .05 criterion with the non-parametric
12 tests. But we get the .05 criterion with the
13 T-test, and that is sort of typical of a lot of
14 things that we see with the nest count data that we
15 have. But there seems to be a dichotomy in the
16 number of nest counts just in this portion of the
17 river. It's not a linear progression or reduction
18 in nest counts over time, but a step down event
19 since approximately 1995.

20 LISA RICHARDSON: Go ahead, Joel.

21 JOEL JORGENSEN: Why did you select
22 the -- limit the analysis to River Mile 72 to 102.
23 I guess 72 just seems kind of an arbitrary number.

24 LISA RICHARDSON: That was where the
25 flow data changes. North Bend -- I mean, the -- the

1 North Bend gage is the nearest gage to the tailrace.
2 It's about 30 miles downstream. After that you
3 start to see more inflows from other tributaries and
4 things, so that was where we broke the analysis.

5 JOEL JORGENSEN: Why at 72? I don't
6 get that. What changes in the river at 72 that
7 makes it -- there's inflows throughout the entire
8 system, I guess. Is there a mechanism to
9 control -- I mean, that would be a no quantity to a
10 certain degree, wouldn't it?

11 LISA RICHARDSON: We just show North
12 Bend because that's where we had the hydrologic
13 data. And I thought that was part of what we
14 discussed at our meeting in March was to limit it to
15 a smaller area. And so North Bend is where --

16 JOEL JORGENSEN: I can't remember
17 that far back, so that's fine. Okay. I just wanted
18 to know if there was something hard or firm there,
19 why 72 was significant in the analysis.

20 LISA RICHARDSON: Matt, do you
21 remember?

22 MATT PILLARD: Matt Pillard. I guess
23 all I can say -- Lisa said that the North Bend gage
24 was the last gage nearest the tailrace for which we
25 had data, and the next gage down is Leshara. Is

1 that right?

2 LISA RICHARDSON: Yes.

3 MATT PILLARD: So that would have
4 been the next gap. And river miles between North
5 Bend and Leshara, Pat, do you know offhand?

6 PAT ENGELBERT: Not off the top of my
7 head.

8 MATT PILLARD: It's quite another
9 distance down river. So in order to reduce the
10 spatial scale, North Bend was the last spot that we
11 had gage data other than moving another 30 miles
12 downstream to Leshara.

13 JOEL JORGENSEN: I guess if you are
14 interested -- if there were to be an effect, and not
15 saying that this analysis would affect it for a
16 number of reasons, the effect would be attenuated as
17 you move downstream.

18 LISA RICHARDSON: Yes.

19 JOEL JORGENSEN: So I guess you are
20 somewhat limiting the data, I guess, given the
21 limited number of data points within a 30-mile
22 stretch -- yeah, I guess I'm fine. I understand
23 decisions have to be made, but, again, 72...

24 And I guess the other thing I would
25 comment about is we know that there are a number of

1 other variables in effect in the tern/plover numbers
2 in the system, and I know you make some assertions
3 here later on in the presentation about a constant
4 and the changes here, so -- but there's definitely
5 other variables at work in the system.

6 LISA RICHARDSON: Absolutely. And we
7 don't know what happened in 1995 that caused it -- a
8 decrease in the nest counts.

9 I'm going to back up one slide to 68.
10 This -- I guess I got this a little bit out of
11 order.

12 This slide, No. 68, shows the highest nest
13 counts summed by river mile. So there you can see
14 102 at the left side of that screen and 72 at the
15 right side, 102 being close to the tailrace, 72
16 being 30 miles downstream at -- approximately at
17 North Bend. So those were the -- that's the data
18 that was basically used to determine -- doesn't seem
19 to be a relationship between distance from the
20 tailrace and the number of nests that were counted.

21 And then we also, moving on to 69, broke
22 it up by year, summed it over the River Mile 72 to
23 102 and saw that kind of stepped relationship.

24 So we also -- to see -- okay, there seems
25 to be something going on in 102 to 72, what's going

1 on in the rest of the river. And I think this is
2 part of what your question was, Joel. We then did
3 look at rest of the river and say, is there
4 something happening in 1995 everywhere. And we also
5 did look at some of the sandpit data that we had as
6 well.

7 This is all river miles from the mouth of
8 the Platte up to the confluence with the Loup and
9 showing there doesn't seem to be anything happening
10 at 1995. 1995 itself is a relatively low year, but
11 the rest of it is pretty scattered. It seems to be
12 fairly consistent. So when you look at all of the
13 data together, you don't see that.

14 We also looked at it, okay, so is there
15 something going on from 102 to 72, what does it look
16 like from 71 down. And, again, this is River Mile
17 71 to 0. You don't really see anything there.

18 So I think we are kind of getting to your
19 question a little bit. We did look at beyond just
20 72 when it seemed like there was something going on.

21 And this is also showing -- this is how
22 the sandpit counts looked in River Mile 72 to 102
23 during that time period.

24 Mary has a question.

25 MARY BROWN: I'm wondering if Marcus

1 could send us the test statistics for this as we go
2 along. The U values and the Ts and all that jazz.
3 Is it reasonable to ask for that, Marcus?

4 MARCUS GRANT: We have the SPSS
5 output for all of this.

6 MARY BROWN: Okay.

7 MARCUS GRANT: These were just
8 descriptive statistics. This was not a hypothesis
9 test.

10 MARY BROWN: That's fine. It might
11 be a little easier to interpret some of this if we
12 saw the values.

13 LISA RICHARDSON: Yes. And as Marcus
14 said, we have the SPSS output for all of the
15 analysis. That is part of the report. And I meant
16 to start off with this piece of analysis was
17 submitted late. We had some things that we needed
18 to clarify with Marcus the last week or so. He was
19 called out of the country on a family emergency, so
20 we had to delay getting the statistical information
21 into the report. But as was submitted on Tuesday to
22 FERC, the write-up for the analysis as well as
23 Attachment H, which includes all of the SPSS output
24 files for all of the analyses that are were done.

25 MARY BROWN: Okay. That's fine.

1 It's just a little easier to interpret things like
2 this if I do see the test statistics with is all.

3 LISA RICHARDSON: So here's kind of a
4 summary of the analysis that we did for this -- this
5 analysis per river mile. We looked at 102 to 72,
6 106 to 0, and 71 to 0, both on- and off-river data
7 for parts of those segments and identified that
8 there seems to be something going on pre- and
9 post-1995 just in the 102 to 72 river mile segment.

10 But, as we have noted in the report,
11 project operations were unchanged during that
12 period, so we don't feel that there's something
13 project related that happened in that 1995 time
14 frame.

15 JOEL JORGENSEN: Well, that -- I
16 guess I question that conclusion. I mean, you are
17 sort of -- there's sort of a syllogism there that
18 with you are making a conclusion. Because, I mean,
19 potentially there could be far fewer least terns in
20 the world during those different time periods that
21 would be available to put down nests, so that would
22 affect your nest numbers in the system.

23 LISA RICHARDSON: Yes.

24 JOEL JORGENSEN: And it's made later
25 on too the sort of suggestion because you have a

1 constant variable in project operations, and you
2 have variation in the number of nests, that this
3 constant variable isn't affecting the other, and I
4 guess that's perpetually not an appropriate
5 statement to make because given that you have noisy
6 data, you have a number of variables at play that
7 are affecting what you are looking at, and you are
8 not controlling for any of those. It's -- there may
9 be an effect, but you are not able to detect it. I
10 think that's the important way to present that. We
11 don't know. We are limited and hamstrung by the
12 data, and we can't say either way. But, again, to
13 stress that there is noisy data and other variables
14 at play here.

15 LISA RICHARDSON: Okay.

16 JOEL JORGENSEN: Including that there
17 just could be fewer terns in the world during the
18 different time periods here.

19 LISA RICHARDSON: Right.

20 We also did some more analysis to try to
21 determine is there a relationship from -- with
22 distance from the tailrace to the number of nests
23 that were counted. This is something that we
24 specifically talked about with Joel and Mary about
25 doing binary logistic regression, which basically

1 reduced all the nest count data to a
2 presence/absence variable. So if there were nests
3 in the river mile, that was identified as one. If
4 there were no nests identified in a river mile, that
5 was identified as a zero.

6 Just a point of clarification, I didn't
7 mention this earlier, but there were several times
8 when visits were recorded that no nests were
9 counted, but there was nothing -- there was nothing
10 entered in the nest column of the database. Those
11 were treated as null values and were not actually
12 included in the analysis. So they weren't included
13 as zero. They weren't included at all.

14 So, again, this simplified a very larger
15 amount of data to a presence/absence variable. It
16 eliminated any magnitude associated with the nest
17 counts, you know, was it one nest, was it ten nests.
18 It didn't matter. It was one or zero.

19 And, again, no relationship was detected
20 between nest presence and distance from the
21 tailrace.

22 Marcus, do you want to expand on this just
23 a little bit?

24 MARCUS GRANT: Well, you covered it
25 pretty well. The logistic regression analysis, of

1 course, was a work around for the fact that the data
2 were not normally distributed and there could be
3 problems from using a correlation analysis, a
4 parametric correlation analysis. And as Lisa
5 pointed out, a certain amount on information, of
6 course, is sacrificed when you go from count data to
7 presence/absence data.

8 The results were very consistent in the
9 binary logistic regression, and those results are
10 available to you also in Appendix H, that all of the
11 variables that we tested came out with -- excuse me,
12 odds ratios very close to one, which would be the
13 equivalent to getting an R of zero in parametric
14 regression analysis. So we could not detect any
15 effect of distance from the tailrace on the number
16 of nest counts using that method of analysis.

17 LISA RICHARDSON: Yes, Jeff.

18 JEFF RUNGE: Yeah. Just one quick
19 question here. What's the spatial bounds when you
20 looked at the distance from the tailrace?

21 LISA RICHARDSON: Go ahead, Marcus.

22 MARCUS GRANT: No, go ahead.

23 LISA RICHARDSON: In this particular
24 analysis, it was 102 to 72, the 30 miles immediately
25 downstream of the tailrace.

1 JEFF RUNGE: Okay.

2 LISA RICHARDSON: Additional
3 questions on this slide?

4 Okay. One more analysis related to
5 distance from the tailrace, and I would say we
6 didn't find anything, so we kept looking to see if
7 we could find some other type of analysis, if there
8 was some relationship. This was a multiple
9 regression on the log transform nest counts as the
10 dependent variable. The number of adult tern counts
11 was also included in that regression as were the
12 variables of peak mean daily flow, river mile, year,
13 and percent diverted flow.

14 There was a high association with the
15 number of adults counted. That's perfectly
16 reasonable and not a surprise there. There was no
17 association with the other variables of peak mean
18 daily flow, year, and river mile. There appeared to
19 be a slight association with the annual percent of
20 diverted flow. And in that case, the more flow that
21 was diverted, it was showing that you would expect
22 to see more nests. There was no real logic. That
23 didn't make any sense for that type of a conclusion
24 to be drawn, so Marcus did some additional analysis
25 and was -- determined that what was showing up

1 initially was not really there.

2 Marcus, I will let you explain that a
3 little bit better.

4 MARCUS GRANT: Sure. And we saw this
5 in the -- to point out, we saw this in the logistic
6 regression analysis flow, annual percent flow
7 diverted was a very problematic variable. And the
8 correlation matrix was very unstable. It's just the
9 nature of the way that that data or those data were
10 collected, I believe.

11 And when we looked at the multiple
12 regression analysis of log transform, which was not
13 normalized I should point out, but the regression
14 residuals looked pretty good with the log transform
15 scores, so I had some confidence in it.

16 What was going on there was that very weak
17 association that appeared to be was annual
18 percentage converted flow was actually a very strong
19 correlation between annual residuary flow and peak
20 mean daily flow. They were sort of catching
21 themselves so to speak at the correlation variance
22 matrix in the multiple correlation, and that's what
23 we are seeing when you account -- again, when you
24 account for that relationship, then the apparent
25 relationship between annual percent diverted flow

1 and nest count goes away, it becomes trivial.

2 LISA RICHARDSON: Any questions?

3 JEFF RUNGE: Since a lot of these
4 other -- a lot of the other studies look at
5 effective discharge as your measure of comparison
6 across these segments, I guess I wonder why peak
7 mean daily flow was selected as opposed to these
8 other measures that were already in place?

9 LISA RICHARDSON: Marcus, I think
10 that had to do with the factor analysis and the
11 collinearity.

12 MARCUS GRANT: Right. That may have
13 been a somewhat arbitrary decision, and I would have
14 to go back and review those data, but a lot of those
15 variables were collineary, and we were choosing the
16 ones that we felt at the time were most
17 representative.

18 LISA RICHARDSON: And, actually,
19 Jeff, now I remember part of it. The effective
20 discharge, dominant discharge, and peak mean daily
21 flow loaded on the same factor in the factor
22 analysis, so there was -- they were very similar.
23 Peak mean daily flow was something that we had data
24 for for every -- we could calculate for every river
25 mile, whereas effective discharge and dominant

1 discharge were not something that we had at every
2 river mile, so that's -- we were doing the analysis
3 by river mile, so we couldn't do it based on
4 effective discharge or dominant discharge because we
5 didn't have that data.

6 JEFF RUNGE: I guess that leads me to
7 another question then. If peak mean daily flow and
8 dominant discharge or effective discharge are very
9 similar when looking at -- or are very similar
10 factors, I guess if there's no relationship between
11 peak mean daily flow and nest counts, I guess could
12 it also be implied that this is not a very good
13 measure to look at project effects because we do see
14 significant effects when it comes to other
15 parameters and effective and dominant discharge, but
16 if this shows that there's no relationship, I guess
17 does that mean that this analysis can't detect the
18 effects of the project?

19 LISA RICHARDSON: From an effective
20 and dominant discharge perspective, I guess we
21 couldn't do that analysis, but the sediment
22 transport, which is really what you are getting at
23 through the effective or dominant discharge, the
24 sediment analysis determined that the system is flow
25 limited, not supply limited. So the amount of

1 sediment -- and Pat can help me out here if I'm
2 incorrectly stating something, but the amount of
3 sediment that's being carried is all that can be
4 carried by the flow that's there.

5 PAT ENGELBERT: I think in looking at
6 the effective and the dominant, that's kind of the
7 long-term analysis relative to the sediment
8 transport, evaluating what is that discharge that
9 conveys the most sediment over the long term. I
10 think when they were applying the daily values they
11 were seeing if there was a response maybe to that
12 single discharge in time, so it's kind of looking at
13 two different things, I guess.

14 JEFF RUNGE: But don't they aggregate
15 the data to make a long-term analysis though --

16 PAT ENGELBERT: The sediment data,
17 yes. I don't know about the bird data.

18 LISA RICHARDSON: I'm not sure what
19 you mean, Jeff.

20 JEFF RUNGE: Well, you said that the
21 effective and dominant discharges looks at long-term
22 effects to channel geometry, but wasn't this data
23 for the species also analyzed within the long-term?

24 LISA RICHARDSON: Yes. Yes, it was.

25 MARCUS GRANT: From 1987 to 2009.

1 JEFF RUNGE: Okay.

2 LISA RICHARDSON: So in that case, we
3 had to take like the average of the flow -- of the
4 peak mean daily flow for that 24-year period, and
5 the total numbers of nests that were counted or -- I
6 mean, it was done over the -- each piece of -- each
7 year had several pieces of data in it, and then it
8 was aggregated in various ways.

9 GEORGE HUNT: I think the dominant
10 and effective discharges used in the factor
11 analysis, the annual dominant and effective
12 discharge, not the long-term.

13 JEFF RUNGE: Okay. So there wasn't
14 an aggregate comparison that looks at changes in
15 effective and dominant discharge on the
16 longitudinal, and does that affect the aggregate
17 nesting over the long-term as well? There hasn't
18 been that comparison then?

19 LISA RICHARDSON: No, not
20 specifically.

21 JEFF RUNGE: Okay.

22 LISA RICHARDSON: Any other questions
23 on this slide?

24 Okay. And then we also did analysis of
25 nest counts in relation to annual change in peak

1 mean daily flow. So basically as the flow changed
2 from year to year how did that affect nest counts.
3 A one-way ANOVA analysis was conducted for River
4 Miles 102 to 72. What that analysis, and Marcus is
5 going to have to chime in here, what that analysis
6 showed is that the change in flow between years was
7 statistically significant but the change in flow
8 from -- between river miles was not. Now, that was
9 for the 72 to 102, so basically -- essentially
10 showing that you are seeing relatively consistent
11 flow over those river miles.

12 What we did see is what appears to be a
13 relationship, that high flows followed by low flows
14 produced more nests, which is kind of a theory
15 that's talked about quite a bit. The data was
16 actually somewhat inconsistent, but we did do some
17 analysis trying to look at that relationship.

18 On this graphic, you can see that in
19 1993 -- this is a normal -- this is a standardized
20 flow graphic, so basically the highest flow that was
21 recorded during that '87 to 2010 period was the
22 denominator to each of the highest flows in each of
23 the years. So the highest flow over that period was
24 in 1993, so that's a one value. And then in 1994
25 you had less than 20 percent of that same amount of

1 flow the following -- in the following year. You
2 saw that again in the '99 to 2000, and '99 is
3 actually not shown on here because we didn't have
4 any nest count data in '99. And then you saw it
5 again in 2005 and 2006 where you had relatively high
6 flows followed by fairly low flows.

7 So we looked at what does it look like
8 when you compare the flows and the nest counts, the
9 sums of those nest counts for those years. In 1993
10 you had an average of 2.76 nests counted, and then
11 in 1994 that went up to 7.8, and that was determined
12 to be a statistically significant difference between
13 those years.

14 But when we did the same look at 1990 and
15 1991 when we had actual data, there's a less
16 dramatic change in the flow, 1990 to 1991, but there
17 wasn't any data available -- bird nesting data or
18 enough between '99 and 2000 and 2005 and 2006, and
19 we looked at '90 and '91, and you saw actually an
20 inverse relationship.

21 Now, I know that there's some -- the Game
22 and Parks reports have said that there was some --
23 the '91 data was collected maybe outside of the
24 normal window so that could also be a factor in why
25 this number is lower than this one instead of higher

1 as we saw in the '93 to '94 data.

2 So any questions on the peak mean daily
3 flow analysis related to nest counts?

4 Okay. Then I will move on to conclusions
5 from kind of the summary of all of these slides. We
6 found that nest counts were weakly associated with
7 the number of data collection visits per year, that
8 nest counts were strongly associated with number of
9 adult terns, and there's no measurable relationship
10 between nest counts and distance from the tailrace
11 in that initial 30 miles of the river, there's no
12 measurable relationship between the presence of nest
13 counts and distance from the tailrace, year, peak
14 mean daily flow, or percent diverted, and that there
15 is a potential relationship between high flows --
16 low flows followed by high flows that produces more
17 nests and that there's no significant difference in
18 the changes in flow within those 30 river miles.

19 ISIS JOHNSON: This is Isis Johnson
20 from FERC. Can you go over that -- what is that,
21 the bullet that's the third from the bottom? Do you
22 mean there's no measurable relationship between the
23 presence of nests or between nest counts?

24 MARCUS GRANT: Presence/absence.

25 ISIS JOHNSON: Okay. Presence and

1 absence of nests, correct?

2 MARCUS GRANT: Correct.

3 LISA RICHARDSON: Yes.

4 ISIS JOHNSON: Okay.

5 LISA RICHARDSON: Any other
6 questions?

7 All right. Stephanie, do you want to take
8 a quick break before we go into hydrocycling?

9 STEPHANIE WHITE: Yes. Do you have
10 one more slide?

11 LISA RICHARDSON: I have a questions
12 slide.

13 STEPHANIE WHITE: Let's take a break.
14 Let's reconvene in 15 minutes, which would be close
15 to ten minutes of. Is that about right? Let's
16 reconvene at ten minutes to the hour, so we will
17 have a break.

18 (10:34 a.m. - Recess taken.)

19

20

21

22

23

24

25

1 (At 10:50 a.m., the following proceedings
2 were had, to-wit:)

3 STEPHANIE WHITE: All right. When
4 you are ready, Pat.

5 PAT ENGELBERT: For those of you that
6 are on the phone, we are up to Slide 83. We are
7 going to talk about the analysis that was performed
8 for the hydrocycling study for this updated study
9 report.

10 Moving on to Slide 84, just as we had done
11 with the sedimentation study, I will review the
12 goals -- the goal for this study as well as the
13 objective that we are covering for this updated
14 study.

15 To review the goal of the hydrocycling was
16 to determine if project hydrocycling operations
17 benefit or adversely affect the habitat used by
18 interior least terns, piping plovers, and pallid
19 sturgeon in the lower Platte River.

20 The first two objectives associated with
21 this do not relate to what we did as part of this
22 updated study report. But Objective 3 did, and that
23 objective is to assess the effects, if any, that
24 hydrocycling, the current operations, have on
25 sediment transport parameters.

1 So a quick review. We are now on
2 Slide 87. This is the study area for the
3 hydrocycling report -- the hydrocycling study. It
4 goes from just upstream of the tailrace, that being
5 Site 3, down to Louisville. We have a slightly
6 smaller area that we will be evaluating for this
7 updated study report, but I wanted to refresh your
8 memory on the study area for the hydrocycling study
9 itself.

10 Moving on to Slide 88, the previous
11 analysis that was conducted for the hydrocycling
12 study included developing the sediment transport
13 indicators for current operations as well as
14 run-of-river condition, and those three sediment
15 transport indicators are the total sediment
16 transported, the effective discharge, and the
17 dominant discharge. We have talked both about
18 effective and dominant during the sedimentation
19 discussion. The total sediment transport, that's
20 just the amount of sediment that's transported for
21 whichever study period you are evaluating.

22 This is a slide -- moving on to the next
23 slide, Slide 89. Based on the previous sediment
24 transport calculations that we performed, I just
25 wanted to refresh everyone's memory. We looked at a

1 typical wet year, a typical dry, year, and a typical
2 normal year based on the hydrologic classifications
3 by the Service, and we compared the total sediment
4 that was transported for the current operations as
5 well as the run-of-river, and we did that at Site 3,
6 which is upstream of the tailrace return, Site 4,
7 which is downstream from the tailrace return, and
8 then down at the North Bend gage, as well as Site 5,
9 which is near the North Bend gage.

10 And what we showed was, for example, at
11 Site 3, the total sediment transported for current
12 ops is the same as run-of-river as it should be,
13 that is upstream of the tailrace return. However,
14 at Site 4 we saw a slight decrease in the total
15 sediment that was transported under the run-of-river
16 condition as opposed to the current operations,
17 run-of-river, in that they are not storing any water
18 and whatever they divert runs right through the
19 system, so there's no hydrocycling under the
20 run-of-river condition.

21 Moving downstream, we saw a very close --
22 very close to same amount of sediment that was being
23 transported. Actually, a slight increase under the
24 run-of-river condition down at North Bend, a very,
25 very slight increase. And that was for a normal

1 year.

2 For a wet year, which was 2008, at Site 4,
3 again, we had a slight decrease in the amount of
4 sediment that was transported when the project was
5 operating under run-of-river conditions as opposed
6 to current operations.

7 So in a wet year at Site 4, slight
8 decrease to the total sediment transported if they
9 go a run-of-river condition.

10 That is consistent with what we saw at the
11 USGS gage site, a slight decrease. However, at
12 North Bend we saw essentially the same amount of
13 sediment transported under those two conditions.

14 Moving on to the dry year, a typical dry
15 year, again, at Site 4 we saw a slight decrease in
16 the amount of sediment transported under a
17 run-of-river condition as compared to a current
18 operations condition; a slight decrease at the North
19 Bend gage, but, again, just a very slight increase
20 at the North Bend site, that being Site 5.

21 So I just wanted to refresh your memories
22 that based on our previous analysis we saw a
23 slight -- at Site 4 we saw a slight decrease in the
24 total sediment being transported when the project
25 was operated under a run-of-river condition as

1 opposed to a current condition scenario.

2 Moving on to Slide 92, I'm just going to
3 summarize FERC's request in the last study plan
4 determination letter that we are evaluating this
5 updated study report. HEC-RAS predicts -- this is
6 per FERC's letter. HEC-RAS predicts whether there
7 would be aggradation or degradation for various
8 project operations, will allow FERC to evaluate
9 relative effects of project -- that project
10 operations have on sediment transport, channel
11 geometry, and water service. Therefore, they
12 directed Loup Power District to evaluate the
13 sediment transport using the sediment transport
14 module within HEC-RAS.

15 Moving on to Slide 93, in evaluating the
16 capability of what HEC-RAS can do from a sediment
17 transport perspective, this is right out of the
18 Hydraulic Reference Manual. It's the very first
19 thing you read, and it states that the data utilized
20 to predict bed change is fundamentally uncertain and
21 the theory employed is empirical and highly
22 sensitive to a wide array of physical variables.
23 However, you can utilize a calibrated sediment
24 transport model to predict -- and this is the
25 important part -- regional long-term trends that can

1 inform planning decisions and can be used to
2 evaluate project alternatives.

3 So I would like you to keep that in mind
4 that we are not overstating the ability of this
5 model, that we are -- it truly was developed to
6 evaluate regional, long-term trends.

7 JEFF RUNGE: Do they describe at all
8 as to what they mean by long-term?

9 PAT ENGELBERT: They didn't give a
10 range of dates. I think in other studies that have
11 been performed you would typically be looking at
12 that ten-year -- probably eight- to ten-year would
13 probably be a minimum. I would think based on what
14 we have seen, but certainly in that eight- to ten-
15 to twenty-year time frame.

16 And hopefully that will become evident
17 when I go through the model development process as
18 to the very nature of the complexity of the model
19 and why that is so.

20 Yes, Lisa.

21 LISA RICHARDSON: Pat, are we still
22 planning something next week?

23 As much as Pat is going to talk today, he
24 can talk even more --

25 PAT ENGELBERT: You might find it

1 hard to believe, but I'm going to be summarizing the
2 model develop and the model results today. For
3 those that are interested in really getting down in
4 the weeds of the model development, we have set a
5 date of Wednesday, September 14th. We are going to
6 hold kind of a live meeting with anyone who is
7 interested to get into much more detail on the model
8 inputs, simulation parameters, and those types of
9 things from 12:30 Central to 3:30 Central. So right
10 now I know Paul Makowski from FERC would like to
11 participate in that, and we would welcome anyone
12 else that would like to participate. Please send me
13 an e-mail if you are interested, and we will make
14 sure that we send you the link in order to access
15 kind of a similar presentation, but, again, getting
16 quite a bit more down into the weeds.

17 Today due to lack of time and probably
18 interest from a lot of folks, I'm going to state at
19 a pretty high level, just summarizing model inputs
20 and results. That's next Wednesday, September 14th,
21 12:30 Central to 3:30 Central. If you are
22 interested, send me an e-mail, and we will send you
23 the link to participate.

24 So in developing the model, we looked at a
25 series of sources, the Loup River -- a model had

1 been developed of the Loup River as part of the ice
2 study as part of this relicensing process. The
3 Corps of Engineers developed or updated the study
4 for the Platte River, so we used that. And that's
5 more of a regional model, pretty coarse spacing.
6 And then we supplemented those two models with the
7 HEC-RAS models that we developed for the study sites
8 as part of this relicensing process.

9 Some -- moving on to Slide 95, some of the
10 model considerations or constraints when evaluating
11 sediment transport is they suggest a fairly coarse
12 cross sectional spacing because at every time step
13 it's balancing sediment in and sediment out. The
14 narrower you have the cross-sections, you introduce
15 quite a bit of model instability, so they strongly
16 recommend fairly coarse spacing or spacing close
17 enough that it doesn't incur model instability.

18 Also simulation, they -- all of the
19 manuals and literature suggests a pretty significant
20 warm-up time, maybe a six month or a year warm-up
21 time, which allows the model to become
22 computationally stable. And I will explain how we
23 did that in a minute.

24 And, again, they also suggest long-term
25 simulations. What that does allow us to do is

1 calibrate to long-term trends that we saw at the
2 gaged sites.

3 Because of the time step and the
4 simulation length associated with these models, we
5 actually broke it into two models. One model
6 included Sites 3 and 4, and then a model included
7 Site 5. And the biggest reason we had to do this
8 was just to evaluate about two miles around North
9 Bend required -- in evaluating the daily flows as
10 well as the realtime flows, each simulation took
11 approximately 8 to 12 hours just for it to grind
12 through the length of simulation that was required.

13 If we were to connect Sites 3 and 4 all of
14 the way down to North Platte, so two miles to 8 to
15 12 hours, have a 35-mile long river segment, to
16 evaluate sediment transport would have taken 15
17 times that.

18 TOM ECONOPOULY: Was this on your
19 laptop or --

20 PAT ENGELBERT: We actually -- we got
21 quite a souped-up computer that we have. It's very
22 high processing speed in our -- and the guys that
23 were running it always refer to that computer as
24 Canseco because it was all juiced up. So for those
25 baseball fans. If you are an A's fan, I apologize.

1 But anyway.

2 But I will talk, Tom, a little bit later,
3 some of the discrepancies that we found in modifying
4 input files and other things on various computers
5 and having it run. Good question. I will get into
6 that. But it was a pretty souped-up computer.

7 Moving on to Slide 96. So the hydrology
8 that we incorporated into the models, we looked at a
9 three-year warm-up period, and we ran just a base
10 steady flow during that three-year warm-up period,
11 and we used the effective discharge for that.

12 The next term -- the next part of the
13 hydrology that we evaluated was a long-term
14 hydrologic simulation, and we chose from 1990 to
15 2005 for a couple of reasons. One was there was
16 good distribution between wet years and dry years
17 and normal years between 1990 and 2005. We had
18 approximately six wet years, five normal years, and
19 six dry years -- no, six wet, five dry, and six
20 normal years, I believe, but we had good
21 representation in evaluating that long-term trend
22 using that length of time.

23 Plus in order -- and then at the end of
24 those year, we would tack on either a wet year or a
25 dry year or a normal year using the realtime data,

1 and that started in 2006, so we thought that
2 provided us a good transition into those wet years,
3 dry year, and normal years.

4 Relative to boundary conditions, for
5 the -- the model had included Sites 3 and 4, we
6 incorporated the Loup and the Platte as upstream
7 boundary conditions for that model which allowed us
8 to evaluate the sediment contribution from the Loup
9 and the Platte as it comes into Sites 3, and then --
10 as well as to Site 4.

11 The other thing that we evaluated was the
12 tailrace return contribution. And in looking at the
13 Missouri River Basin Commission Study, they state
14 that there is a sediment concentration in the
15 tailrace returns that were approximately 350,000
16 tons per year. However, to evaluate the worst case
17 scenario related to sediment transport, we assumed
18 no sediment concentration coming in from the
19 tailrace return. That would paint the worst case
20 scenario from a sediment transport perspective at
21 Site 4, so I just wanted to make that clear.

22 So down at North Bend, we just used -- for
23 boundary conditions, we wanted to make sure we
24 incorporated the North Bend gage because we used
25 that for calibration, so the North Bend gage kind of

1 serves as a -- upstream of the North Bend gage kind
2 of serves as our boundary conditions there.

3 Real quickly I just want to show the
4 graphics looking at Slide 97. These are the modeled
5 cross-sections that we used. We were looking at
6 model stability. We have cross-section spacings
7 typically of about 1500 feet. It still allowed us
8 to have either four or five cross sections in Study
9 Site 3, Study Site 4, and Study Site 5. But this is
10 just a graphical representation of the model limits.
11 We have got a couple miles up the Loup, a couple
12 miles on the Platte, and then we see Site 3 and
13 Site 4, and then we extended it down a couple of
14 miles.

15 It was important to have our boundary
16 conditions sufficient enough distance upstream that
17 boundary conditions weren't controlling our study
18 areas, that being Sites 3, 4, and 5, so you want to
19 create that buffer in the models.

20 Here we are in Site 5, and what I wanted
21 to note there is we did go upstream of the North
22 Bend gage about a mile and a half. We did use the
23 North Bend gage for our calibration process, and I
24 will go into that in just a moment.

25 So moving on to Slide 99, how the model

1 calculates sediment transport. It looks at the bed
2 gradation, the available material that can be
3 stirred up and transported, and it asks you to
4 select a sediment transport method, so based on our
5 initial study report and second initial study
6 report, we again chose Yang's Unit Stream Power
7 equation because that has been successfully applied
8 to the Platte River. So it takes the bed gradation,
9 that relationship, and then the computed hydraulics
10 at every time step, and then it calculates what the
11 sediment transport is at that particular time step.

12 Moving on to Slide 100, the only place
13 that we had data for which to calibrate the models
14 was at the North Bend gage, and we had bed gradation
15 measurements that were taken, we had suspended
16 sediment measurements that were taken, plus we had
17 the long-term gage reading at the North Bend gage,
18 so we used the model that included Site 5 as our
19 calibration model.

20 One thing that I would like to note in --
21 and I'm on to Slide 101. When evaluating the
22 sediment transport results, recall that we are
23 looking at long-term trends, we are not necessarily
24 looking at absolute values. And one of the
25 by-products of getting the model warmed up is that

1 the first initial time steps you will see a quick
2 drop, a very quick degradational trend that's
3 occurring. That's just the model's response to
4 picking up the material to get to equilibrium when
5 it starts its sediment transport run. So on some of
6 the graphics, you will see us evaluating a trend
7 line that's slightly lower than the measure data.
8 That doesn't necessarily mean the model is not
9 predicting it correctly, it's just recognizing that
10 there's an initial adjustment period.

11 Okay. So moving on to the North Bend
12 gage, one of the first calibration metrics that we
13 had was is the model trending similar to what the
14 long-term gage data was showing. So here we are at
15 the North Bend gage location, and we looked at the
16 cross-sections in the model just downstream of the
17 bridge, at the bridge, which is where the gage site
18 is located, and then just upstream of the bridge,
19 and we saw that the long-term trend are represented
20 in the blue diamonds -- this is on Slide 102 --
21 versus the solid purple line which shows the mean
22 channel invert elevation in the model. Those are
23 the average of the points that are used to define
24 the river channel in the model. So you have the
25 banks on either end and whatever points were used to

1 describe the channel, it averages those, and that's
2 what this line represents.

3 What we see is just a very, very slight
4 long-term degradational trend. Just very slight,
5 half a foot over the 15 or 16 years. And we see
6 also a very similar long-term trend at the North
7 Bend gage. That gave us -- that told us that the
8 model was trending very similar to what the
9 long-term gage had shown.

10 Secondly is we evaluated the -- what the
11 model computed, the bed gradation that it took from
12 the bed, did that represent what has been measured
13 out in the field.

14 Here are a couple of lines on this
15 graphic -- I'm on Slide 103. The green line is what
16 the model stated it was pulling from its source for
17 bed material. The other lines on there are
18 measurements, either long-term gage measurements
19 that were taken or recent measurements that were
20 taken in 2010 by the USGS. What this tells us is
21 that the model is accurately representing the
22 material that's available for it to pick up and
23 transport as part of the sediment transport
24 calculation.

25 Jeff?

1 JEFF RUNGE: Yes. Before you move on
2 here, the USGS 2010 document doesn't describe the
3 results. It describes the methods, but there wasn't
4 any published sediment data that came out of the
5 report.

6 PAT ENGELBERT: The report that we
7 had had gradations and tables I believe in the back.
8 George, do you recall where we pulled those from?

9 GEORGE HUNT: Yeah, it had PDF tables
10 of the data.

11 PAT ENGELBERT: Quite a large number
12 of them.

13 JEFF RUNGE: That's odd because they
14 collected the data and they were to send it to the
15 Corps, and the Corps would process -- would sort the
16 data -- they would hire a contractor to sort the
17 data. And I even gave them a call too, the authors,
18 and I guess I wasn't quite sure. I even looked up
19 the report, and I didn't see the sediment gradations
20 in the report.

21 PAT ENGELBERT: When we get back to
22 the office, I will look it up, and I'm quite
23 confident that we have that material. Would that be
24 okay if we looked it up for you?

25 JEFF RUNGE: And please point out the

1 sections to me or provide me a copy, please, because
2 that would be appreciated.

3 PAT ENGELBERT: Okay.

4 JEFF RUNGE: The other question too
5 is when you looked at the model cross-sections, you
6 look at average, is that an average over time or is
7 that the average at the beginning or the end of the
8 run?

9 PAT ENGELBERT: In -- as far as this
10 gradation curve?

11 JEFF RUNGE: Yeah, the green line.

12 PAT ENGELBERT: That was at the end
13 of the simulation.

14 JEFF RUNGE: Okay.

15 PAT ENGELBERT: We didn't do it
16 finish each time step.

17 And just for -- to throw out numbers, each
18 year -- when we looked at long-term simulation, we
19 used daily data. And that calculated -- we provided
20 a one flow per day, so we had -- for that year there
21 were 365 flow points.

22 JEFF RUNGE: Oh, sure.

23 PAT ENGELBERT: We then broke that
24 down -- I believe it was on the -- George, correct
25 me if I'm wrong, a 15-minute or a 6-minute time

1 step, we had it calculate a sediment transport.

2 JEFF RUNGE: Okay.

3 PAT ENGELBERT: So that's broken down
4 again.

5 JEFF RUNGE: Okay.

6 PAT ENGELBERT: When you get into the
7 realtime data, 30-minute data, you have to provide
8 over 17,000 coordinates to describe every
9 30 minutes. So if we were to plot every single day,
10 I think the output is 14 gig.

11 GEORGE HUNT: Each set of model
12 results, the output was about 16 gig.

13 PAT ENGELBERT: About 14 gig worth of
14 data. So to get through that -- that's why we
15 showed just the end simulation.

16 JEFF RUNGE: Oh, no, this is helpful.
17 The average -- it's helpful to know that that's an
18 average of the output at the very end.

19 PAT ENGELBERT: At end of the
20 simulation.

21 JEFF RUNGE: But as far as what you
22 initially started with, is that on there, or is
23 that --

24 PAT ENGELBERT: Yeah, we initially
25 started with --

1 JEFF RUNGE: -- or did you use
2 like --

3 PAT ENGELBERT: Something very
4 similar to the purple curve, which is the combined
5 gradation that we used in the initial study report.

6 JEFF RUNGE: Okay.

7 PAT ENGELBERT: We did have to take
8 out some of the finds because we had dramatic model
9 instability when we did that. It was picking up
10 everything and dropping off of the bottom.

11 JEFF RUNGE: Okay.

12 PAT ENGELBERT: Again, another one of
13 the modeling limitations. But the results, you
14 know, indicate to us that its source is very nearly
15 what's been measured in the bed, which gives us a
16 good feel that it's accurately describing what's
17 going on --

18 JEFF RUNGE: Uh-huh.

19 PAT ENGELBERT: -- out in the river.

20 Any other questions on either the model
21 development or some of the calibration that we
22 discussed at this point?

23 If not I will go on to the next slide.
24 Again, this is at the North Bend gage itself, and
25 this is a plot of the -- the orange squares on

1 Slide 104. The orange squares are the measured
2 suspended sediment data taken by the USGS. The dark
3 line is the sediment discharge rating curve that we
4 developed for the initial study report and the
5 second initial study report. The green circles, and
6 they are all pretty well clustered around the
7 sediment discharge rating curve line, but the green
8 circles are what the model calculates is the
9 cross-section's capacity to convey sediment. So
10 based on the hydraulics and the bed gradation,
11 here's how much that particular location can convey.
12 The purple dots represent the rate at which the
13 model is transporting sediment, so if the rate is
14 higher than the calculated capacity, it will drop
15 its sediment load. If the rate is less than the
16 calculated capacity, it will pick up sediment to get
17 to that equilibrium point.

18 What this shows is we had very, very
19 nearly -- the sediment was being transported at its
20 capacity for the majority of the time. There were
21 instances where it wasn't, but by and large the very
22 tight clustering that we see tells us that the river
23 is transporting its sediment at its capacity.

24 JEFF RUNGE: I guess I missed the
25 earlier explanation there. I guess I should have

1 been paying closer attention, but maybe by providing
2 us an example here where the transport rate is
3 greater than the capacity, is that possible, or is
4 that just a consequence of the modeling, or --

5 PAT ENGELBERT: It -- between
6 cross-sections, the capacity changes. And at every
7 time step that capacity changes. So when the
8 Cross-Section 1 hands off its sediment transport
9 load to Cross-Section 2, Cross-Section 2 may not --
10 the calculated hydraulics may not have the capacity
11 to convey what the section upstream is giving it.
12 So it will drop or pick up. So it calculates the
13 rate and the capacity at each cross-section for
14 every single time step.

15 JEFF RUNGE: Okay.

16 PAT ENGELBERT: So it's basically
17 making a hand off as you work your way from upstream
18 to downstream.

19 JEFF RUNGE: So in this case when
20 you've got your transport rate is higher than any
21 capacities, I guess what's the explanation for that?

22 PAT ENGELBERT: Well, what that's
23 telling us is that that particular cross-section at
24 that point in time, its capacity wasn't high enough
25 to carry the sediment load that was being brought

1 into its -- what do they call it, control section.

2 JEFF RUNGE: Okay.

3 PAT ENGELBERT: And, again, this is
4 at every single cross-section for every single time
5 step, so it's -- it chugs through quite a lot.

6 JEFF RUNGE: Okay.

7 GEORGE HUNT: So when that happens,
8 it's just handed off its load from upstream, it will
9 have to deposit that.

10 JEFF RUNGE: Okay.

11 PAT ENGELBERT: And that kind of
12 explains the need for fairly coarse cross-section
13 spacing so it can distribute that over a greater
14 distance than if they are very close. That's where
15 we saw some -- on some of the earlier runs that we
16 made, we used all of the cross-sections within the
17 study sites, the nine that we surveyed, and we just
18 had dramatic model instability because of that
19 change between capacity is what we were seeing.

20 JEFF RUNGE: With that, you know,
21 just looking at the opposite one, and I'm not sure
22 if you've got those graphics here, but Site 3,
23 Genoa, and Duncan, the capacity is higher than the
24 transport.

25 PAT ENGELBERT: Yeah, we will get to

1 those in a little bit.

2 JEFF RUNGE: Okay. I will just wait
3 until those come up then.

4 PAT ENGELBERT: But I think, Jeff,
5 what you will see in general is there's a pretty
6 tight clustering around the capacity and the rate.

7 JEFF RUNGE: Yeah.

8 PAT ENGELBERT: But we will get into
9 that in just a little bit.

10 JEFF RUNGE: Okay.

11 PAT ENGELBERT: Okay.

12 So we did not have data at either Sites 3
13 or 4 or Site 5 itself, so we did -- you know, kind
14 of very loosely using the term validation, but we
15 did more of a qualitative analysis in looking at
16 model performance. We needed to have a good comfort
17 that the model was responding as you would expect.

18 So a couple of things that we evaluated,
19 for example, in the Sites 3 and 4 model, we looked
20 at the trend in the Loup -- in the 2-mile stretch of
21 the Loup and the 2-mile stretch of the Platte, we
22 looked at its trend, its model trend, and we
23 compared to the gages on the Platte at Duncan, which
24 is seven or eight miles upstream, as well as the
25 Loup at Genoa, which is 39 miles upstream, but we

1 wanted to get a sense of was our 2-mile reach of
2 both the Loup and the Platte trending similarly to
3 what the gages farther upstream were trending,
4 again, to give us some comfort that the model was
5 responding according.

6 Similarly, we did the same thing with the
7 bed gradations within the model for those two small
8 reaches. And then we looked at the transport versus
9 measured rate, again, similar to the graphic that I
10 just showed.

11 Next we looked at Sites 3 and 4, and at
12 Site 5. We looked at the long-term trend of the
13 study sites to see if the model was responding to
14 higher flow rates. As you would expect, when you
15 see a higher flow occurring, typically see a dip in
16 the long-term trend in response to higher flows
17 coming in and drumming up the sediment. So we
18 compared those.

19 We also compared for the -- in 2010 we ran
20 a 2010 at the end of the long-term simulation to see
21 if the model was responding similarly to what had
22 been surveyed in 2010, so I will go through those
23 results.

24 And finally we did look at the model
25 versus the measured gradation within those study

1 sites because we have that data. So, again,
2 although it's not hard validation, it gave us some
3 level of reasonableness evaluating the model
4 performance qualitatively.

5 Now, I will begin a series of graphs, kind
6 of death by graphics, but I am going to go through a
7 lot of them, and I am open to questions at any
8 point. I will probably run through them fairly
9 quickly. They are all in the report, but feel free
10 to ask questions at any point.

11 So looking at the Site 3 and 4 model, the
12 first thing that we compared -- the first thing that
13 we evaluated qualitatively was is the Loup reach
14 that's coming in trending similar to how the Genoa
15 gage had trended. What we see again are the blue
16 diamonds showing the long-term Loup measurements,
17 the gage measurements, versus the solid purple
18 line -- again, we are on Slide 106 -- showing the
19 model results. We had a stable trend for the
20 measured gage data, and we had a stable trend for
21 the model results for that stretch of the Loup River
22 that was coming in.

23 Similarly at the Platte, the Platte at
24 Duncan showed a fairly neutral trend, a stable
25 trend. Our model results showed a slight decrease

1 within the first three years of our long-term trend.
2 And then it seemed to level off with possibly a
3 slight degradational trend. So although we didn't
4 have a perfect match, it was a reasonable match that
5 we felt comfortable moving forward on.

6 Okay. You can see as I go through these,
7 not in every instance did we hit each of validation
8 metrics that we were using or the qualitative
9 analysis metrics we were using, but in Genoa they
10 all seemed to correlate.

11 Here's a graphic showing the Genoa bend
12 sediment gradation versus some of the measurements
13 that were taken. Although we were slightly -- what
14 the model resulted was slightly coarser, it was
15 still within the same log scale of the measurements
16 that had been taken.

17 The Duncan gage as compared to the Duncan
18 reach in the model, it fell right in the middle of
19 the measurements that were taken as well as the
20 long-term USGS measurements.

21 I'm moving on now to Slide 110. This is a
22 graphic representing the Genoa gage, the suspended
23 measurements that had been taken by the USGS versus
24 the capacity and rate measurements that were
25 simulated. And we are slightly below the long-term

1 trend that we had used for our initial results, but,
2 again, the model is showing that the transport rate
3 and the transport capacity are very nearly
4 clustered, which is consistent with some of the
5 previous findings that we had.

6 So this is the Genoa gage itself, 30 miles
7 upstream, comparing it to what the model simulated
8 on the Loup reach.

9 JEFF RUNGE: This would be a good
10 stopping point here. I mean, this is an example.
11 Since we are looking at a log scale, these are
12 pretty big differences, in my opinion, as to you've
13 got a capacity but then your ability to transport is
14 less than that. And, you know, across -- you know,
15 across quite a range of discharges, there's certain
16 instances where your transport falls below capacity.

17 PAT ENGELBERT: Yes, that is true.
18 And then we have -- there are instances where the
19 transport falls above itself capacity.

20 So one of the -- one of the slides I will
21 show later is how at certain points in time we see
22 aggradation and at certain points in time we see
23 degradation. And remember these are points at every
24 single time step along the way, so even within a
25 given day you will see some balancing up and down.

1 JEFF RUNGE: But based on the
2 previous assumption though when looking at the
3 sediment yield, there's a multiple of sediments
4 applied compared to what can be transported based on
5 the Missouri River Basin Commission results. And
6 with that, I mean, would that ever be a case that
7 since there's a conclusion made that it was not
8 supply limited that there would never be a case that
9 your transport would be less than capacity?

10 PAT ENGELBERT: I certainly think
11 there are instances of that, and you will see when
12 we show the slide. There are periods of
13 aggradation, but there are periods of degradation.
14 Again, I think it's important to evaluate the
15 long-term trend, what does the long-term trend show
16 us.

17 JEFF RUNGE: Okay.

18 PAT ENGELBERT: Clearly there are
19 days when it's degraded, which would suggest that
20 the rate is higher -- I'm sorry, lower than the
21 capacity. And clearly there are days where it's
22 aggrading, which would suggest that the rate is --
23 well, the opposite of what I said before. But the
24 long-term trend is what we are -- again, what we are
25 evaluating.

1 JEFF RUNGE: Okay.

2 GEORGE WALDOW: George Waldow, HDR.
3 Is not that totally consistent with the dynamic
4 equilibrium concept that we have carried forward
5 through all of these discussions? Is that a way to
6 summarize it?

7 PAT ENGELBERT: Yeah, good point,
8 George. In a braided integrated system, as we have
9 said repeatedly, you will see periods of aggradation
10 and periods of degradation over this long-term --
11 over the long-term.

12 JEFF RUNGE: Okay. But I guess in
13 conclusion though, even in a system that is not
14 supply limited, you would still have difference in
15 transport capacities and actual sediment transport,
16 you will have fluctuations from degradation to
17 aggradation.

18 PAT ENGELBERT: Yes. Looking at each
19 separate time step.

20 Any questions on that? Paul, do you have
21 anything, or anybody?

22 PAUL MAKOWSKI: I'm good. Thank you.

23 PAT ENGELBERT: Okay. Moving on to
24 Slide 111. This is a similar graphic showing this
25 is the Duncan gage compared to the Platte River

1 reach that's coming into Site 3. Again, a
2 consistent trend showing a clustering around the
3 rates and the capacities and similar to the
4 suspended measurements that had been taken at the
5 USGS gage.

6 So we felt we had reasonable agreement
7 with the trends that had been evaluated, the rates
8 and capacities that had been evaluated, and the
9 gradations that had been evaluated on the incoming
10 sediment coming into Site 3, so we moved into -- now
11 we are down into the Site 3 location. This is Study
12 Site 3, and we are down on Slide 112. Again, we
13 didn't have any hard data here, so this is, again,
14 where we get into more of the qualitative analysis.

15 The first thing that we looked at is in
16 evaluating the long-term trend, we put this -- the
17 vertical light blue line represents the date in
18 which the peak discharge occurred in that given year
19 because we wanted to see if the model was responding
20 accordingly. For example, if you look at 1991
21 during a high flow event, you saw a dip -- you saw
22 some channel response at a higher flow event and
23 then a recovery. We see very similar situations
24 occurring as you look down the system. It wasn't
25 perfect. It didn't happen every time. But in quite

1 a few of the instances, we saw that channel
2 response, which again told us qualitatively that the
3 model is responding accordingly.

4 What we see here again is a slight
5 degradational trend occurring between 1990 and 1994,
6 and then kind of a stabilizing or a leveling off of
7 the system from '93/'94 out through 2005.

8 Okay. Here is a snapshot in time, Jeff, a
9 little bit of what I was describing. We are now on
10 Slide 113. This top line is -- we just chose a date
11 in August of 1993. So for a date in August of 1993,
12 that is the mean -- effective mean invert elevation
13 within Site 3, so between 1993 and 1998, the red
14 line, it had aggraded from what it had been in 1993.
15 Now, that doesn't mean that it was a gradual
16 aggradation. It might have bounced up and down a
17 couple of times, but for that date in August and
18 between 1993 and 1998 we saw it aggrade.

19 The next line -- the next date that we
20 evaluated was 2003, and we saw that it degraded. So
21 it aggraded and then it degraded. And then between
22 2003 and 2010, it was fairly stable, kind of
23 slightly aggradational on the downstream end of the
24 study site and slightly degradational at the upstream
25 end of the study site.

1 All we wanted to represent here was just
2 the variability of what's occurring within the study
3 site, that there are periods of aggradation and
4 periods of degradation, but when evaluating a
5 long-term trend, we were seeing periods of long-term
6 stability.

7 The next qualitative metric that we used
8 was to look at the mean channel invert elevation,
9 the change between the survey dates that were done
10 in 2010, how did the model predict that.

11 Each of these lines represent the date in
12 which the survey was obtained in 2010, and the
13 purple line is the mean channel invert elevation of
14 Site 3.

15 And if you recall from the second initial
16 study report, we saw slight decreases in the flow
17 area between each successive survey date, which
18 would suggest that there was some aggradation
19 occurring, but it was very minor, 2 to 3 percent
20 change in flow area, which would suggest a minor
21 aggradational trend within that time period.

22 The model within Site 3, and it's very
23 difficult to see with the naked eye, but there is a
24 very slight aggradational trend that occurred
25 between May 1st and I believe the middle of August

1 at Site 3, and, again, a very slight aggradational
2 trend that occurred between the second survey and
3 the third survey. Again, from a qualitative
4 perspective, it appears that the model is responding
5 accordingly.

6 Here again is the bed sediment gradations
7 that have occurred, what was measured versus what
8 was modeled. And we have a slightly coarser
9 gradation in the model by a couple of tenths of a
10 foot. You know, if you were to pick it up in your
11 hands, I don't know that you could visually tell the
12 difference in the gradations, but we felt that was a
13 good accurate representation of what was occurring.

14 Here we are at ungauged Site 3. This is
15 the modeled sediment transport rate as well as
16 capacity. Again, we see really consistent
17 clustering that is occurring. Although you do see
18 some -- as you would expect, some variability. At
19 1,000 CFS, it ranges from 500 or 600 tons per day up
20 to 5,000 or 6,000 tons per day. Again, it's
21 iterating depending on the hydraulics -- the
22 hydraulics and the bed gradations at that point in
23 the model.

24 Moving on to Slide 117, kind of a summary
25 of what we saw within Site 3 based on the model

1 results is that the long-term trend within Site 3
2 seemed consistent with the channel's responses to
3 high flows. The model versus the survey trend was
4 consistent. The model versus the 2010 measured
5 gradations were consistent. And the model versus
6 the computed sediment transport capacity was
7 transporting its capacity -- or transporting at its
8 capacity.

9 Okay. So we have kind of looked at the
10 boundary conditions, what was in the Loup and the
11 Platte, and that seemed reasonable. We have now
12 looked at Site 3, and those trends seem reasonable,
13 so -- but before I go on to Site 4, are there any
14 questions in some of the qualitative assessments
15 that we have made in this model so far?

16 Any questions?

17 Moving into Site 4, Slide 118, we again
18 evaluated kind of the mean peak annual flow and did
19 we see any channel response on the long-term trend,
20 and we did see some minor responses, not as
21 significant as what we had seen in Site 3. We did
22 have a slight aggradational trend from 1990 to '98,
23 although we are talking a couple tenths of a foot,
24 and then kind of a leveling off or even slightly
25 degradational from that point. But over the

1 long-term, it seemed to bounce between three-tenths
2 of a foot or so over the 15-year simulation.

3 Looking at Site 4 between the measure
4 dates, on to Slide 119, what had been measured in
5 the field again at Site 4 was a slight aggradational
6 trend. There was a minor difference in the flow
7 areas that were computed, 3 and 4 percent. What the
8 model predicted was a slight degradational
9 occurrence, so we weren't dead on on that particular
10 metric. However, the difference being within a
11 tenth of a foot, again, we didn't hit it perfectly
12 but there was a relatively small aggradational trend
13 that was measured, we showed a pretty small
14 degradational trend that was measured. Not perfect,
15 but sure seemed reasonable given just the nature of
16 the model itself.

17 Looking at the bed --

18 COURT REPORTER: Go ahead.

19 PAT ENGELBERT: The reporter was
20 shaking her hand out. I was giving her a break.
21 Imagine how my jaw feels.

22 But the measure -- again, the measure in
23 the model seemed fairly close at Site 4, and that is
24 Figure 534 in the report. That was a reminder for
25 me to put that figure in there. I probably should

1 have taken that out.

2 Here we are at the capacity versus rate
3 that the model had. In comparing it to the sediment
4 discharge rate curve that we developed for the
5 initial studies, again we see good clustering
6 between rate and capacity, which, again, suggests
7 that the river is transporting sediment at its
8 capacity, and it is clustered around the sediment
9 discharge rating curve that we had developed for the
10 initial part of the study, the ISR and the SISR.

11 So in summary on Site 4, the long-term
12 trend and channel response to high flow seemed
13 reasonable. The model versus survey trend wasn't
14 perfect, although we didn't see, you know,
15 relatively major swings either way. Had reasonable
16 approximation of what was modeled versus the
17 measured bed material gradations. And then the
18 model versus computer sediment transport capacity,
19 it seems to be conveying it at its capacity.

20 The next thing we evaluated was having a
21 pretty good feel that the model is reasonable, it's
22 stable, we evaluated the current operations versus
23 the run-of-river for a wet year, a dry year, and a
24 normal year using the model. You recall in our hand
25 calculations we showed that we were transporting

1 less sediment under the run-of-river scenario than
2 we were under the current operations for all
3 conditions. At Site 4, the model was showing
4 slightly less sediment being transported for the
5 run-of-river operation for about a six-month period,
6 but then the curves reverse little bit. The lighter
7 shade on Slide 123 is run-of-river, and the darker
8 shade is current operations. It seemed to switch.
9 There was less sediment being transported under
10 run-of-river for a time and then there was more
11 sediment transported under a normal hydrologic
12 classification later in the simulation. So kind of
13 different than the results than we had seen during
14 the computations that were performed in the second
15 initial study report.

16 However, looking at a dry year, we saw a
17 similar relationship between run-of-river and
18 current ops that we saw on the second initial
19 study result -- study report results in that we were
20 transporting less sediment under run-of-river
21 operations than we were under current ops on Site 4.

22 However that relationship reverses again
23 when we are evaluating a wet year. The model
24 results show that under current operations we are
25 transporting less sediment under current operations

1 than we would be under a run-of-river scenario. So
2 kind of a mixed bag when comparing the model results
3 to what we had computed in the second initial study
4 report.

5 Any questions on any of that before we
6 move forward? Jeff?

7 JEFF RUNGE: For all of these sites,
8 does that look at the elevations or like the
9 aggregate average elevation of all of the
10 cross-sections?

11 PAT ENGELBERT: It looks at the
12 average elevation of the cross sections within the
13 study site.

14 JEFF RUNGE: Within the study site.
15 Okay.

16 PAT ENGELBERT: For example, I
17 believe at Sites 3 and 4 we have four of the
18 original surveyed cross-sections within the study
19 site, again, due to the spacing limitations and
20 things like that. So we averaged all four of those.

21 JEFF RUNGE: Okay.

22 PAT ENGELBERT: So kind of in
23 summary, when we are looking at current ops and the
24 run-of-river trend as well, the transport rate was,
25 you know, very near capacity at all cases within

1 Site 4. Within a normal year, we saw no change in
2 the sediment transport. It was slightly higher and
3 then slightly lower as we move through the year.

4 A dry year we had a decrease in transport
5 for the run-of-river condition as compared to the
6 current operations. However, that relationship
7 flipped when we looked at the wet year. And just
8 recall, again, that the second initial study report
9 results showed that we were transporting less
10 sediment under all cases under the run-of-river
11 scenario. So when comparing the results, it's a
12 little bit of a mixed bag.

13 I'm going to go ahead and move on to
14 Site 5 where we performed a similar qualitative
15 analysis. Here we are at ungaged Site 5. Again, we
16 wanted to evaluate how the channel was responding to
17 those higher flows. Again, during those -- just
18 looking at the peak annual discharges, we didn't
19 look at all of the big events, but there seemed to
20 be a little bit of a dip during those higher flows,
21 which would suggest that the model is performing
22 reasonably.

23 However, we do see kind of a slightly
24 degradational trend within the first six or seven
25 years and then a slightly aggradational trend near

1 the end. So probably in general we were showing a
2 slightly degradational trend, which is consistent
3 with what we saw at the North Bend gage itself, a
4 slightly degradational trend.

5 Here again is another graphic showing the
6 variability at certain point in time how we see the
7 model aggrade or degrade. The red line is 1998, and
8 the dark blue line is 1993. So between -- for this
9 date in 2003 we selected, we saw kind of a
10 degradational trend between '98 and '93.

11 And I apologize. This is on Slide 128.
12 So comparing '93 to '98, we saw a degradational
13 trend, between '98 and 2003 a slight aggradation
14 trend, but between 2003 and 2010, an aggradation
15 trend, just showing the variability of the model
16 through the simulation.

17 Here we look at the survey dates as
18 compared to the model results, and I'm on Slide 129.
19 The survey showed that there was, again, a very
20 slight aggradation trend, 2 or 3 percent in the flow
21 area. Here the model results depicts something very
22 similar, a slight aggradational trend.

23 Finally we are looking at the bed
24 gradations of Model Site 5 versus what was measured,
25 and we have very consistent gradation, so the model

1 seemed to be performing reasonably.

2 Finally the sediment being transported,
3 the rate versus the capacity, it's all very
4 clustered around the Yang's Unit Stream Power curve
5 that we had developed for the initial and second
6 initial study reports.

7 So in summary at Site 5 the long-term
8 trend and the channel response to high flows was
9 reasonable. The model versus the survey trend is
10 very similar to what was surveyed. The gradations
11 appear reasonable. And then the model versus
12 computed sediment transport capacity were all very
13 clustered around each other. So for the long-term,
14 we saw it was transporting at its capacity.

15 Here we are at Site 5 evaluating the
16 current operations versus the run-of-river scenario
17 for a wet year, a dry year, and a normal year. This
18 graphic on Slide 133 shows that we did have a
19 slightly less sediment being transported under the
20 run-of-river scenario than we did for current
21 operations, and this is for a normal year.

22 Similarly for a dry year we saw slightly
23 less sediment being transported under a run-of-river
24 condition than under current operations.

25 And finally for a wet year, again, we saw

1 slightly less sediment being transported under the
2 run-of-river condition than we did under the current
3 operations, which is consistent with our results
4 from the second initial study report.

5 So in this instance, the model seemed to
6 replicate the results that we showed from the
7 computations in the second initial study report.

8 So in summary of Site 5 when comparing
9 run-of-river versus current ops, the transport rate,
10 the river is transporting at capacity in all cases,
11 wet, dry, and normal. The normal dry and wet year,
12 there's a decrease in transport during a
13 run-of-river condition than under the current
14 operational condition, and that compares favorably
15 with the analysis that we did during the second
16 initial study report.

17 So what conclusions could we draw from the
18 model results. In all cases the reaches appear to
19 be stable, which is consistent with the prior
20 findings, that it's in a state of dynamic
21 equilibrium, we showed trends of degradation, we
22 showed trends of aggradation, but over the long term
23 it's stable, consistent with what you could see in a
24 braided system.

25 The model sediment transport rate matched

1 the previous sediment transport line, calculated for
2 the second initial study report.

3 And then the transport, it is conveying at
4 capacity in all cases, so, again, consistent with
5 the previous findings, we find it to be a not supply
6 limited system, which is consistent with the regime
7 analysis performed showing it's a braided system,
8 it's a fundamental characteristic of a braided
9 system.

10 Moving on to Slide 138, to give you an
11 appreciation for the difficulty of performing
12 sediment transport calculations using RAS, there was
13 a lot of dark days, a lot of periods of instability.
14 At times, weren't sure if we were going to get the
15 model to stabilize. Some of the things that we
16 found in running the model that we would like to
17 caution anybody who is going to pick up the model
18 and make different operating scenarios is that you
19 have to take great care when you are making these
20 simulations. You need to be very consistent as to
21 what computer you are modifying the flow input
22 files, the start and stop dates.

23 What was very, very interesting, if we
24 made a simulation using a 32 -- a computer that had
25 a 32 bit processor versus a computer that had a

1 64 bit processor, we would get different results.
2 Not sure why, but we would get different results.
3 Also, when you modified a plan, a plan file within
4 HEC-RAS, which that tells the model which geometry
5 should I use, which flow file should I use, which
6 sediment file should I use, when you make
7 modifications using different computers, even though
8 when you look at the input files and they are
9 exactly the same you would get different results.

10 Lastly, if you -- and as we were trying to
11 evaluate why this is occurring, we would run a model
12 that had the same start date, but we would modify
13 the end date -- 20 years later we would modify the
14 end date. Early on in the simulation in Year 1 we
15 would get different results. We would modify it by
16 one day. And this is just ending the simulation.

17 So we would start it in 1987 and we would
18 change the end simulation date to 2006, we would get
19 different results back in 1987. We just modified
20 the end date. Not quite sure why that occurred. So
21 we were very, very careful to make sure we did all
22 of our modifications on Canseco to make sure that we
23 had consistent results through the process.

24 We are in the process of developing a --
25 kind of a memo that we are going to send to the

1 folks at HEC. They don't typically provide
2 technical support. It is public domain software,
3 but we just want to see if anyone else has
4 encountered these problems in running the sediment
5 transport models.

6 So a little bit of sympathy along the way.
7 But just to caution folks, when you are running
8 these, be very, very careful when you are making
9 adjustments within the input files.

10 That's all I had on the sediment transport
11 model, the development, the results, comparisons to
12 the prior studies. If anybody has any questions, I
13 would be happy to field those now. And also
14 remember Wednesday, the 14th, we are going to
15 probably -- we are going to dig into a little more
16 detail if you are interested.

17 JEFF RUNGE: I'm trying to integrate
18 all of the different aspects of the study here.
19 Based on the -- just using North Bend as an example
20 here, North Bend based on the Missouri River Basin
21 Commission study identified that there would be like
22 5,770,000 tons of sediment that would be transported
23 from these different tributaries like the North
24 Loup, the South Loup at North Bend. But when
25 looking at sediment transport at Site 4, there's

1 only, on average annual basis, 2,970,000 tons of
2 sediment that's transported by the flow to North
3 Bend from Site 4 on an average annual basis.

4 Is there an extension to this modeling, to
5 the HEC-RAS model, or any other models in place that
6 would explain the difference that would explain for
7 these other mechanisms that would allow for the
8 sediment to come from these different subbasins to
9 North Bend, to explain that difference on an average
10 annual basis?

11 PAT ENGELBERT: So you are talking
12 the supply that comes off of the basin in the form
13 of erosion and those types of things?

14 JEFF RUNGE: Exactly.

15 PAT ENGELBERT: I am not aware of a
16 model that would evaluate rainfall runoff
17 concentrations coming off the basin and then
18 performing sediment transport within the system.
19 Gary, I don't know. George? I'm not aware of any
20 model.

21 GARY LEWIS: If you write it, I would
22 like to have it. Yeah, I've not encountered that.

23 PAT ENGELBERT: I'm not aware.

24 JEFF RUNGE: Well, the Missouri River
25 Basin Commission is not a model but an assessment

1 that can come up with that number, can develop that
2 number, but the mechanisms aren't really explained
3 as to how that gets transported to or from outside.

4 PAT ENGELBERT: My understanding of
5 the commission report is they evaluate it based on
6 ground cover and average annual rainfall. This is
7 the amount on average, the average annual supply of
8 sediment. And then what we were able to evaluate is
9 what is the capacity of the system to convoy that
10 sediment.

11 Any other questions?

12 I think we might be just in time for
13 lunch.

14 STEPHANIE WHITE: We are ten minutes
15 early. So lunch will be delivered at 12:00. You
16 will have a few minutes to yourself. Lunch will be
17 served, and we will reconvene at 1:00.

18 (11:51 a.m. - Recess taken.)
19
20
21
22
23
24
25

1 (At 1:00 p.m., the following proceedings
2 were had, to-wit:)

3 STEPHANIE WHITE: Okay. We have Isis
4 Johnson and Janet Hutzal from FERC. Those are our
5 only phone participants. So far we expect Paul in a
6 little bit, and Marcus won't be with us this
7 afternoon. So, Matt, I'm going to turn it over to
8 you.

9 MATT PILLARD: Okay. I'm going to
10 try to do this without the microphone. Can everyone
11 hear me okay?

12 This afternoon we are going to start the
13 last part of our discussion here today on a species
14 summary of the interior least tern and piping
15 plovers.

16 At our last meeting, the second initial
17 study results meeting, there was a discussion kind
18 of near the end of that meeting talking about how
19 can we pull kind of the information from all of the
20 studies together, look at that in a way that focuses
21 then on the impact to the species or focusing on
22 issues that might deal with the species, and so what
23 we tried to do then is to take the results from the
24 sedimentation study, the results from the
25 hydrocycling study, the results from the flow

1 depletion to flow diversion studies, those separate
2 studies, and then look at them and then how
3 combined, you know, how do these affect habitat and
4 how do these affect species and what can we learn by
5 looking at kind of all of these things in
6 culmination.

7 The other thing that we did in the species
8 summary was some pretty simply I'll call it
9 re-discussion I guess of areas of interest or
10 statistics relative to the species themselves. So I
11 will kind of go through these. It's not going to be
12 new information. It's just getting our mind frame
13 set again to the species that we were focusing on.

14 You know, obviously the interior least
15 terns was one of the species we wanted to look at
16 the culmination of the studies on. They winter in
17 South America. They arrive in Nebraska in early May
18 to mid June. They spend about four to five months
19 here. Their breeding range extends from Montana to
20 Texas and from Southern Indiana to New Mexico.

21 Lott did a census back in 2006 that looked
22 at what are the distribution of those least terns.
23 You can kind of see there they range -- they are
24 pretty heavy there, over half on the lower Missouri
25 River system. The Arkansas River system carries

1 about 11 and a half percent. The Red River,
2 10.4 percent. Missouri River system around 7
3 percent, and the Platte River system about
4 4.5 percent. Again, that was in 2006.

5 Just a little background information then
6 on the piping plover. They winter in the southern
7 Atlantic coast in the U.S. They also winter in the
8 Gulf of Mexico coast, in the Unites States and
9 Mexico, and the Caribbean islands. Again, similar
10 to the least tern, they arrive in late April and
11 early May, and they spend about three to four months
12 here in Nebraska at the breeding sites.

13 Their breeding range includes northern
14 Great Plains from Alberta to Manitoba and south here
15 to Nebraska, the Great Lakes beach areas, the
16 Atlantic coastal beaches from Newfoundland to
17 North Carolina.

18 The most recent information we have on the
19 general population for the piping plovers came from
20 the breeding census of 2006, and over half of these
21 were found in the United States and northern
22 Canada -- and Canada Northern Great Plains regions
23 and the Prairie Canadian regions.

24 Kind of focusing on the habitat here in
25 Nebraska then, because that's really what we are

1 interested in from the project perspective, you
2 know, what do the least terns, piping plovers, what
3 do they use for habitat here in Nebraska.

4 They nest on barren sandbar and gravel
5 shores and islands of rivers and lakes. The size
6 and the heights of sandbars, there's probably a lot
7 of discussion on these. I pulled a few -- some of
8 the information from the species summary as well as
9 the PAD on these species. Size of islands for
10 terns, it can vary, but 3.58 acres was what was
11 found by the Kirsch study in 1996 as a general size
12 and about 3 feet above the water is what they were
13 finding on average, I believe, for those. And I'm
14 sure, Mary and Joel, you probably know these
15 backwards and forwards. I'm simplifying some things
16 here, so if I misstate an average versus an actual
17 number, let me know, but it kind of gives us an idea
18 of the size of habitat that we are talking about
19 that they found them on.

20 And then here, obviously, Brown and
21 Jorgensen, their 2008 study, a little bit larger
22 size on average they found in that particular year,
23 and the height they were finding was about 2.29 feet
24 above the water level. I don't know if we can trust
25 that data or not.

1 But the piping plover information, we were
2 finding, you know, 3.89 acres in size for our first
3 sandbar and about .6 feet above water level. I
4 think the Ziewitz study found that through the
5 different studies that -- information that he was
6 using that a good size for piping plovers would be
7 about 3.58 acres size and about 1.48 feet above
8 water level.

9 So you can kind of see that the two
10 species vary a little bit on size and height above
11 water level.

12 I don't know -- you know, I suppose this
13 number is currently being worked on as we learn more
14 about the birds. This isn't an end-all-be-all for
15 what they like, but the most recent information that
16 we have and what's been studied.

17 We also know that at least here in
18 Nebraska sandpits are highly used habitat. We know
19 that those are areas they've been using, including
20 the District's North Sand Management Area. They
21 have been monitoring that more regularly now since
22 2009, I believe, to monitor those birds on that
23 particular parcel.

24 Kind of summarizing some of the threats
25 that exist here in Nebraska as well as, you know,

1 nationally, I guess, to tern and plovers. This is
2 back from a five-year review information that was
3 issued on least terns from the Service. This first
4 one is little dated, but I think that the threats
5 are still prevalent.

6 Habitat alteration and destruction was
7 listed as a main threat. Human disturbance was
8 listed as another threat to the species' existence,
9 specifically due to recreational and commercial
10 development activity in their habitat areas.

11 Piping plover, information again from the
12 five-year review. This is from 2009. Destruction
13 of the wintering habitat due to human development.
14 Reservoirs, channelization, and flow modifications
15 were a concern, predation, human disturbance again,
16 and vegetation encroachment, you know, losing those
17 sandbars and those areas to vegetation versus the
18 barren nature that the birds like.

19 Kind of to summarize, review of agency
20 concerns as we began the scoping process for this
21 project and developing the studies way back a couple
22 years ago when we started the process, kind of
23 summarize a few of the issues here relative to terns
24 and plovers.

25 You know, habitat may decrease in

1 suitability due to material changes in the Loup and
2 the lower Platte River sediment transport regime.
3 That was one of the issues that was brought up early
4 on in the study as a concern. Habitat diversity,
5 connectivity, and suitability may diminish in the
6 lower Platte River due to erosion of sandbars by
7 project hydrocycling operations. Project
8 hydrocycling operations may cause an inundation of
9 interior least tern and piping plover nests on the
10 lower Platte River. And the last one, habitat
11 connectivity and suitability may be diminished in
12 the Loup River bypass reach due to the diversion of
13 flows.

14 I believe these agency concerns also
15 grouped in pallid sturgeon as well, but the last one
16 probably being more specific to the pallid sturgeon
17 than the interior least tern or piping plover.

18 So that was kind of a quick summary of
19 some of the concerns. I'm going to, again, kind of
20 summarize the study results here and then pull that
21 together on how to -- how we group that with the
22 species themselves. So this is just a little
23 summary of each of the studies.

24 The sedimentation study, one of the
25 results was that the Loup River bypass reach and the

1 lower Platte River are not supply limited. That we
2 are in a state of -- well seated in a state of
3 dynamic equilibrium. These systems aren't aggrading
4 or degrading on a long-term trend basis. That these
5 rivers exhibit a braided morphology and they are
6 well within that regime of a braided river system.
7 And based on the statistics work that we did, the
8 first -- you know, for both studies, the updated
9 study plan as well as the initial, that we couldn't
10 find a statistical relationship between the nest
11 count variability and river mile location. And,
12 again, that was on the statistics that we had just
13 performed.

14 From a hydrocycling perspective, from that
15 study, the summary of those result were that project
16 hydrocycling operations result in higher flows and
17 stage on a daily basis than a run-of-river scenario.
18 We found that natural seasonal variability is equal
19 to or greater than those hydrocycling effects. That
20 was that benchmark kind of studies that we were
21 looking at before that we went over last February.

22 The differences in flow and stage between
23 current operations and run-of-river operations
24 diminished with increased flow. The existence of
25 the benchmark flows are a result of natural high

1 flow events, those big events during whatever time
2 of year that would cause those, normally spring and
3 late summer. All benchmark exceedances under
4 current operations were due to high flow events that
5 also caused benchmark exceedance on run-of-river
6 scenarios.

7 Hydrocycling operations results in
8 slightly more sediment transport than run-of-river
9 operations. However, as we kind of discussed and
10 revalidated, that the system is transporting at
11 capacity, and degradation on a long-term basis is
12 not occurring.

13 The flow depletion and flow diversion
14 study. This looked at flow depletions on the Platte
15 River as well as potential flow depletions on the
16 Loup River.

17 From the Platte River perspective, we
18 identified that based on project operations there
19 are no depletions occurring on the Platte River. On
20 the Loup River, in comparing those two systems --
21 I'm sorry, the Loup River, comparing the differences
22 between above the diversion and below the diversion
23 that there is a difference in the physical
24 characteristics of the channel above and below the
25 Diversion Weir.

1 And in trying to analyze the bird
2 information, the nest counts or other, above and
3 below the Diversion Weir, there wasn't enough bird
4 data to really ascertain the differences in
5 these physical -- in the differences of physical
6 characteristics and the impact by the use of the
7 terns or the plovers.

8 So that was kind of a brief summary of the
9 studies and a little bit of a summary on the species
10 themselves. So kind of the collective analysis
11 then. As we look at, you know, how do these
12 different studies affect the elements of the
13 species. We broke that down into how does this
14 maybe affect sandbar formation. We know the birds
15 use the sandbars in the river. How do these studies
16 affect sandbar formation and kind of reiterating
17 that we -- you know, we have identified through our
18 studies that the system is not supply limited and
19 that sediment removal from the canal would not limit
20 then the supply for potential sandbar creation, and
21 that sediment removal from the system would not
22 create a sediment deficit that would potentially
23 erode those sandbars at a faster rate. Again, this
24 is over the long-term.

25 And then we know that the system is in a

1 state of dynamic equilibrium indicating the channel
2 morphology, that we are in a braided channel, that
3 exist under the current operations and has shown to
4 provide tern and plover habitat. The birds are
5 using the system as it is today.

6 And as a result of not being a
7 supply-limited system and if the system is seated in
8 a braided river system, the effects of hydrocycling
9 was not shown to affect sediment supply available
10 for sandbar creation.

11 We also then kind of looked at how this
12 might affect suitable habitat availability. We know
13 that nest distribution -- in looking at the
14 statistical analysis that we did, that the nest
15 distribution variability was not related to the
16 proximity to the tailrace return or by river mile,
17 that that variability and nest distribution was not
18 related by location, so it would appear that the
19 tailrace itself or the proximity to the tailrace was
20 not a factor for nest site selection.

21 We looked at -- one of the statistical
22 things that we also looked at identified that that
23 period of relatively high counts, from '87 to '95,
24 was followed by a drop, but a static count again
25 from '95 to 2008, between those 30 river miles that

1 we looked at. I think we had a little bit of
2 discussion before. Project operations have remained
3 during that time period. There was a factor or a
4 series of factors that might have caused that drop,
5 but the operations of the project were consistent
6 during that time period.

7 Kind of more from a hydrocycling
8 perspective, kind of looking at that study and what
9 it means. We do know that daily fluctuations in
10 stage due to hydrocycling affect that wetted fringe
11 of a sandbar that serves as habitat. This effect is
12 greatest when upstream Platte River flows are the
13 lowest. This effect also is expected to diminish as
14 you move downstream. However, kind of stating back
15 again, we didn't find that correlation between
16 location of the tailrace to nest count variability.

17 We know that there are many factors that
18 probably account for a bird determining suitable
19 habitat on a year-to-year basis, like flows,
20 predation, that wetted fringe difference is probably
21 a factor in that as well, nesting disturbance due to
22 recreation or other means. Many factors, you know,
23 go into determining suitable habitat.

24 Kind of when analyzing the Loup River
25 physical characteristics, there are differences in

1 channel widths above and below the Diversion Weir.
2 It was wider channel above, narrower channel below.
3 That project operational changes are limited with
4 respect to altering those physical parameters.

5 You know, a change in operations may or
6 may not affect how that river channel looks below
7 the weir.

8 There hasn't been any morphological
9 changes in the Loup River system over the last
10 25 years. And based on the existing conditions that
11 are there, no change in morphology is expected if
12 conditions remain the same.

13 That's how we summarized, I guess, looking
14 at all of the different studies combined. I'm sure
15 there's some questions that we have on how we did
16 that or questions on how we came to some of those
17 conclusions.

18 JOEL JORGENSEN: I guess I have some
19 questions or comments regarding, particularly --
20 Joel Jorgensen, by the way -- Slide 153, sort of
21 when you are concluding things here.

22 You are discussing suitable habitat
23 availability is the top point there, and you are
24 using the analysis using the tern and plover data,
25 the nest count information, which was -- I mean,

1 that analysis was an exploratory analysis, and you
2 didn't find any significant relationships, which is
3 not a surprise given all of the variability and all
4 of the issues and that noise that goes along with
5 that data. So I guess, you know, there wasn't any
6 significant relationship that was detected, I guess,
7 and that's sort of where that should have been left.

8 MATT PILLARD: Okay.

9 JOEL JORGENSEN: Because that
10 doesn't that -- I think there's just a very high
11 probability for an error with that analysis, and
12 then trying to make the next step and make a
13 definitive conclusion that proximity to the tailrace
14 is not a factor I think is over- -- overemphasizing
15 the results from that analysis.

16 MATT PILLARD: Okay.

17 JOEL JORGENSEN: And then also too, I
18 guess with that statement the way it's written on
19 there, you have nest site selection specifically
20 mentioned, and when you are talking about nest site
21 selection, that -- I mean, from an ecological
22 definition and from a methodological standpoint, if
23 you are talking about site selection, you are
24 talking -- I mean, that implies that there was some
25 assessment of the habitat availability in the system

1 at the time when you were assessing how birds were
2 selecting a site. And from this analysis, there was
3 no consideration of habitat during those specific
4 times when birds were making selections about where
5 they were going to put down nests.

6 MATT PILLARD: This was just count
7 data.

8 JOEL JORGENSEN: Right. And, again,
9 there's -- you are making a leap there.

10 MATT PILLARD: Okay.

11 JOEL JORGENSEN: And since habitat
12 wasn't part of the equation and was not considered,
13 again, I think it's a tenuous statement to say that
14 definitively.

15 And, again, with the second point here, I
16 pointed this out earlier.

17 MATT PILLARD: Yeah.

18 JOEL JORGENSEN: The -- having these
19 two sentences or statements right next to each other
20 sort of implies that because you have a constant --
21 because operations were constant, I don't know
22 what -- I mean, is that implying something there
23 about -- you know, that project operations aren't
24 having an effect? It's sort of implied, I guess,
25 the way it's presented here, but it's really

1 probably not an appropriate relationship to state
2 because, again, it could -- that relationship
3 there -- I mean, that statement could have been
4 strengthened if you would have shown from
5 a different stretch of the river nest counts
6 remained relatively constant, if there was some sort
7 of a control to compare that to.

8 MATT PILLARD: Okay.

9 JOEL JORGENSEN: Again, I'm concerned
10 how that is presented in that slide.

11 So that will conclude my remarks. Thank
12 you, Matt.

13 MATT PILLARD: Thanks, Joel.

14 ISIS JOHNSON: I have a couple of
15 questions, Matt.

16 MATT PILLARD: Go ahead.

17 ISIS JOHNSON: Okay. I guess my
18 first question was looking at Slide 151, you know,
19 when we are talking about removal of sediment from
20 the canal and that it doesn't create a supply
21 limited system. I guess one of my questions would
22 be whether there was any discussion in any of your
23 results and your conclusions about how -- even
24 though you have shown throughout your studies that
25 we are at a state of equilibrium, if you discussed

1 at all how that equilibrium might be different if
2 the sediments hadn't been removed, for example.

3 MATT PILLARD: Let me try to restate
4 the question. How might the equilibrium be
5 different if the sediment weren't removed?

6 ISIS JOHNSON: Right. I think -- or
7 at least some of my thinking is that, you know, I
8 don't think anyone is contesting that it's a state
9 of equilibrium, but it may be at a different state
10 than it would be without the hydrocycling and
11 without removal of sediment. So I guess from my
12 perspective and in looking at project effects, we
13 would want to look at how current operations have
14 essentially changed the system now but also how they
15 are going to potentially change in the future.

16 MATT PILLARD: Okay. I think the
17 best way to address that might lean on Gary or Pat.
18 I think some of the analysis that we looked at
19 relative to how it's seated in the braided river
20 system might be the best way to answer that. Pat or
21 Gary, I might defer to you to expand on that.

22 PAT ENGELBERT: Isis, it sounded like
23 there were two questions in there. Can you separate
24 those for me?

25 ISIS JOHNSON: I can do my best.

1 Essentially I guess the first question
2 that sort of popped into my mind is that we keep
3 talking about the fact that, you know, the river is
4 behaving like a braided system and it's in a state
5 of equilibrium. I guess my question is -- I guess
6 maybe I will start here. If the sediment, for
7 example, wasn't being removed -- I mean, I think
8 it's obvious. You can look at any Google Earth map
9 and sort of see that conditions in the way that the
10 sandbars are being developed and being formed is
11 different, you know, above, you know, the project
12 diversion and below and that even though the
13 system within -- I guess that's being affected
14 primarily by project operation is in a state of
15 equilibrium, it looks considerably different from
16 the system both above and below the project
17 location.

18 So I guess my question is that in your
19 conclusion or in your discussion if there's any --
20 if there's any discussion of how that state of
21 equilibrium may be different from what's happening
22 both above and below it and whether that's either
23 beneficial to, detrimental to, or has no effect on
24 the presence of piping plovers or least terns. Does
25 that make sense?

1 PAT ENGELBERT: I can address the
2 first part relating to the removal of sediment from
3 the system, how would that have impact or effect on
4 the dynamic equilibrium.

5 The capacity of the system downstream of
6 the weir is based on the current condition of the
7 channel. And we have shown that after the sediment
8 is removed, the channel and its capacity is -- has a
9 value of X, and that does exceed the supply when
10 taking into consideration that that supply has been
11 removed.

12 We made a statement at the previous -- the
13 second initial study report that the channel
14 downstream of the weir would look very similar to
15 the channel upstream of the weir, you know, given
16 the fact that they -- if they were to divert for
17 some significant period of time. So I think our
18 statement was that it has reached a state of
19 equilibrium based on the current operations of the
20 system.

21 LISA RICHARDSON: I have a question I
22 want to clarify because I heard a little different
23 question than you answered, Pat.

24 Pat, I think you were referring to the
25 Loup River, right?

1 PAT ENGELBERT: The bypass, yes.

2 LISA RICHARDSON: Yes, the bypass
3 region. Isis, I thought you were asking about the
4 Platte River.

5 ISIS JOHNSON: Right.

6 LISA RICHARDSON: And you are
7 suggesting that there's differences in the Platte
8 River upstream of the return weir?

9 ISIS JOHNSON: Right.

10 PAT ENGELBERT: Okay. I
11 misunderstood. Again, what our analysis has shown,
12 and if you look at the survey data as well as the
13 modeling results, the hydraulics associated with
14 Site 3 do differ from the hydraulics associated with
15 Site 4, and it appears that the channel has adjusted
16 itself to the point of its carrying capacity
17 downstream of the weir matches the amount of
18 sediment that's coming in. The survey results that
19 we showed didn't show any degradational trends, the
20 modeling that we did didn't show any degradational
21 trend -- long-term degradational trend. So in our
22 view it appears to have adjusted.

23 Now, how it would respond without the
24 elimination of that -- of that sediment, we didn't
25 evaluate that per se, but I would -- I would

1 estimate the fact that the supply -- and, again,
2 it's two different analyses of how the supply is
3 calculated versus the capacity. The supply still
4 far exceeds its capacity to convey even with the
5 dredged amount being pulled out of the system.

6 Now, how does that affect birds and
7 habitat, I don't have an answer to that question.

8 ISIS JOHNSON: Okay. I guess from my
9 standpoint, again, I mean, I guess I was just sort
10 of wondering whether this -- if this was something
11 that you guys had considered in your -- not
12 necessarily when collecting data but in terms how
13 you get to your conclusions or how -- you know, the
14 way that you sort of worked your way through your
15 discussion of the results of these studies because
16 what I'm going to have to do is look at different
17 scenarios to see what type of effects are happening
18 to the bird habitat and also how those impacts can
19 potentially be mitigated.

20 So I guess for me -- it would be helpful
21 if there was some discussion of -- you know, even
22 though the Platte above the diversion return is --
23 or before the tailrace return, I'm sorry, is in a
24 state of equilibrium and isn't supply limited that
25 there are definite differences between that part of

1 the river and what's happening below. And so, I
2 mean, there's a lot -- I know that there's a lot of
3 factors involved in that, but in sort of making
4 definitive conclusions, you sort of need to have
5 discussions of all of these sort of potentially
6 different alternatives because that's what we are
7 going to be basing our analysis on. Does that make
8 sense?

9 MATT PILLARD: George?

10 GEORGE WALDOW: George Waldow.

11 I'm not sure what you mean by all of these
12 alternatives, and I'm also hearing the term
13 equilibrium used without dynamic. I think that
14 needs to be clarified. It's in general equilibrium.
15 It doesn't mean that it doesn't vary.

16 ISIS JOHNSON: Sure.

17 MATT PILLARD: I guess from the
18 alternatives perspective, I think what you are
19 asking, Isis, is part of the conclusions of these --
20 in using these studies, can we use these to look at
21 alternatives such as -- I will just say a no bypass
22 scenario where none of the water is in the canal and
23 it's all going down the river and how might that
24 change the bypass reach, the portion of the Platte
25 River that's between the Loup confluence and the

1 tailrace return, and below the tailrace return, how
2 might that change or affect habitat, and is that
3 better or worse for the species from a habitat
4 perspective? Is that kind of what you are thinking?

5 ISIS JOHNSON: Right. That's part of
6 it. I guess what I'm saying is that in making
7 conclusions and sort of saying that there is an
8 effect or there is not an effect, you kind of have
9 to qualify it and say, Well, under these conditions,
10 you know, we don't think that there's an effect. Or
11 the effect, you know, based on run-of-river
12 operations, which we have talked a lot about today,
13 is different from impacts based on hydrocycling.
14 And so I just want to make sure that there is some
15 discussion of that when we get to the end of all of
16 this because that's the information that I'm going
17 to need to use when doing my analysis. Does that
18 clarify?

19 MATT PILLARD: Yes.

20 GEORGE WALDOW: We have a very
21 pregnant silence going on here. I will speak up,
22 but it's still unclear to me, Isis. And maybe it's
23 the way it's written or presented that we are not
24 being -- communicating, but my interpretation here
25 is that the -- given the information on sediment

1 transport and on hydrocycling that we have discussed
2 earlier in the meeting, these conclusions that Matt
3 presented and summarized here, granted it's not in
4 maybe the detail that you need for your analysis,
5 but my interpretation of it is that we have done
6 this -- done the studies, evaluated the study
7 results with respect to the birds and their habitat
8 and their utilization or nonutilization.

9 I don't see that we are able to present
10 conclusions other than what we have said. I don't
11 see that there's -- there's more factual -- more
12 scenarios that we can factually bring out from the
13 study results.

14 And I'm hoping if someone wants to say
15 that maybe we are -- is there some door that we
16 haven't opened here that we have the information to
17 do so with with respect to the birds and their
18 utilization?

19 ISIS JOHNSON: I think what I'm
20 saying is that you are making conclusions and that
21 you are even stating that based on the results of
22 these studies that these are the impacts, and I
23 guess what my question is is that seems like there's
24 a -- and maybe there's nothing to be done about this
25 but that there is sort of a bit of a gap between

1 where the results end and your conclusions begin,
2 that there could be -- I mean, again, maybe it's
3 just the way that they are presented thus far and
4 maybe it's just based on the information that I have
5 read in the -- in this last report that's been
6 filed, but it seems as though they are sort of this
7 is the data that we have and so things are in
8 equilibrium and so there is no effect. And I guess
9 what I'm looking for is a little bit more detailed
10 description of what you mean by that, that there's
11 no impacts at all and this is why, or there are more
12 impacts on this scenario and not on the other.

13 Again, if what you are saying is that we
14 have presented all that we have and there's no --
15 and there's nothing else that, you know, that you
16 have to sort of qualify your conclusionary
17 statements, then that's what I will have to make --
18 do my analysis based on.

19 I was just sort of asking if there was
20 more discussion on, you know, even though -- the
21 fact that even though the system is in a state of
22 dynamic equilibrium, if there's been any thought to
23 the fact that it could be in a different state of
24 dynamic equilibrium than it would be if certain
25 things were or were not occurring.

1 MATT PILLARD: Rick Holland had a
2 comment.

3 RICK HOLLAND: This is Rick Holland
4 from the Game and Parks Commission.

5 It seems to me that from the questions
6 you've been asking that you're looking at a
7 different question than what the HDR analysis was
8 aimed at. They were looking at the scenario that
9 compare run-of-river as the base scenario given the
10 project as a given, that its presence would be here,
11 and then comparing it to hydrocycling and what
12 impact that would have. Their conclusion is derived
13 from that analysis. The question of whether or not
14 there has been an impact by the project itself is a
15 different question, and we were informed that that
16 was not something FERC was considering as part of
17 this, that the project was given; is that correct?

18 ISIS JOHNSON: Right. And that's not
19 the question that I'm asking.

20 RICK HOLLAND: It kind of sounded
21 like it was when you were talking about putting a
22 scenario with no sediment restrictions on there, so
23 I think what you've characterized sounded to me like
24 a nonproject scenario, which we would consider, of
25 course, but I think FERC is --

1 MATT PILLARD: Just a second, Isis.
2 Can you start this last comment over? Just start
3 now, I guess.

4 ISIS JOHNSON: Okay. I guess my
5 question is that whether or not -- I mean, we keep
6 using this term that the river system is in a state
7 of dynamic equilibrium. I'm not talking about going
8 back to pre-project. What I'm saying is if -- if
9 the water is still being diverted and we are just
10 letting the water run through there's going to be
11 certain things that are happening, if we are
12 hydrocycling there's going to be certain things that
13 are happening, and if we are removing sediment
14 there's certain things that may or may not be
15 happening.

16 And so I guess my question was, which is
17 what my original question was, is that with removal
18 of the sediment, even though it's not creating a
19 supply-limited system, I was wondering whether there
20 was any discussion of what might be different if the
21 sediment wasn't being removed. I'm not talking
22 about taking out the project and taking out the
23 canal and having a no diversion scenario. What I
24 said originally was that if there was any discussion
25 of whether or not the amount of -- I mean, I know

1 that we are talking about, you know, the fact that
2 there's no aggradation or degradation over the
3 long-term, but I'm wondering if there was any
4 discussion of how the river might be -- how the
5 bypass reach might be different if -- or the river
6 bed might be different if the sediment was not being
7 removed, or less -- or, I'm sorry, a lesser amount
8 of sediment were being removed. Even though it's
9 not creating an aggradation or degradation, whether
10 that was something that was discussed. That was my
11 question.

12 I didn't articulate that clearly
13 initially, but that was what I was trying to get at.

14 LISA RICHARDSON: Okay. I think that
15 part of our confusion on it is that really it's not
16 possible to operate the project without removing
17 sediment, and you really can't remove less sediment.

18 NEAL SUESS: The sediment basin --
19 Isis, this is Neal Suess with Loup Power District.
20 The sediment basin would fill up and you could not
21 divert any water if you did not dredge the -- did
22 not remove the sediment from the sediment basin.
23 Therefore, I mean, if you didn't remove sediment,
24 within a year or two, you would not have a project
25 anymore. The canal -- you couldn't get water into

1 the canal, and therefore you would be back to
2 pre-project operation.

3 ISIS JOHNSON: Thank you for
4 clarifying that because that wasn't -- that wasn't
5 part of my understanding.

6 NEAL SUESS: Okay.

7 JEFF RUNGE: One point though I
8 think, maybe to add on top of what Isis has said,
9 and maybe -- maybe she wasn't implying this, but for
10 me this is my perspective, there's a lot of discrete
11 studies that are evaluated discretely and reported
12 discretely, and there's no integration -- or there
13 is some integration, but there needs to be that
14 integration from geomorphic effects to how does that
15 affect habitat to how does that affect the species,
16 and then that will help to make the -- likely to
17 adversely affect or not likely to adversely affect
18 determination.

19 One example that I pointed out this
20 morning is that one metric that was being used was
21 effective or dominant discharge and sediment
22 transported, but a lot of the -- and the purpose of
23 effective and dominant discharge was to look at
24 long-term -- a long-term effective or dominant
25 discharge and how that affects channel morphology

1 over the long-term, but in the -- I forgot the
2 ordination or principal component analysis, but this
3 was evaluated on an annual basis. And there was no
4 comparison about, Okay, this stretch has this
5 effective or dominant discharge, this stretch had
6 this effective or dominant discharge, and there
7 wasn't a comparison of species use to your metric
8 that you use for geomorphology and that integration,
9 that step from geomorphic to habitat to species use
10 wasn't made. So I guess that's what I would
11 recommend is to encourage that the integration of
12 your studies to come up with that final
13 determination.

14 MATT PILLARD: Okay. We did try to
15 look at how river mile -- you know, we look at nest
16 counts by river mile. Is there anything that can be
17 explained in those nest counts variation by river
18 mile, so that part we have tried to look at. Maybe
19 we can build on that for what you are saying, Jeff.
20 I'm not saying that's the end of it, but...

21 JEFF RUNGE: To integrate the results
22 with the metrics that you have already developed.

23 RICK HOLLAND: The problem is a
24 question of scale. We are talking about reaches
25 that have certain length of river, which has been

1 described hydrologically through sediment transport.
2 It may be too large of a stretch for us to define
3 the impact that the project is having in terms of
4 degradation versus aggradation. It may be too short
5 of a stretch of river that is being impacted
6 compared to the overall equilibrium of the 10-mile
7 or 20-mile or 30-mile stretch of river. If someone
8 wants to pay for that kind of detailed hydrologic
9 analysis, we can probably get there. Do you have
10 another 5 million?

11 JEFF RUNGE: Well, and we recognize
12 too that there's a lot of effects that -- that the
13 effect determination doesn't necessarily have to be
14 solely contained within the study analyses.

15 One example is the sand management pile,
16 the north sand management area, to where we have
17 worked with the contractors there that removed that
18 sediment and we worked with the Loup to develop a
19 berm so that you don't wash out nest. Well, that is
20 a direct effect to a species that is due to -- a
21 potential effect that is due to District operations,
22 and that -- there's no need for an analysis, but
23 that is a potential may-effect situation that needs
24 to be considered.

25 And so look at your entire effects and

1 make sure that they aren't necessarily contained
2 within -- you know, to also consider the effects not
3 necessarily contained within the studies.

4 Another one you mentioned, the wetted sand
5 area and how that changes longitudinally, there
6 wasn't a study, but there could be potential effects
7 from that. It's just that there's no way within a
8 two-year study that you could quantify those
9 effects.

10 JOEL JORGENSEN: Sort of echoing some
11 the same things I said earlier. There are just some
12 very severe limitations that we know about with the
13 data. We can't retroactively go back over the past
14 25 years and look at what was in the system. But,
15 again, with that said, I think it just needs to
16 be -- we need to be very cautious about making
17 conclusions because -- based on some metric such as
18 nest counts, which if we are thinking about habitat
19 suitability, I mean, some definitions of suitability
20 explicitly incorporate within it, you know, a level
21 of reproduction -- successful reproduction. And I
22 know that would be desirable.

23 If there's problems with what's available,
24 and I don't think it's faulting anybody, what they
25 are trying to do, it's just sort of the way it was.

1 But I don't -- I think there's still -- just the --
2 the data that's available, the analysis has such
3 limitations that I think concluding that there's no
4 effect, I mean, is probably a precarious conclusion
5 to make given the limitation of the science that's
6 available, so...

7 MATT PILLARD: I think some of the
8 things Jeff was talking about he started using the
9 language that would be discussed as part of the
10 biological assessment. That is kind of a next step
11 that is going to be developed -- and I don't want to
12 skip ahead to the next steps because I don't want to
13 end this discussion yet, but Lisa will handle kind
14 of the next steps after this and developing that
15 preliminary license proposal is part of that next
16 step as is developing that biological assessment
17 that ultimately then looks at these different
18 factors and will ultimately be a decisionmaking
19 process of an effect determination through that
20 biological assessment process.

21 JEFF RUNGE: The other thing too
22 is -- I forgot the title. There's a title about
23 sediment and the sturgeon. Let me find that. But
24 when you don a biological assessment, a single
25 effect to a single individual, so if there's a

1 potential to wash out a single egg, if there's a
2 potential to affect a single pallid sturgeon, that
3 constitutes a may effect under The Endangered
4 Species Act, and so that's the job of the biological
5 assessment is to identify those effects to
6 individuals and to try -- attempt to quantify what
7 that effect is.

8 Now, the significance of the effect,
9 whether or not that effect is important or not
10 important to the species, that role is done by the
11 Fish and Wildlife Service under a biological
12 opinion, and there's a lot of information. You have
13 to look at how the species is doing, you have to
14 look at the recovery objectives of the species and
15 whether or not this local area or regional area is
16 supporting those objectives, you have to look at the
17 threats to the species, and the accumulative effects
18 to the species. And so there's really a large
19 amount of information that we are required to
20 evaluate when looking at the importance of those
21 effects to the species.

22 So I guess, again, to keep your focus on
23 those effects to individuals versus whether or not
24 it's important to the species as a whole.

25 MATT PILLARD: Okay.

1 LISA RICHARDSON: I guess I would
2 give the folks on the phone one more chance. I'm
3 not certain if we answered all of your questions or
4 not.

5 ISIS JOHNSON: I have one more
6 question. On Slide 155 there's a statement that
7 says, Project operational changes are limited with
8 respect to altering physical parameters. Can you
9 clarify what that means exactly?

10 MATT PILLARD: Yes, Isis.

11 The question is can we clarify the second
12 bullet, Project operational changes are limited with
13 respect to altering physical parameters. All that
14 is simply saying is that based on the existing
15 project operations there's little that can be done
16 project operation-wise that could alter the physical
17 parameters below the Diversion Weir.

18 ISIS JOHNSON: Okay. Thank you.

19 MATT PILLARD: It goes back to your
20 sediment removal discussion. You can't decide to
21 remove less sediment or more sediment or introduce
22 more or less. The system operates the way the
23 system operates.

24 ISIS JOHNSON: Okay. That's helpful.
25 Thank you.

1 STEPHANIE WHITE: Any other questions
2 from those of you participating on the phone today?

3 JANET HUTZEL: No.

4 STEPHANIE WHITE: We are going to
5 move to Slide 157, which takes us to the last part
6 of our agenda, which is next steps.

7 Lisa?

8 LISA RICHARDSON: Okay. This is
9 really just a rehash of the next steps slide that I
10 showed at the beginning of the presentation.

11 With respect to the studies, those first
12 four bullets are really with respect to the studies.
13 As I mentioned earlier, on September 23rd, the
14 District will file a summary of this meeting, and
15 then that kind of sets the time frame for agencies
16 to provide comments both on the summary and on the
17 studies themselves, and so those comments from
18 agencies will be due October 24th. And that is also
19 the time that -- the deadline for any requests for
20 additional analysis or new studies, anything like
21 that, that any of these requests must follow the
22 FERC process and identify the rationale for why a
23 study is requested and why it's requested now, is
24 there new information available, or something to
25 that effect.

1 So then on November 23rd, the District
2 will file responses to all of the comments and
3 questions that have been provided by agencies.

4 And then December 23rd, FERC will make a
5 determination as to whether there's anything else
6 that needs to be done study-wise or not.

7 In the middle of that, November 18th is
8 when the District will be submitting a draft license
9 application. And then April 16th of next year is
10 when the official license application will be filed.
11 And there is a comment period in there between the
12 draft license application and the final application.
13 I believe -- I may have that on my next slide.

14 So, yes, February 16th is when the
15 comments would be due on the draft license
16 application and a draft biological assessment if
17 that is filed with the draft application. Then
18 about the middle of February is when comments would
19 be due, and then the District would review those and
20 make any changes that they would see necessary for
21 the actual license application for April 16th.

22 So that -- that kind of starts the
23 Section 7 process officially when the draft EA is
24 submitted. Our intent is to submit a draft EA with
25 a draft license application so that the comments

1 would be reviewed -- received by mid February and
2 then hopefully incorporated.

3 I think I have one more slide.

4 And then beyond that, there's more steps
5 into the process, and these kind of get into the
6 post-filing steps. Around July 1st is when we would
7 expect that the application would be accepted and
8 ready for additional analysis. That's kind of --
9 ready for environmental analysis. That's based on
10 an idea that the application as submitted in April
11 will be determined to be adequate by FERC, that they
12 don't have additional information requests that they
13 need. It's possible that there will be something
14 that they need and it won't be quite ready for
15 environmental analysis, but that's kind of an
16 approximate time frame.

17 Sixty days after that is when comments are
18 due again from agencies regarding recommendations
19 and preliminary terms and conditions or fishway
20 prescriptions.

21 And then right around May of 2013 is when
22 FERC is anticipating that they would issue their
23 environmental assessment related to the relicensing,
24 so taking the information that's provided in the
25 studies and the application and developing an

1 environmental assessment related to the relicensing
2 of the project.

3 And then the official biological opinion
4 is due 135 days after the EA is issued.

5 And I know that, Bob, you and some folks
6 from the Game and Parks talked with FERC three or
7 four weeks ago about kind of that last process and
8 time frames of when things would be due.

9 Isis or Janet, anyone from FERC, do you
10 have any comment on what I have laid out as the next
11 steps?

12 JANET HUTZEL: Janet. I don't.

13 ISIS JOHNSON: I don't either.

14 LISA RICHARDSON: Any questions about
15 next steps or comments?

16 RICK HOLLAND: What do you mean by
17 the preliminary fishway prescriptions?

18 LISA RICHARDSON: That's a specific
19 terminology from The Power Act, the preliminary
20 fishway prescriptions.

21 RICK HOLLAND: Okay. What does it
22 mean?

23 JANET HUTZEL: Do you want me to
24 explain it?

25 LISA RICHARDSON: That would be good.

1 JANET HUTZEL: Preliminary fishway
2 prescriptions, that is the Fish and Wildlife Service
3 Section 18 authority to prescribe fishways.
4 Everything is in the ILP, you have a preliminary,
5 and then you have after the EA is filed modified
6 conditions. So they give you preliminary one for
7 the EA. I believe that's the fine print. After the
8 EA is -- or EIS -- I think we are doing EA is
9 issued, they can modify them depending on
10 information received, but preliminary fishway
11 prescriptions is basically Fish and Wildlife
12 Services' ability to require fishways or structures
13 of that nature or decide to not require them or to
14 assert their authority to require them at a later
15 date.

16 LISA RICHARDSON: Any other
17 questions?

18 PAUL MAKOWSKI: This is Paul Makowski
19 from FERC. Can I remind the -- with the draft
20 license application that we do recommend that if
21 there are any proposed measures that they be
22 included in the draft license application?

23 LISA RICHARDSON: Right. Yes, we are
24 aware of that.

25 PAUL MAKOWSKI: And throughout the

1 day I heard that, you know, certain people were
2 requiring references. It would be really helpful if
3 the references were actually submitted to the
4 secretary so that they -- so they can be entered
5 into the public records, so that everybody has that
6 information available to them.

7 PAT ENGELBERT: The USGS measurement
8 is --

9 LISA RICHARDSON: Okay. You are
10 talking about the USGS measurements?

11 PAUL MAKOWSKI: Well, any information
12 that was actually being requested. Rather than send
13 it to one entity, to make sure that -- it could be
14 on your project -- on the project Web site, but, you
15 know, just so that it's available to most everyone,
16 that would be really helpful.

17 LISA RICHARDSON: Okay. I
18 understand.

19 PAUL MAKOWSKI: I may not even know
20 to ask for something and then go to the project Web
21 site and it's there.

22 LISA RICHARDSON: So you are not
23 specifically asking that all of the references that
24 are used in the studies be submitted, right?

25 PAUL MAKOWSKI: No, no, no, no. I'm

1 just saying if someone is asking for a specific
2 reference to be available that it be, you know, put
3 into a public record, either on the project Web site
4 or filed with us.

5 LISA RICHARDSON: Okay. I think
6 specifically Pat is going to track down that USGS
7 reference. I think the only other thing that we
8 talked about today is getting the statistical
9 outputs to Mary. Those were filed with the
10 statistical analysis information on Tuesday, so that
11 is available. It's not on our Web site because
12 normally the attachments are quite large, so I will
13 e-mail those to Mary and to Joel. But FERC, you
14 guys already have those.

15 PAUL MAKOWSKI: Uh-huh.

16 LISA RICHARDSON: Okay. If there are
17 no more questions, I guess we will adjourn a little
18 bit early today.

19 Thank you all for coming.

20 (1:57 p.m. - Adjournment.)

21 ** ** ** **

22

23

24

25

C E R T I F I C A T E

1
2 STATE OF NEBRASKA)
) ss.
3 COUNTY OF DOUGLAS)

4 I, Kara D. Holland, CSR (IA), Court
5 Reporter and General Notary Public within and for
6 the State of Nebraska, do hereby certify that the
7 foregoing was taken by me in shorthand and
8 thereafter reduced to typewriting by use of
9 Computer-Aided Transcription, and the foregoing
10 one hundred seventy-seven (177) pages contain a
11 full, true and correct transcription to the best of
12 my ability;

13 That I am not a kin or in any way
14 associated with any of the parties to said cause of
15 action, or their counsel, and that I am not
16 interested in the event thereof.

17 IN WITNESS WHEREOF, I hereunto affix my
18 signature and seal this 16th day of September, 2011.

19
20 _____
21 KARA D. HOLLAND, CSR (IA)
22 GENERAL NOTARY PUBLIC

23 My Commission Expires:
24
25

	106/10 106/13	120/10 120/12 122/4 128/14
'85 [1] 29/2	14th [3] 95/5 95/20 133/14	2011 [3] 1/11 11/11 178/18
'87 [2] 85/21 146/23	15 [5] 14/16 17/4 88/14	2013 [1] 173/21
'87 to [1] 85/21	97/16 103/5	21 [1] 21/22
'90 [1] 86/19	15,000 [1] 52/3	23 [2] 22/16 22/24
'91 [2] 86/19 86/23	15-minute [1] 105/25	2300 [1] 47/10
'93 [4] 87/1 119/7 128/10	15-year [1] 123/2	23rd [4] 14/18 171/13 172/1
128/12	1500 feet [1] 100/7	172/4
'93 to [1] 87/1	151 [1] 151/18	24 [1] 23/10
'93/'94 [1] 119/7	153 [1] 148/20	24-year [1] 84/4
'94 [3] 41/16 87/1 119/7	155 [1] 170/6	24th [2] 14/20 171/18
'94 data [1] 87/1	157 [1] 171/5	25 [7] 23/15 25/24 26/23
'95 [3] 41/18 146/23 146/25	16 [3] 17/18 103/5 106/12	29/12 41/14 148/10 167/14
'98 [4] 122/22 128/10 128/12	16th [4] 172/9 172/14 172/21	25 percent [3] 31/8 31/10
128/13	178/18	32/12
'99 [4] 86/2 86/2 86/4 86/18	17 [1] 18/23	27 [3] 22/21 22/21 24/20
.	17,000 [1] 106/8	28 [1] 25/14
	1700 [3] 37/6 40/19 50/13	29 [1] 26/10
	177 [1] 178/10	2:30 [3] 8/4 9/5 9/7
.02 [1] 65/23	18 [2] 20/2 175/3	3
.038 [1] 65/18	18th [2] 15/17 172/7	3 feet [1] 139/12
.04R [1] 65/13	19 [1] 20/15	3 percent [1] 120/19
.05 [2] 69/11 69/12	1950 [1] 28/25	3,000 [1] 38/25
.071 [1] 69/9	1978 [1] 29/4	3.58 [2] 139/10 140/7
.2 [1] 22/15	1982 [1] 57/8	3.89 [1] 140/2
.23 [1] 22/13	1985 [3] 25/23 27/17 38/23	30 [9] 19/16 26/18 55/25
.26 [1] 22/15	1987 [5] 63/1 68/1 83/25	70/2 71/11 87/11 87/18 106/9
.26 millimeters [1] 22/15	132/17 132/19	146/25
.6 [1] 140/3	1989 [1] 41/17	30 miles [3] 72/16 78/24
0	1990 [6] 86/14 86/16 98/14	115/6
	98/17 119/5 122/22	30,000 [2] 52/3 52/5
0.038 [1] 65/17	1991 [3] 86/15 86/16 118/20	30-mile [3] 59/17 71/21 166/7
0.71 [1] 69/9	1993 [9] 85/19 85/24 86/9	30-minute [1] 106/7
1	119/11 119/11 119/13 119/14	31 [1] 26/25
	119/18 128/8	32 [2] 131/24 131/25
1,000 [7] 23/25 42/23 52/2	1994 [3] 85/24 86/11 119/5	33 [1] 28/4
52/12 52/16 52/19 121/19	1995 [15] 68/9 68/9 68/11	34 [2] 28/12 28/18
1,500 [1] 38/25	68/13 68/20 68/21 68/24	35 feet [1] 54/19
1.48 feet [1] 140/7	68/25 69/19 72/7 73/4 73/10	35-mile [1] 97/15
10,000 [1] 52/3	73/10 75/9 75/13	350,000 [1] 99/15
10-mile [1] 166/6	1996 [1] 139/11	36 [1] 29/16
10.4 percent [1] 138/2	1998 [3] 119/13 119/18 128/7	365 [1] 105/21
100 [2] 35/11 101/12	1:00 [2] 135/17 136/1	38 [1] 34/2
101 [1] 101/21	1:57 [1] 177/20	39 [2] 31/14 111/25
102 [16] 59/14 59/19 68/3	1st [2] 120/25 173/6	3:30 [3] 9/6 95/9 95/21
69/22 72/14 72/15 72/23	2	4
72/25 73/15 73/22 75/5 75/9		4 percent [2] 60/19 123/7
78/24 85/4 85/9 102/20	2,970,000 [1] 134/1	4.5 [1] 138/4
103 [1] 103/15	2-mile [3] 111/20 111/21	40 [1] 31/24
104 [1] 108/1	112/1	40 percent [1] 50/24
106 [3] 60/8 75/6 113/18	2.29 feet [1] 139/23	42 [1] 41/4
10:34 [1] 88/18	2.76 [1] 86/10	44 [1] 41/22
10:50 [1] 89/1	20 [2] 21/10 132/13	45 [1] 48/20
11 [1] 138/1	20 percent [1] 85/25	46 [1] 42/19
110 [1] 114/21	20-mile [1] 166/7	47 [1] 43/3
111 [1] 117/24	2000 [2] 86/2 86/18	48 [1] 43/9
112 [1] 118/12	2003 [11] 27/20 27/21 28/3	5
113 [1] 119/10	34/25 38/20 38/23 119/20	5 million [1] 166/10
117 [1] 121/24	119/22 128/9 128/13 128/14	5,000 [3] 52/3 52/5 121/20
118 [1] 122/17	2005 [5] 86/5 86/18 98/15	5,770,000 [1] 133/22
119 [1] 123/4	98/17 119/7	50 [3] 44/18 46/17 49/10
11:51 [1] 135/18	2006 [7] 86/5 86/18 99/1	500 [2] 52/2 121/19
12 [4] 15/22 16/1 97/11	132/18 137/21 138/4 138/20	51 [1] 46/17
97/15	2008 [5] 11/2 29/5 92/2	513 [1] 33/12
123 [1] 125/7	139/21 146/25	534 [1] 123/24
1277 [1] 48/22	2009 [16] 11/10 12/3 25/24	54 [1] 51/13
128 [1] 128/11	27/17 27/20 27/21 28/3 29/2	55 [2] 51/24 52/18
129 [1] 128/18	34/25 38/20 38/23 38/24	56 [1] 52/4
12:00 [1] 135/15	51/23 83/25 140/22 141/12	57 [1] 52/7
12:30 [2] 95/9 95/21	2010 [21] 11/7 11/8 28/25	58 [3] 52/13 52/13 52/21
133 [1] 129/18	29/8 39/7 39/8 41/21 51/23	
135 [1] 174/4	57/8 68/1 85/21 103/20 104/2	
138 [1] 131/10	112/19 112/20 112/22 119/22	
14 [5] 16/19 56/3 56/10		

6	addition [5] 16/13 18/15 32/25 36/13 64/7	altering [3] 148/4 170/8 170/13
6-minute [1] 105/25	additional [25] 10/19 10/19 11/17 12/18 12/19 12/23 13/2 13/15 13/17 13/19 14/23 14/24 15/3 15/12 24/19 43/25	alternate [1] 9/25
600 [1] 121/19	53/15 56/5 56/7 59/9 79/2 79/24 171/20 173/8 173/12	alternatives [5] 94/2 157/6 157/12 157/18 157/21
64 [1] 132/1	Additionally [1] 58/12	America [1] 137/17
67 [1] 67/16	address [2] 152/17 154/1	amount [20] 22/5 35/13 64/25 65/2 77/15 78/5 82/25 83/2 85/25 90/20 91/22 92/3 92/12 92/16 135/7 155/17 156/5 162/25 163/7 169/19
68 [2] 72/9 72/12	addressed [1] 17/11	analyses [4] 67/21 74/24 156/2 166/14
69 [2] 68/22 72/21	adds [1] 51/5	analysis [142]
7	adequate [1] 173/11	analysis we [1] 92/22
7.8 [1] 86/11	adjourn [2] 8/4 177/17	analyze [2] 18/16 145/1
70 [1] 63/23	Adjournment [1] 177/20	analyzed [1] 83/23
71 [3] 73/16 73/17 75/6	adjust [1] 63/8	analyzing [2] 68/3 147/24
72 [21] 59/16 59/19 68/4 69/22 69/23 70/5 70/6 70/19 71/23 72/14 72/15 72/22 72/25 73/15 73/20 73/22 75/5 75/9 78/24 85/4 85/9	adjusted [2] 155/15 155/22	annual [16] 56/18 79/19 80/6 80/17 80/19 80/25 84/11 84/25 122/18 127/18 134/1 134/3 134/10 135/6 135/7 165/3
72.0 [1] 64/8	adjustment [1] 102/10	anomaly [1] 42/25
72.2 [3] 62/24 63/23 64/2	adjustments [1] 133/9	ANOVA [2] 59/9 85/3
72.8 [2] 63/24 64/8	adjusts [1] 37/17	answer [9] 36/24 37/19 38/3 50/17 51/4 53/20 53/24 152/20 156/7
8	adult [8] 55/15 56/17 60/23 60/24 65/21 67/6 79/10 87/9	answered [3] 35/24 154/23 170/3
83 [1] 89/6	adults [1] 79/15	anticipating [1] 173/22
84 [1] 89/10	adversely [3] 89/17 164/17 164/17	anybody [6] 33/7 53/24 117/21 131/17 133/12 167/24
87 [1] 90/2	affect [22] 64/19 71/15 75/22 84/16 85/2 89/17 137/3 137/4 145/12 145/14 145/16 146/9 146/12 147/10 148/6 156/6 158/2 164/15 164/15 164/17 164/17 169/2	anymore [1] 163/25
88 [1] 90/10	affix [1] 178/17	anyway [1] 98/1
89 [1] 90/23	afternoon [3] 8/4 136/7 136/12	apologize [2] 97/25 128/11
8th [1] 14/16	agencies [6] 11/5 14/20 171/15 171/18 172/3 173/18	apparent [1] 80/24
9	agency [2] 141/19 142/14	appear [3] 129/11 130/18 146/18
90 percent [3] 21/14 22/14 23/16	agenda [5] 3/11 8/2 8/12 9/6 171/6	appeared [2] 79/18 80/17
92 [1] 93/2	aggradation [18] 13/7 13/12 17/2 93/7 115/22 116/13 117/9 117/17 119/16 120/3 120/18 128/13 128/14 128/20 130/22 163/2 163/9 166/4	appears [5] 32/6 85/12 121/4 155/15 155/22
93 [1] 93/15	aggradation/degradation [3] 13/7 13/12 17/2	Appendix [1] 78/10
95 [1] 96/9	aggradational [10] 52/23 119/23 120/21 120/24 121/1 122/22 123/5 123/12 127/25 128/22	applicability [1] 57/14
96 [1] 98/7	aggrade [2] 119/18 128/7	application [15] 12/2 15/18 172/9 172/10 172/12 172/12 172/16 172/17 172/21 172/25 173/7 173/10 173/25 175/20 175/22
97 [1] 100/4	aggraded [2] 119/14 119/21	applied [5] 49/2 63/4 63/12 101/7 116/4
99 [1] 100/25	aggrading [2] 116/22 143/3	applies [1] 55/3
9:00 [1] 8/23	aggregate [4] 83/14 84/14 84/16 126/9	apply [2] 11/23 50/10
A	aggregated [1] 84/8	applying [1] 83/10
a different [1] 151/5	ago [3] 13/18 141/22 174/7	appreciated [1] 105/2
A's [1] 97/25	agreed [3] 57/15 58/8 59/5	appreciation [1] 131/11
a.m [3] 88/18 89/1 135/18	agreement [1] 118/6	appropriate [3] 57/2 76/4 151/1
ability [4] 94/4 115/13 175/12 178/12	ahead [12] 41/1 51/11 53/25 58/17 61/7 69/20 78/21 78/22 123/18 127/13 151/16 168/12	approved [2] 12/8 12/9
able [8] 3/8 8/15 18/3 25/22 55/13 76/9 135/8 159/9	Aided [1] 178/9	approximate [1] 173/16
about site [1] 149/23	aimed [1] 161/8	approximately [12] 19/16 25/24 28/25 31/7 31/10 59/14 59/16 69/19 72/16 97/11 98/18 99/15
absence [6] 59/6 77/2 77/15 78/7 87/24 88/1	al [1] 13/20	approximation [2] 65/20 124/16
absolute [1] 101/24	Alberta [1] 138/14	April [4] 138/10 172/9 172/21 173/10
Absolutely [1] 72/6	ALBRECHT [2] 2/3 5/23	April 16th [2] 172/9 172/21
accepted [1] 173/7	allow [3] 93/8 96/25 134/7	arbitrary [2] 69/23 81/13
access [2] 3/8 95/14	allowed [2] 99/7 100/7	are even [1] 159/21
account [4] 63/9 80/23 80/24 147/18	allows [1] 96/21	are the [1] 90/15
accounted [2] 66/17 67/3	allude [1] 37/3	area [49]
accumulative [1] 169/17	alter [1] 170/16	
accuracy [1] 55/16	alteration [1] 141/6	
accurate [2] 53/21 121/13		
accurately [2] 103/21 107/16		
acres [3] 139/10 140/2 140/7		
Act [2] 169/4 174/19		
action [1] 178/15		
active [2] 9/22 40/7		
activities [1] 11/13		
activity [1] 141/10		
actual [6] 59/22 66/11 86/15 117/15 139/16 172/21		
add [3] 35/4 35/25 164/8		
added [2] 13/10 51/21		
adding [1] 60/23		

A	134/23 175/24 axis [1] 29/18	168/20 168/24 169/4 169/11 172/16 174/3
area--were [1] 32/4 areas [11] 31/23 36/3 46/24 50/7 100/18 123/7 137/9 138/15 140/19 141/10 141/17 Arkansas [1] 137/25 array [1] 93/22 arrive [2] 137/17 138/10 articulate [1] 163/12 ascertain [1] 145/4 Ashland [13] 13/8 19/20 41/14 41/15 41/17 42/7 42/17 42/18 43/8 43/16 43/17 52/10 52/16 asked [17] 13/10 13/21 18/13 18/16 20/3 24/18 24/23 25/13 25/16 34/3 35/15 43/12 51/16 51/17 51/18 53/14 56/5 asking [8] 53/5 155/3 157/19 160/19 161/6 161/19 176/23 177/1 asks [1] 101/3 aspects [1] 133/18 assert [1] 175/14 assertions [1] 72/2 assess [3] 13/11 63/4 89/23 assessing [1] 150/1 assessment [11] 56/12 134/25 149/25 168/10 168/16 168/20 168/24 169/5 172/16 173/23 174/1 assessments [1] 122/14 associated [9] 60/20 77/16 87/6 87/8 89/20 97/4 155/13 155/14 178/14 association [4] 79/14 79/17 79/19 80/17 assumed [1] 99/17 assuming [1] 36/11 assumption [5] 37/4 37/20 62/3 62/8 116/2 at changes [1] 84/14 Atlantic [2] 138/7 138/16 Attachment [1] 74/23 attachments [1] 177/12 attempt [1] 169/6 attendees [1] 10/1 attention [1] 109/1 attenuated [1] 71/16 attributed [1] 46/24 August [8] 11/7 11/10 12/3 12/17 119/11 119/11 119/17 120/25 August/September [1] 12/17 authority [2] 175/3 175/14 authors [1] 104/17 availability [4] 16/13 146/12 148/23 149/25 available [20] 13/23 15/6 55/10 58/9 62/2 66/12 75/21 78/10 86/17 101/2 103/22 146/9 167/23 168/2 168/6 171/24 176/6 176/15 177/2 177/11 average [19] 84/3 86/10 102/23 105/6 105/6 105/7 106/17 106/18 126/9 126/12 134/1 134/3 134/9 135/6 135/7 135/7 139/13 139/16 139/22 averaged [2] 36/18 126/20 averages [1] 103/1 aware [4] 134/15 134/19	B back [26] 11/2 11/7 11/10 12/3 12/10 34/2 34/12 51/12 52/18 52/21 56/23 64/14 70/17 72/9 81/14 104/7 104/21 132/19 137/21 141/2 141/21 147/14 162/8 164/1 167/13 170/19 background [5] 17/19 17/21 20/6 20/14 138/5 backwards [1] 139/15 bag [2] 126/2 127/12 balancing [2] 96/13 115/25 banks [2] 39/24 102/25 bar [2] 29/17 31/25 barren [2] 139/4 141/18 base [2] 98/9 161/9 baseball [1] 97/25 based [37] bases [1] 69/5 basic [1] 59/6 basically [16] 7/8 47/14 55/25 58/22 59/13 60/12 60/18 67/23 68/19 72/18 76/25 85/1 85/9 85/20 109/16 175/11 basics [1] 13/1 basin [10] 13/21 99/13 116/5 133/20 134/12 134/17 134/25 163/18 163/20 163/22 basing [1] 157/7 basis [8] 134/1 134/3 134/10 143/4 143/17 144/11 147/19 165/3 beach [1] 138/15 beaches [1] 138/16 bed [20] 36/12 37/14 37/17 37/20 93/20 101/1 101/8 101/14 103/11 103/12 103/17 107/15 108/10 112/7 121/6 121/22 123/17 124/17 128/23 163/6 bedded [1] 36/16 beds [1] 22/8 began [3] 41/17 41/17 141/20 beginning [2] 105/7 171/10 behalf [1] 7/24 behaving [1] 153/4 believe [16] 36/3 38/3 41/15 57/8 80/10 95/1 98/20 104/7 105/24 120/25 126/17 139/13 140/22 142/14 172/13 175/7 believe -- I [1] 172/13 benchmark [4] 143/20 143/25 144/3 144/5 bend [48] BENDER [2] 2/3 6/8 beneficial [1] 153/23 benefit [1] 89/17 berm [1] 166/19 best [9] 33/11 40/21 55/14 58/4 58/9 152/17 152/20 152/25 178/11 better [5] 48/1 54/9 54/11 80/3 158/3 beyond [2] 73/19 173/4 big [3] 115/12 127/19 144/1 biggest [2] 46/1 97/7 binary [2] 76/25 78/9 biological [8] 168/10 168/16	biometricians [1] 69/3 bird [10] 18/22 53/7 55/18 57/6 83/17 86/17 145/1 145/3 147/18 156/18 birds [12] 57/21 60/25 140/14 140/22 141/18 145/14 146/4 150/1 150/4 156/6 159/7 159/17 bit [41] black [3] 21/11 21/23 23/2 blocks [1] 20/24 blue [6] 23/1 23/12 102/20 113/15 118/17 128/8 board [1] 10/25 Bob [3] 5/10 6/14 174/5 BOMBERGER [2] 2/4 5/16 bottom [3] 63/7 87/21 107/10 bounce [1] 123/1 bounced [1] 119/16 boundaries [1] 37/4 boundary [8] 39/18 99/4 99/7 99/23 100/2 100/15 100/17 122/10 bounds [1] 78/19 box [4] 11/21 11/21 11/22 68/22 braided [12] 45/14 50/12 117/8 130/24 131/7 131/8 143/5 143/6 146/2 146/8 152/19 153/4 break [6] 9/2 9/2 88/8 88/13 88/17 123/20 breaks [2] 9/23 10/4 breeding [4] 137/19 138/12 138/13 138/20 bridge [3] 102/17 102/17 102/18 brief [1] 145/8 briefly [1] 12/25 bring [1] 159/12 Bringing [1] 51/20 broad [1] 24/5 broke [5] 70/4 72/21 97/5 105/23 145/13 broken [2] 55/24 106/3 brought [3] 11/25 109/25 142/3 BROWN [4] 2/4 5/17 56/24 139/20 buffer [1] 100/19 build [1] 165/19 bullet [2] 87/21 170/12 bullets [2] 24/20 171/12 by-products [1] 101/25 bypass [16] 16/12 16/21 16/25 28/15 28/22 28/23 30/18 30/21 40/24 142/12 142/25 155/1 155/2 157/21 157/24 163/5
		C calculate [2] 81/24 106/1 calculated [7] 25/18 105/19 108/14 108/16 109/10 131/1 156/3 calculates [4] 101/1 101/10 108/8 109/12 calculation [2] 24/1 103/24 calculations [8] 14/6 16/23 17/24 17/25 18/3 90/24 124/25 131/12

C		
calibrate [2] 97/1 101/13	channels [1] 37/15	111/3 134/8 135/1 165/12
calibrated [5] 23/9 23/13 23/21 26/23 93/23	characteristic [1] 131/8	comes [3] 82/14 99/9 134/12
calibration [5] 99/25 100/23 101/19 102/12 107/21	characteristics [10] 13/14 16/16 25/13 25/16 32/3 43/11 45/25 144/24 145/6 147/25	comfort [2] 111/16 112/4
call [3] 104/17 110/1 137/8	characteristics--velocity [1] 32/3	comfortable [1] 114/5
called [3] 31/2 66/21 74/19	characterize [2] 16/20 16/24	coming [12] 8/8 27/24 44/1 99/18 112/17 113/14 113/22 118/1 118/10 134/17 155/18 177/19
calls [1] 10/5	characterized [1] 161/23	comment [6] 14/21 71/25 161/2 162/2 172/11 174/10
Canada [2] 138/22 138/22	chart [3] 24/5 44/17 66/13	comments [11] 7/23 15/9 148/19 171/16 171/17 172/2 172/15 172/18 172/25 173/17 174/15
Canadian [1] 138/23	charts [2] 28/10 31/25	commercial [1] 141/9
canal [8] 27/25 59/13 145/19 151/20 157/22 162/23 163/25 164/1	Chen [1] 13/20	commission [18] 2/9 2/11 2/12 2/17 4/1 5/9 5/20 5/22 12/4 13/21 17/8 99/13 116/5 133/21 134/25 135/5 161/4 178/23
Canseco [2] 97/24 132/22	chime [4] 53/22 53/25 62/14 85/5	communicating [1] 158/24
capability [1] 93/16	choosing [1] 81/15	compare [9] 16/13 16/16 27/18 27/19 27/25 42/2 86/8 151/7 161/9
capacities [4] 109/21 117/15 118/3 118/8	chose [6] 26/13 26/19 27/21 98/14 101/6 119/10	compared [22] 25/8 25/9 25/17 30/9 30/22 31/7 36/14 41/25 42/1 69/8 91/3 92/17 111/23 112/18 112/19 113/12 114/17 116/4 117/25 127/5 128/18 166/6
capacity [44]	chronological [1] 15/14	compares [1] 130/14
care [1] 131/19	chugs [1] 110/5	comparing [25] 14/5 29/22 30/1 30/5 30/13 30/24 31/1 31/3 31/4 31/9 31/22 32/17 33/13 33/20 36/1 43/5 115/7 124/3 126/2 127/11 128/12 130/8 144/20 144/21 161/11
careful [2] 132/21 133/8	circles [2] 108/5 108/8	comparison [7] 25/8 27/14 81/5 84/14 84/18 165/4 165/7
Caribbean [1] 138/9	circumstances [1] 15/5	comparisons [2] 25/3 133/11
Carolina [1] 138/17	clarification [1] 77/6	completed [2] 12/23 15/13
carried [3] 83/3 83/4 117/4	clarified [1] 157/14	completely [2] 48/9 49/23
carries [1] 137/25	clarify [6] 64/14 74/18 154/22 158/18 170/9 170/11	complexity [1] 94/18
carry [1] 109/25	classifying [1] 164/4	component [2] 16/2 165/2
carrying [1] 155/16	classification [1] 125/12	computationally [1] 96/22
case [9] 34/25 67/5 79/20 84/2 99/16 99/19 109/19 116/6 116/8	classifications [1] 91/2	computations [2] 125/14 130/7
cases [5] 126/25 127/10 130/10 130/18 131/4	CLAUSEN [2] 2/5 6/14	computed [6] 101/9 103/11 122/6 123/7 126/3 129/12
catching [1] 80/20	clear [2] 38/23 99/21	computer [10] 26/14 26/22 97/21 97/23 98/6 124/18 131/21 131/24 131/25 178/9
cause [4] 33/25 142/8 144/2 178/14	clearly [3] 116/18 116/21 163/12	Computer-Aided [1] 178/9
caused [3] 72/7 144/5 147/4	close [15] 9/15 22/3 30/16 30/16 37/11 39/24 44/22 72/15 78/12 88/14 91/21 91/22 96/16 110/14 123/23	computers [2] 98/4 132/7
caution [2] 131/17 133/7	closely [2] 32/11 32/20	concentration [2] 99/14 99/18
cautious [1] 167/16	closer [3] 10/10 67/24 109/1	concentrations [1] 134/17
cell [1] 10/2	closest [1] 26/14	concept [1] 117/4
census [2] 137/21 138/20	cluster [1] 47/15	concern [3] 55/16 141/15 142/4
Central [5] 50/6 95/9 95/9 95/21 95/21	clustered [5] 108/6 115/4 124/8 129/4 129/13	concerned [1] 151/9
CENTURY [2] 2/8 6/7	clustering [5] 108/22 111/6 118/2 121/17 124/5	concerns [3] 141/20 142/14 142/19
certain [14] 39/25 70/10 78/5 115/15 115/21 115/22 128/6 160/24 162/11 162/12 162/14 165/25 170/3 176/1	coarse [6] 55/22 58/15 96/5 96/11 96/16 110/12	conclude [1] 151/11
certainly [3] 24/3 94/14 116/10	coarser [2] 114/14 121/8	concluded [1] 38/4
certify [1] 178/6	coast [2] 138/7 138/8	concludes [1] 46/6
CFS [10] 23/25 35/11 38/25 38/25 52/3 52/5 52/12 52/17 52/19 121/19	coastal [1] 138/16	concluding [2] 148/21 168/3
chance [1] 170/2	code [1] 28/7	conclusion [9] 75/16 75/18 79/23 116/7 117/13 149/13 153/19 161/12 168/4
change [21] 43/15 43/18 45/16 45/18 47/18 50/23 84/25 85/6 85/7 86/16 93/20 110/19 120/9 120/20 127/1 132/18 148/5 148/11 152/15 157/24 158/2	coefficient [2] 66/22 67/1	conclusionary [1] 160/16
changed [3] 59/25 85/1 152/14	collected [6] 57/7 57/11 59/24 80/10 86/23 104/14	conclusions [13] 87/4 130/17 148/17 151/23 156/13 157/4 157/19 158/7 159/2 159/10 159/20 160/1 167/17
changes [26] 12/22 17/3 32/19 32/24 37/17 37/18 40/17 43/19 45/24 57/9 59/2 63/11 69/25 70/6 72/4 84/14 87/18 109/6 109/7 142/1 148/3 148/9 167/5 170/7 170/12 172/20	collecting [1] 156/12	
changing [2] 39/3 39/4	collection [10] 11/13 57/10 59/23 59/25 60/1 60/2 61/2 62/15 66/3 87/7	
channel [36]	collective [1] 145/10	
channel's [1] 122/2	collinear [1] 56/12	
channelization [1] 141/14	collinearity [1] 81/11	
	collineary [1] 81/15	
	colonial [1] 58/3	
	color [1] 28/7	
	Columbus [30]	
	column [1] 77/10	
	combination [1] 62/6	
	combinations [1] 22/21	
	combine [1] 18/13	
	combined [3] 22/9 107/4 148/14	
	combined, [1] 137/3	
	combined, you [1] 137/3	
	come [7] 39/13 62/4 64/14	

C		
<p>condition [16] 39/19 90/14 91/16 91/20 91/24 92/9 92/17 92/18 92/25 93/1 127/5 129/24 130/2 130/13 130/14 154/6</p> <p>conditions [18] 39/18 40/9 92/5 92/13 99/4 99/7 99/23 100/2 100/16 100/17 122/10 125/3 148/10 148/12 153/9 158/9 173/19 175/6</p> <p>conduct [1] 67/8</p> <p>conducted [4] 14/2 55/21 85/3 90/11</p> <p>confidence [19] 13/5 18/17 20/1 20/3 20/9 20/23 21/2 21/4 21/6 21/14 22/1 22/11 22/14 22/19 23/11 23/17 24/4 24/9 80/15</p> <p>confident [1] 104/23</p> <p>confirmed [1] 44/7</p> <p>confluence [6] 19/10 19/12 19/16 60/7 73/8 157/25</p> <p>confusion [1] 163/15</p> <p>connect [1] 97/13</p> <p>connectivity [2] 142/5 142/11</p> <p>consequence [1] 109/4</p> <p>CONSERVATION [3] 2/5 5/17 56/25</p> <p>conservative [1] 69/5</p> <p>consider [2] 161/24 167/2</p> <p>considerably [1] 153/15</p> <p>consideration [2] 150/3 154/10</p> <p>considerations [1] 96/10</p> <p>considered [4] 64/9 150/12 156/11 166/24</p> <p>considered in [1] 156/11</p> <p>considering [1] 161/16</p> <p>consistent [37]</p> <p>constant [6] 72/3 76/1 76/3 150/20 150/21 151/6</p> <p>constantly [1] 37/17</p> <p>constitutes [1] 169/3</p> <p>constraints [3] 49/11 49/21 96/10</p> <p>consultant [1] 5/7</p> <p>contain [1] 178/10</p> <p>contained [3] 166/14 167/1 167/3</p> <p>contesting [1] 152/8</p> <p>continue [2] 57/3 58/24</p> <p>continuing [1] 56/14</p> <p>contractor [1] 104/16</p> <p>contractors [1] 166/17</p> <p>contribution [3] 66/2 99/8 99/12</p> <p>control [3] 70/9 110/1 151/7</p> <p>control -- I [1] 70/9</p> <p>controlled [1] 65/4</p> <p>controlling [3] 65/5 76/8 100/17</p> <p>conversation [1] 7/20</p> <p>converted [1] 80/18</p> <p>convey [4] 108/9 108/11 109/11 156/4</p> <p>conveying [2] 124/19 131/3</p> <p>conveys [1] 83/9</p> <p>convoy [1] 135/9</p> <p>COO [1] 3/4</p> <p>coordinates [2] 61/20 106/8</p> <p>copy [4] 3/7 3/8 8/13 105/1</p>	<p>Corps [4] 49/13 96/3 104/15 104/15</p> <p>correct [6] 53/20 88/1 88/2 105/24 161/17 178/11</p> <p>correctly [1] 102/9</p> <p>correlate [1] 114/10</p> <p>correlation [14] 31/11 56/10 60/9 65/16 66/9 66/14 67/8 78/3 78/4 80/8 80/19 80/21 80/22 147/15</p> <p>corresponding [1] 45/17</p> <p>counsel [1] 178/15</p> <p>count [19] 55/9 55/15 55/15 55/17 55/20 63/15 63/23 63/24 67/5 69/14 77/1 78/6 81/1 86/4 143/11 146/24 147/16 148/25 150/6</p> <p>counted [15] 55/18 60/10 60/11 60/18 61/4 61/13 62/16 62/25 68/8 72/20 76/23 77/9 79/15 84/5 86/10</p> <p>counter [1] 64/18</p> <p>counter-intuitive [1] 64/18</p> <p>counting [3] 61/19 61/24 64/18</p> <p>country [1] 74/19</p> <p>counts [46]</p> <p>COUNTY [1] 178/3</p> <p>couple [13] 13/19 57/20 98/15 100/11 100/11 100/13 103/14 111/18 119/17 121/9 122/23 141/21 151/14</p> <p>course [4] 64/20 78/1 78/6 161/25</p> <p>Court [1] 178/4</p> <p>cover [5] 9/9 46/11 57/22 69/5 135/6</p> <p>covered [3] 17/13 17/23 77/24</p> <p>covering [1] 89/13</p> <p>create [7] 20/8 21/3 22/11 22/21 100/19 145/22 151/20</p> <p>created [1] 28/9</p> <p>creating [3] 50/21 162/18 163/9</p> <p>creation [2] 145/20 146/10</p> <p>criteria [1] 15/1</p> <p>criterion [2] 69/11 69/12</p> <p>cross [34]</p> <p>cross-section [13] 34/20 36/11 36/17 37/7 38/1 40/16 100/6 109/8 109/9 109/13 109/23 110/4 110/12</p> <p>Cross-Section 2 [1] 109/9</p> <p>cross-section's [1] 108/9</p> <p>cross-sections [14] 26/6 36/10 36/18 37/13 39/25 40/19 96/14 100/5 102/16 105/5 109/6 110/16 126/10 126/18</p> <p>CSR [2] 178/4 178/20</p> <p>culmination [2] 137/6 137/16</p> <p>current [29] 89/24 90/13 91/4 91/11 91/16 92/6 92/17 93/1 124/22 125/2 125/8 125/18 125/21 125/24 125/25 126/23 127/6 129/16 129/20 129/24 130/2 130/9 130/13 143/23 144/4 146/3 152/13 154/6 154/19</p> <p>currently [2] 11/20 140/13</p> <p>curve [15] 20/4 20/7 20/12 20/20 20/22 23/14 28/1 28/2 105/10 107/4 108/3 108/7</p>	<p>124/4 124/9 129/4</p> <p>curves [10] 13/6 18/18 22/22 23/1 23/20 24/10 27/3 27/7 27/17 125/6</p> <p>cutting [1] 24/13</p> <p>cycles [2] 23/24 60/1</p>
		<p>D</p> <p>D50 [2] 21/9 22/6</p> <p>daily [18] 56/18 79/12 79/18 80/20 81/7 81/20 81/23 82/7 82/11 83/10 84/4 85/1 87/2 87/14 97/9 105/19 143/17 147/9</p> <p>dark [3] 108/2 128/8 131/13</p> <p>darker [1] 125/7</p> <p>data [156]</p> <p>database [3] 60/5 62/25 77/10</p> <p>date [16] 17/22 95/5 118/17 119/10 119/11 119/17 119/19 120/11 120/17 128/9 132/12 132/13 132/14 132/18 132/20 175/15</p> <p>dated [1] 141/4</p> <p>dates [6] 37/9 94/10 120/9 123/4 128/17 131/22</p> <p>DAVE [2] 2/17 5/21</p> <p>day [12] 9/15 14/15 37/10 37/11 105/20 106/9 115/25 121/19 121/20 132/16 176/1 178/18</p> <p>days [8] 14/16 37/7 37/25 116/19 116/21 131/13 173/17 174/4</p> <p>dead [1] 123/9</p> <p>deadline [1] 171/19</p> <p>deal [1] 136/22</p> <p>deals [1] 9/11</p> <p>death [1] 113/6</p> <p>December [2] 15/11 172/4</p> <p>December 23rd [1] 172/4</p> <p>decide [2] 170/20 175/13</p> <p>decides [1] 58/6</p> <p>decision [1] 81/13</p> <p>decisionmaking [1] 168/18</p> <p>decisions [2] 71/23 94/1</p> <p>decrease [12] 72/8 91/14 92/3 92/8 92/11 92/15 92/18 92/23 113/25 127/4 130/12 141/25</p> <p>decreases [1] 120/16</p> <p>deep [1] 37/15</p> <p>defer [1] 152/21</p> <p>deficit [1] 145/22</p> <p>define [3] 50/3 102/23 166/2</p> <p>defines [2] 36/22 51/1</p> <p>defining [2] 49/5 50/21</p> <p>definite [1] 156/25</p> <p>definitely [2] 47/18 72/4</p> <p>definition [1] 149/22</p> <p>definitions [1] 167/19</p> <p>definitive [2] 149/13 157/4</p> <p>definitively [1] 150/14</p> <p>degradation [14] 13/7 13/12 17/2 93/7 115/23 116/13 117/10 117/16 120/4 130/21 144/11 163/2 163/9 166/4</p> <p>degradational [18] 52/20 52/23 102/2 103/4 114/3 119/5 119/24 122/25 123/8 123/14 127/24 128/2 128/4 128/10 128/12 155/19 155/20 155/21</p> <p>degrade [1] 128/7</p>

D	<p>diamonds [2] 102/20 113/16 dichotomy [3] 68/10 68/20 69/15 differ [1] 155/14 difference [19] 34/17 35/22 37/3 38/11 38/12 41/11 60/20 68/23 69/2 86/12 87/17 117/14 121/12 123/6 123/10 134/6 134/9 144/23 147/20 differences [15] 33/16 33/20 33/20 33/23 33/25 43/22 60/3 115/12 143/22 144/21 145/4 145/5 147/25 155/7 156/25 different [51] difficult [3] 18/24 28/6 120/23 difficulty [1] 131/11 dig [1] 133/15 dimensional [1] 26/21 diminish [2] 142/5 147/13 diminished [2] 142/11 143/24 dip [3] 112/15 118/21 127/20 direct [1] 166/20 directed [1] 93/12 directly [2] 54/4 54/14 Director [1] 6/14 discharge [118] discharge/width [1] 49/4 discharges [14] 27/6 33/15 34/6 34/23 35/10 36/6 43/22 43/24 45/23 50/13 83/21 84/10 115/15 127/18 discrepancies [1] 98/3 discrete [1] 164/10 discretely [2] 164/11 164/12 discuss [3] 10/18 10/20 57/1 discussed [7] 70/14 107/22 144/9 151/25 159/1 163/10 168/9 discussing [2] 69/2 148/22 discussion [20] 7/20 11/24 90/19 136/13 136/17 137/9 139/7 147/2 151/22 153/19 153/20 156/15 156/21 158/15 160/20 162/20 162/24 163/4 168/13 170/20 discussion of [1] 156/21 discussions [4] 11/6 15/2 117/5 157/5 dismissal [1] 8/3 distance [13] 67/22 68/7 71/9 72/19 76/22 77/20 78/15 78/20 79/5 87/10 87/13 100/16 110/14 distribute [1] 110/13 distributed [1] 78/2 distribution [5] 98/16 137/22 146/13 146/15 146/17 DISTRICT [25] 2/5 2/7 2/10 2/13 2/16 2/16 2/20 3/5 6/5 6/11 6/13 6/15 7/1 7/3 12/6 14/16 15/8 15/17 93/12 163/19 166/21 171/14 172/1 172/8 172/19 District's [1] 140/20 disturbance [3] 141/7 141/15 147/21 diversion [15] 19/2 19/3 38/5 137/1 142/12 144/13 144/22 144/22 144/25 145/3 148/1 153/12 156/22 162/23 170/17 diversity [1] 142/4 divert [3] 91/18 154/16</p>	<p>163/21 diverted [8] 56/19 79/13 79/20 79/21 80/7 80/25 87/14 162/9 document [1] 104/2 doesn't that [1] 149/10 doing [7] 60/1 60/2 76/25 82/2 158/17 169/13 175/8 domain [1] 133/2 dominant [36] dominated [2] 31/18 45/4 don [1] 168/24 door [1] 159/15 dots [2] 23/4 108/12 DOUGLAS [1] 178/3 download [1] 8/16 downstream [29] 19/3 19/5 19/11 19/13 19/16 19/18 25/6 32/24 42/24 45/23 48/14 49/20 58/21 59/1 59/19 70/2 71/12 71/17 72/16 78/25 91/7 91/21 102/16 109/18 119/23 147/14 154/5 154/14 155/17 draft [11] 15/18 172/8 172/12 172/15 172/16 172/17 172/23 172/24 172/25 175/19 175/22 dramatic [3] 86/16 107/8 110/18 draw [1] 130/17 drawn [1] 79/24 dredge [1] 163/21 dredged [1] 156/5 drop [5] 102/2 108/14 109/12 146/24 147/4 dropping [1] 107/10 drumming [1] 112/17 dry [15] 91/1 92/14 92/14 98/16 98/19 98/19 98/25 99/3 124/23 125/16 127/4 129/17 129/22 130/11 130/11 due [19] 40/3 95/17 126/19 141/9 141/13 142/1 142/6 142/12 144/4 147/10 147/21 166/20 166/21 171/18 172/15 172/19 173/18 174/4 174/8 dump [1] 26/15 Duncan [20] 13/8 19/9 41/8 41/13 41/24 41/25 42/12 42/22 43/4 43/13 43/21 44/9 52/10 52/16 110/23 111/23 113/24 114/17 114/17 117/25 dynamic [10] 33/3 117/3 130/20 143/3 146/1 154/4 157/13 160/22 160/24 162/7</p>
		E
		<p>e-Library [1] 13/24 e-mail [3] 95/13 95/22 177/13 EA [7] 172/23 172/24 174/4 175/5 175/7 175/8 175/8 EA is [1] 175/8 earlier [9] 32/22 48/3 77/7 108/25 110/15 150/16 159/2 167/11 171/13 early [8] 8/3 53/5 132/14 135/15 137/17 138/11 142/3 177/18 Earth [1] 153/8 easier [3] 28/9 74/11 75/1 easy [1] 67/14 echoing [1] 167/10</p>
<p>degraded [3] 116/19 119/20 119/21 degrading [1] 143/4 degree [2] 48/20 70/10 delay [1] 74/20 delivered [1] 135/15 DENNIS [2] 2/7 5/25 denominator [1] 85/22 Denver [1] 53/16 DEPARTMENT [4] 2/4 2/19 5/15 6/9 dependent [3] 66/18 67/3 79/10 depending [2] 121/21 175/9 depicts [1] 128/21 depletion [2] 137/1 144/13 depletions [3] 144/14 144/15 144/19 deposit [1] 110/9 depth [21] 21/8 21/22 24/25 25/15 26/2 26/11 26/16 27/10 30/8 30/15 32/1 32/3 33/18 35/18 35/19 35/22 39/3 40/4 42/10 43/12 57/6 depths [6] 30/10 30/12 30/17 36/4 42/15 50/7 derived [2] 23/19 161/12 describe [4] 94/7 103/1 104/2 106/8 described [2] 22/9 166/1 describes [1] 104/3 describing [2] 107/16 119/9 description [1] 160/10 descriptive [1] 74/8 design [1] 57/12 desirable [1] 167/22 destruction [2] 141/6 141/12 detail [3] 95/7 133/16 159/4 detailed [2] 160/9 166/8 detect [3] 76/9 78/14 82/17 detected [5] 17/5 55/5 61/10 77/19 149/6 determination [17] 10/18 12/5 12/6 13/4 15/12 17/12 18/11 24/18 53/14 66/22 67/2 93/4 164/18 165/13 166/13 168/19 172/5 determinations [1] 12/24 determine [8] 16/9 17/5 17/14 55/4 60/13 72/18 76/21 89/16 determined [7] 11/10 58/17 61/1 79/25 82/24 86/11 173/11 determining [3] 56/13 147/18 147/23 detrimental [1] 153/23 develop [4] 38/13 95/2 135/1 166/18 developed [20] 18/18 24/9 26/1 26/5 26/20 27/3 27/5 27/17 37/21 94/5 96/1 96/3 96/7 108/4 124/4 124/9 129/5 153/10 165/22 168/11 developing [7] 90/12 95/24 132/24 141/21 168/14 168/16 173/25 development [7] 20/1 94/17 95/4 107/21 133/11 141/10 141/13 deviation [1] 50/4 diameter [1] 22/15</p>		

E	<p>ecological [1] 149/21 ECONOPOULY [2] 2/6 6/23 effect [31] effective [80] effects [22] 49/14 67/20 82/13 82/14 82/18 83/22 89/23 93/9 143/19 146/8 152/12 156/17 164/14 166/12 166/25 167/2 167/6 167/9 169/5 169/17 169/21 169/23 effort [4] 61/9 63/9 64/19 65/1 egg [1] 169/1 eight [3] 94/12 94/14 111/24 Eighth [1] 27/23 EIS [1] 175/8 either [14] 12/16 49/6 51/9 76/12 98/24 100/8 102/25 103/18 107/20 111/12 124/15 153/22 174/13 177/3 electronically [2] 25/23 29/3 elements [1] 145/12 elevation [6] 102/22 119/12 120/8 120/13 126/9 126/12 elevations [1] 126/8 elevator [1] 9/19 eliminated [1] 77/16 elimination [1] 155/24 Elkhorn [1] 17/16 emergency [1] 74/19 empirical [1] 93/21 employed [1] 93/21 employees [1] 60/2 encountered [2] 133/4 134/22 encourage [1] 165/11 encroachment [1] 141/16 end-all-be-all [1] 140/14 Endangered [1] 169/3 ended [1] 56/19 ends [1] 23/18 Energy [2] 4/1 12/4 ENGELBERT [2] 2/6 6/20 ENGINEER [1] 2/7 ENGINEERING [9] 2/6 2/10 2/13 2/14 2/15 2/18 2/18 2/23 6/17 Engineers [2] 49/13 96/3 entered [2] 77/10 176/4 entire [2] 70/7 166/25 entities [1] 3/16 entity [1] 176/13 environment [3] 14/13 49/14 64/20 environmental [8] 2/4 2/8 6/7 6/9 173/9 173/15 173/23 174/1 equal [3] 36/21 38/7 143/18 equation [11] 20/7 20/10 20/15 20/16 21/3 21/12 22/17 23/6 23/9 101/7 150/12 equations [2] 21/1 49/3 equilibrium [26] 33/3 39/9 39/11 102/4 108/17 117/4 130/21 143/3 146/1 151/25 152/1 152/4 152/9 153/5 153/15 153/21 154/4 154/19 156/24 157/13 157/14 160/8 160/22 160/24 162/7 166/6 equivalent [1] 78/13 erode [1] 145/23 erosion [2] 134/13 142/6</p>	<p>error [1] 149/11 especially [1] 49/8 essentially [10] 30/5 34/19 43/15 43/24 47/15 47/21 85/9 92/12 152/14 153/1 established [1] 39/11 estimate [3] 40/21 50/25 156/1 et [1] 13/20 evaluate [21] 18/22 25/14 42/19 43/12 58/24 93/8 93/12 94/2 94/6 97/8 97/16 99/8 99/16 116/14 127/16 132/11 134/16 135/5 135/8 155/25 169/20 evaluated [18] 19/9 34/22 41/7 98/13 99/11 103/10 111/18 113/13 118/7 118/8 118/9 119/20 122/18 124/20 124/22 159/6 164/11 165/3 evaluating [19] 28/21 44/14 46/1 83/8 90/6 90/21 93/4 93/15 96/10 97/9 98/21 101/21 102/6 113/3 116/25 118/16 120/4 125/23 129/15 event [4] 69/18 118/21 118/22 178/16 events [5] 39/20 127/19 144/1 144/1 144/4 everybody [12] 3/5 3/7 3/7 3/18 3/22 7/6 7/12 10/24 15/24 24/13 24/14 176/5 everyone's [1] 90/25 evidence [1] 56/4 evident [1] 94/16 exact [1] 51/25 exactly [5] 33/4 61/19 132/9 134/14 170/9 example [23] 21/16 22/12 25/7 26/10 26/11 34/3 36/17 37/5 37/21 62/24 63/22 65/12 91/10 109/2 111/19 115/10 118/20 126/16 133/19 152/2 153/7 164/19 166/15 exceed [1] 154/9 exceedance [1] 144/5 exceedances [1] 144/3 exceeds [1] 156/4 Excellent [1] 8/11 exception [2] 44/10 45/18 excuse [5] 31/1 60/23 66/3 69/9 78/11 exhibit [1] 143/5 exhibit a [1] 143/5 exist [2] 140/25 146/3 existed [3] 36/20 37/25 49/2 existence [2] 141/8 143/24 existing [3] 17/1 148/10 170/14 expand [2] 77/22 152/21 expanded [1] 21/1 expect [8] 31/18 49/24 79/21 111/17 112/14 121/18 136/5 173/7 expected [3] 35/6 147/13 148/11 Expires [1] 178/23 explain [9] 33/22 33/23 35/1 80/2 96/22 134/6 134/6 134/9 174/24 explained [2] 135/2 165/17 explains [1] 110/12 explanation [6] 37/2 39/17</p>	<p>49/16 49/22 108/25 109/21 explicitly [1] 167/20 exploratory [1] 149/1 extended [1] 100/13 extends [1] 137/19 extension [1] 134/4 extenuating [1] 15/4 eye [1] 120/23</p> <p>F</p> <p>facilitate [1] 5/2 fact [9] 36/8 65/3 78/1 153/3 154/16 156/1 160/21 160/23 163/1 factor [12] 17/15 56/13 58/2 81/10 81/21 81/21 84/10 86/24 146/20 147/3 147/21 149/14 factors [6] 82/10 147/4 147/17 147/22 157/3 168/18 factual [1] 159/11 factually [1] 159/12 fairly [14] 11/4 35/1 35/25 42/8 42/21 73/12 86/6 96/11 96/16 110/12 113/8 113/24 119/22 123/23 fall [4] 15/19 44/22 47/14 49/24 falls [2] 115/16 115/19 familiar [1] 49/3 family [1] 74/19 fan [1] 97/25 fans [1] 97/25 far [13] 11/25 12/18 14/25 33/16 59/4 70/17 75/19 105/9 106/21 122/15 136/5 156/4 160/3 farther [1] 112/3 faster [1] 145/23 faulting [1] 167/24 favorably [1] 130/14 February [7] 11/11 12/13 12/17 143/21 172/14 172/18 173/1 February 16th [1] 172/14 Federal [2] 4/1 12/3 feel [8] 7/9 10/6 54/18 59/10 75/12 107/16 113/9 124/21 feels [1] 123/21 feet [12] 21/18 21/19 21/20 21/21 22/3 22/4 54/19 100/7 139/12 139/23 140/3 140/7 fell [1] 114/18 felt [4] 81/16 114/5 118/6 121/12 FERC [33] FERC's [5] 17/12 18/11 24/17 93/3 93/6 fewer [3] 56/6 75/19 76/17 field [3] 103/13 123/5 133/13 figure [3] 33/12 123/24 123/25 file [5] 132/3 132/5 132/6 171/14 172/2 filed [6] 160/6 172/10 172/17 175/5 177/4 177/9 files [5] 74/24 98/4 131/22 132/8 133/9 filing [2] 15/17 173/6 fill [1] 163/20 filling [1] 4/2</p>
----------	--	--	---

F	final [2] 165/12 172/12 finally [5] 14/8 112/24 128/23 129/2 129/25 find [10] 38/15 64/16 79/6 79/7 94/25 131/5 143/10 147/15 149/2 168/23 finding [3] 139/13 139/23 140/2 findings [3] 115/5 130/20 131/5 finds [1] 107/8 fine [6] 9/19 70/17 71/22 74/10 74/25 175/7 finish [1] 105/16 firm [1] 70/18 first [32] FISH [10] 2/6 2/8 2/15 5/11 6/21 6/23 33/9 169/11 175/2 175/11 fishway [5] 173/19 174/17 174/20 175/1 175/10 fishways [2] 175/3 175/12 fitted [1] 23/9 five [6] 98/18 98/19 100/8 137/18 141/2 141/12 five-year [2] 141/2 141/12 fixed [1] 36/11 flatter [1] 48/21 fledge [1] 55/13 flew [1] 55/19 flipped [1] 127/7 flow [129] flowing [1] 3/14 flows [27] 27/24 35/13 37/8 37/10 40/13 59/1 85/13 85/13 85/22 86/6 86/6 86/8 87/15 87/16 87/16 97/9 97/10 112/16 122/3 127/17 127/20 129/8 142/13 143/16 143/25 147/12 147/19 fluctuations [3] 39/5 117/16 147/9 focus [1] 169/22 focuses [1] 136/20 focusing [3] 136/21 137/13 138/24 folks [16] 3/19 3/21 4/13 4/21 8/15 9/11 10/13 28/7 53/16 60/14 67/17 95/18 133/1 133/7 170/2 174/5 follow [3] 14/25 39/15 171/21 follow-up [1] 39/15 followed [4] 85/13 86/6 87/16 146/24 following [6] 3/1 59/18 86/1 86/1 89/1 136/1 follows [1] 23/6 foot [6] 42/23 103/5 121/10 122/23 123/2 123/11 for for [1] 81/24 foregoing [2] 178/7 178/9 forgot [2] 165/1 168/22 form [2] 48/8 134/12 formation [2] 145/14 145/16 formations [1] 40/14 formed [4] 37/8 37/9 37/10 153/10 forth [1] 50/7 forward [7] 7/9 24/11 41/1 51/20 114/5 117/4 126/6	forwards [1] 139/15 found [14] 46/2 46/3 49/1 52/24 60/9 87/6 98/3 131/16 138/21 139/11 139/19 139/22 140/4 143/18 four [15] 29/10 32/3 33/1 45/24 46/24 47/7 60/15 62/25 100/8 126/17 126/20 137/18 138/11 171/12 174/7 fourth [1] 17/13 frame [6] 11/14 75/14 94/15 137/12 171/15 173/16 frames [1] 174/8 FRANK [2] 2/3 5/23 FREAR [2] 2/7 7/4 free [5] 3/14 7/9 10/6 59/10 113/9 fringe [2] 147/10 147/20 front [1] 7/21 full [5] 12/15 37/1 38/3 41/14 178/11 fundamental [1] 131/8 fundamentally [1] 93/20 further [4] 44/14 57/4 60/22 67/24 future [1] 152/15	76/5 115/25 118/18 123/15 149/3 154/15 158/25 161/9 161/10 161/17 168/5 gives [3] 22/21 107/15 139/17 giving [2] 109/11 123/20 glad [1] 53/23 go [41] goal [4] 10/16 16/9 89/12 89/15 goals [4] 10/15 16/4 16/20 89/12 goes [5] 48/12 81/1 90/4 149/4 170/19 going [67] good [25] 4/17 45/6 46/19 46/21 47/6 47/23 48/1 48/16 69/6 80/14 82/12 98/5 98/16 98/20 99/2 107/16 111/16 115/9 117/7 117/22 121/13 124/5 124/21 140/6 174/25 Google [1] 153/8 governed [1] 45/14 governing [1] 48/25 GPS [1] 61/20 grabbed [2] 27/12 48/15 gradation [11] 101/2 101/8 101/14 103/11 105/10 107/5 108/10 112/25 114/12 121/9 128/25 gradations [11] 104/7 104/19 112/7 118/9 121/6 121/12 121/22 122/5 124/17 128/24 129/10 gradual [4] 43/14 44/10 44/21 119/15 Grand [1] 52/9 GRANT [3] 2/23 4/14 53/17 granted [1] 159/3 graph [12] 20/19 23/18 26/11 29/17 35/15 40/20 47/23 48/19 48/20 50/4 51/25 52/9 graphic [15] 26/18 26/19 28/5 28/17 30/19 41/5 85/18 85/20 103/15 112/9 114/11 114/22 117/24 128/5 129/18 graphical [1] 100/10 graphics [5] 43/10 100/4 102/6 110/22 113/6 graphs [6] 35/23 38/20 50/15 50/22 51/20 113/5 gravel [1] 139/4 great [6] 4/12 9/24 131/19 138/14 138/15 138/22 greater [3] 109/3 110/13 143/19 greatest [2] 35/13 147/12 green [6] 21/13 21/25 103/15 105/11 108/5 108/7 GRENNAN [2] 2/7 5/25 grind [1] 97/11 ground [4] 7/11 9/8 9/9 135/6 group [3] 22/10 58/6 142/21 grouped [1] 142/15 groups [2] 20/24 57/25 guess [63] Gulf [1] 138/8 GUTZMER [2] 2/8 6/6 guys [6] 46/9 53/5 53/8 97/22 156/11 177/14
	G		
	gage [60] gage kind [1] 99/25 gage was [1] 29/3 gaged [14] 17/25 18/1 18/7 19/20 25/2 25/19 26/12 26/12 27/18 28/1 28/22 41/6 45/7 97/2 gaged site [1] 27/18 gages [5] 13/12 41/19 50/20 111/23 112/3 GAME [18] 2/3 2/9 2/11 2/12 2/17 5/9 5/13 5/20 5/22 5/23 17/8 55/10 56/24 57/7 60/2 86/21 161/4 174/6 gap [2] 71/4 159/25 GARY [11] 2/13 6/16 23/24 35/3 44/2 47/3 47/25 48/15 134/19 152/17 152/21 gathered [1] 58/9 general [8] 16/16 111/5 128/1 138/19 139/11 157/14 178/5 178/21 generalized [1] 48/6 generally [1] 20/23 generated [1] 26/22 Genoa [54] geographic [2] 55/22 58/16 geometry [5] 32/7 40/17 83/22 93/11 132/4 geomorphic [2] 164/14 165/9 geomorphologic [4] 13/14 25/13 43/11 45/25 geomorphology [1] 165/8 GEORGE [13] 2/10 2/18 5/6 6/19 19/25 51/12 104/8 105/24 117/2 117/8 134/19 157/9 157/10 getting [13] 37/25 40/1 61/20 67/18 73/18 74/20 78/13 82/22 95/3 95/15 101/25 137/12 177/8 gig [3] 106/10 106/12 106/13 give [6] 17/18 94/9 112/4 131/10 170/2 175/6 given [14] 12/4 64/25 71/20		
		H	
		habitat [33]	

H	HOLLAND [6] 2/9 5/19 161/1 161/3 178/4 178/20	increase [17] 30/2 30/15 42/7 42/12 42/24 43/4 43/5 43/14 43/15 44/10 44/21 45/9 45/22 61/10 91/23 91/25 92/19
half [8] 21/19 22/3 22/4 100/22 103/5 137/24 138/1 138/20	hopefully [3] 51/4 94/16 173/2	increased [2] 61/9 143/24
hamstrung [1] 76/11	hour [1] 88/16	increases [3] 43/20 43/20 45/8
hand [3] 109/17 123/20 124/24	hours [2] 97/11 97/15	increasing [2] 41/25 42/2
handed [1] 110/8	huge [2] 37/14 40/17	incur [1] 96/17
handle [1] 168/13	huh [2] 107/18 177/15	independent [3] 66/16 67/4 67/12
handout [1] 8/13	human [3] 141/7 141/13 141/15	Indiana [1] 137/20
handouts [2] 8/16 28/8	hundred [1] 178/10	indicate [3] 45/16 53/12 107/14
hands [2] 109/8 121/11	HUNT [4] 2/10 6/19 19/25 51/12	indicated [1] 55/11
happen [1] 118/25	HUTZEL [4] 2/22 3/25 4/6 136/4	indicating [1] 146/1
happened [2] 72/7 75/13	hydraulic [3] 6/17 26/21 93/18	indicator [1] 39/4
happening [9] 50/10 73/4 73/9 153/21 156/17 157/1 162/11 162/13 162/15	hydraulics [7] 101/9 108/10 109/10 121/21 121/22 155/13 155/14	indicators [2] 90/13 90/15
happens [2] 9/18 110/7	hydrocycling [30]	individual [1] 168/25
happy [1] 133/13	HYDROELECTRIC [1] 1/3	individually [1] 64/15
hard [6] 4/4 10/9 70/18 95/1 113/2 118/13	hydrologic [11] 55/24 56/3 56/9 56/20 58/16 58/23 70/12 91/2 98/14 125/11 166/8	individually [2] 169/6 169/23
hard validation [1] 113/2	hydrologically [1] 166/1	inflows [3] 59/2 70/3 70/7
HARMS [2] 2/8 5/10	hydrology [4] 27/7 28/2 98/7 98/13	influence [1] 58/25
HDR [24] 2/6 2/7 2/10 2/13 2/14 2/15 2/17 2/18 2/18 2/23 3/9 3/12 4/18 5/1 5/4 5/7 6/1 6/3 6/16 6/18 6/19 6/20 117/2 161/7	hypothesis [1] 74/8	inform [1] 94/1
head [1] 71/7	I	information [36]
hear [13] 7/14 7/20 8/9 15/24 24/13 24/14 24/16 47/5 53/8 54/9 54/23 54/24 136/11	IA [2] 178/4 178/20	informed [1] 161/15
heard [2] 154/22 176/1	ice [1] 96/1	initial [56]
hearing [4] 4/4 10/9 53/3 157/12	idea [2] 139/17 173/10	initially [5] 56/11 80/1 106/22 106/24 163/13
heavy [1] 137/24	identified [9] 12/20 75/7 77/3 77/4 77/5 133/21 144/18 145/17 146/22	Inn [1] 1/22
HEC [14] 14/3 26/5 26/20 36/10 37/4 37/20 93/5 93/6 93/14 93/16 96/7 132/4 133/1 134/5	identify [5] 58/4 58/23 68/9 169/5 171/22	input [4] 98/4 131/21 132/8 133/9
HEC-RAS [13] 14/3 26/5 26/20 36/10 37/4 37/20 93/5 93/6 93/14 93/16 96/7 132/4 134/5	ILP [1] 175/4	inputs [3] 48/10 95/8 95/19
height [3] 63/25 139/23 140/10	Imagine [1] 123/21	insight [1] 33/24
heights [1] 139/6	immediate [1] 38/8	insignificant [1] 61/3
help [3] 28/7 83/1 164/16	immediately [2] 58/20 78/24	instability [5] 96/15 96/17 107/9 110/18 131/13
helpful [8] 16/7 51/6 106/16 106/17 156/20 170/24 176/2 176/16	impact [6] 136/21 145/6 154/3 161/12 161/14 166/3	instance [2] 114/7 130/5
hereunto [1] 178/17	impacted [1] 166/5	instances [5] 108/21 115/16 115/18 116/11 119/1
hesitate [1] 3/15	impacting [1] 49/15	integrate [2] 133/17 165/21
high [17] 39/5 79/14 85/13 86/5 87/15 87/16 95/19 97/22 109/24 118/21 122/3 124/12 129/8 143/25 144/4 146/23 149/10	impacts [5] 156/18 158/13 159/22 160/11 160/12	integrated [3] 8/20 11/19 117/8
higher [15] 34/11 47/9 86/25 108/14 109/20 110/23 112/14 112/15 112/16 116/20 118/22 127/2 127/17 127/20 143/16	implied [3] 64/22 82/12 150/24	integration [5] 164/12 164/13 164/14 165/8 165/11
highest [7] 52/22 63/15 64/4 72/12 85/20 85/22 85/23	implies [2] 149/24 150/20	intensity [1] 63/9
highly [3] 39/19 93/21 140/18	implying [2] 150/22 164/9	intent [1] 172/24
hire [1] 104/16	importance [1] 169/20	interchange [1] 57/25
Historically [1] 62/1	important [10] 24/6 26/9 35/8 76/10 93/25 100/15 116/14 169/9 169/10 169/24	interest [2] 95/18 137/9
history [1] 20/6	inception [1] 28/25	interested [8] 71/14 95/3 95/7 95/13 95/22 133/16 139/1 178/16
hit [5] 24/3 24/3 46/12 114/7 123/11	include [3] 20/3 51/16 51/19	interesting [3] 31/5 31/8 131/23
hitting [1] 69/11	included [13] 13/9 52/9 65/21 77/12 77/12 77/13 79/11 90/12 97/6 97/6 99/5 101/18 175/22	interior [11] 14/9 16/14 17/6 55/6 57/16 58/2 89/18 136/14 137/14 142/9 142/17
hold [4] 9/18 9/20 9/24 95/6	includes [2] 74/23 138/13	intermediate [5] 32/6 32/8 34/20 38/4 38/9
	including [3] 12/11 76/16 140/19	interpret [2] 74/11 75/1
	incoming [1] 118/9	interpretation [2] 158/24 159/5
	inconsistent [1] 85/16	interval [1] 22/20
	incorporate [1] 167/20	introduce [5] 3/21 4/6 4/21 96/14 170/21
	incorporated [5] 27/1 98/8 99/6 99/24 173/2	introduction [1] 11/3
	incorrectly [1] 83/2	introductions [1] 3/18
		intuitive [1] 64/18
		inundation [1] 142/8
		inverse [1] 86/20
		invert [4] 102/22 119/12 120/8 120/13
		involved [2] 11/5 157/3

I	late [3] 74/17 138/10 144/3 lateral [3] 49/11 49/18 49/21 lead [1] 65/3 leading [2] 37/8 37/10 leads [1] 82/6 lean [1] 152/17 leap [1] 150/9 learn [2] 137/4 140/13 left [4] 22/10 29/18 72/14 149/7 length [4] 97/4 97/12 98/22 165/25 Leshara [15] 19/19 41/14 41/17 42/4 42/6 42/14 42/17 43/7 43/14 43/16 43/23 50/22 70/25 71/5 71/12 lesser [1] 163/7 letter [6] 17/12 18/12 24/18 24/22 93/4 93/6 letting [2] 9/22 162/10 level [8] 95/19 113/3 114/2 139/24 140/3 140/8 140/11 167/20 leveling [5] 42/18 43/6 43/7 119/6 122/24 LEWIS [4] 2/13 6/16 23/24 47/3 Library [1] 13/24 license [12] 11/23 12/1 15/18 168/15 172/8 172/10 172/12 172/15 172/21 172/25 175/20 175/22 licensing [2] 8/21 11/19 light [2] 10/20 118/17 lighter [1] 125/6 limit [5] 20/1 21/17 69/22 70/14 145/19 limitation [2] 29/15 168/5 limitations [5] 28/21 107/13 126/19 167/12 168/3 limited [19] 36/14 47/1 58/20 71/21 76/11 82/25 82/25 116/8 117/14 131/6 143/1 145/18 146/7 148/3 151/21 156/24 162/19 170/7 170/12 limiting [2] 17/15 71/20 limits [18] 13/5 18/17 20/4 20/9 20/12 20/23 21/2 21/5 21/6 21/14 22/1 22/11 22/14 23/11 23/17 24/5 24/9 100/10	19/15 102/18 location [17] 18/15 19/6 25/5 27/21 29/10 41/6 42/16 62/25 63/15 63/25 102/15 108/11 118/11 143/11 146/18 147/16 153/17 locations [23] 16/17 17/25 18/1 18/4 18/7 18/9 18/21 19/21 24/25 25/2 25/19 25/21 26/1 26/4 26/13 27/16 29/10 32/16 41/11 41/20 47/8 55/25 64/9 log [7] 23/24 59/7 79/9 80/12 80/14 114/15 115/11 logic [1] 79/22 logistic [5] 59/8 76/25 77/25 78/9 80/5 long [63] long-term [57] longer [1] 41/12 longitudinal [3] 25/3 44/19 84/16 longitudinally [1] 167/5 look [60] looked [48] looking [52] looks [9] 30/14 69/7 83/21 84/14 101/1 126/11 148/6 153/15 168/17 loosely [1] 111/14 losing [1] 141/16 lot [27] 15/18 37/15 48/1 53/18 57/9 59/2 59/2 59/18 60/3 60/14 69/13 81/3 81/4 81/14 95/18 110/5 113/7 131/13 131/13 139/6 157/2 157/2 158/12 164/10 164/22 166/12 169/12 Lott [1] 137/21 loud [1] 54/18 Louisville [14] 13/8 19/20 41/9 41/13 42/9 42/18 42/23 43/8 43/17 44/9 52/11 52/22 55/23 90/5 LOUP [95] Loup/Platte [1] 19/12 low [4] 73/10 85/13 86/6 87/16 lower [28] 16/22 16/25 17/16 21/14 21/17 22/1 22/14 22/19 22/19 23/10 23/18 25/4 40/2 40/13 42/25 43/1 49/8 68/12 86/25 89/19 102/7 116/20 127/3 137/24 142/2 142/6 142/10 143/1 lowermost [2] 22/25 23/19 lowermost Yang [1] 23/19 lowest [1] 147/13 lunch [5] 9/2 9/4 135/13 135/15 135/16
J	JANET [7] 2/22 3/23 3/25 4/5 136/4 174/9 174/12 jaw [1] 123/21 jazz [1] 74/2 JEFF [21] 2/15 6/21 33/8 33/9 34/3 34/16 35/8 36/24 37/19 39/13 49/16 49/25 78/17 81/19 83/19 103/25 111/4 119/8 126/6 165/19 168/8 Jeff's [1] 36/2 JENNIGES [2] 2/10 6/4 JIM [4] 2/7 2/10 6/4 7/4 job [1] 169/4 JOEL [11] 2/11 5/12 56/24 61/7 69/20 73/2 76/24 139/14 148/20 151/13 177/13 JOHN [4] 2/3 2/16 6/8 6/10 JOHNSON [5] 2/23 4/8 4/10 87/19 136/4 JORGENSEN [5] 2/11 5/12 56/24 139/21 148/20 juiced [1] 97/24 July [1] 173/6 July 1st [1] 173/6 June [1] 137/18	
K	Kara [2] 178/4 178/20 keep [5] 10/14 94/3 153/2 162/5 169/22 Kendall [6] 13/11 18/21 51/17 52/14 52/15 68/16 kept [1] 79/6 kin [1] 178/13 kind [88] Kircher [2] 44/4 46/3 Kirsch [1] 139/11 know [83] know which [1] 61/23 knowledge [3] 9/14 66/17 67/4 knows [1] 39/7 KOCH [2] 2/12 5/8 KUMPF [2] 2/13 6/12	line [32] linear [7] 23/2 23/6 23/14 23/20 48/8 56/2 69/17 lines [6] 21/13 21/25 23/12 103/14 103/17 120/11 link [2] 95/14 95/23 LISA [14] 2/15 3/11 4/23 5/3 7/7 7/10 7/25 8/6 15/24 70/23 78/4 94/20 168/13 171/7 list [1] 12/15 listed [2] 141/7 141/8 listen [1] 9/19 lists [1] 16/18 literature [3] 17/2 35/19 96/19 little [49] live [1] 95/6 load [4] 108/15 109/9 109/25 110/8 loaded [1] 81/21 local [1] 169/15 located [5] 19/5 19/11 19/13
L	lack [1] 95/17 laid [1] 174/10 lakes [2] 138/15 139/5 language [1] 168/9 laptop [1] 97/19 large [6] 57/22 104/11 108/21 166/2 169/18 177/12 larger [2] 77/14 139/21 lastly [2] 10/7 132/10	M magnitude [1] 77/16 mail [3] 95/13 95/22 177/13 main [2] 21/7 141/7 maintain [1] 40/1 major [1] 124/15 majority [1] 108/20 making [12] 15/11 65/4 75/18 109/17 131/19 133/8 150/4 150/9 157/3 158/6 159/20 167/16 MAKOWSKI [6] 2/22 4/7 4/9

M			
MAKOWSKI... [3]	46/14 95/10	175/18	management [3]
140/20 166/15	166/16	manager [2]	5/4 6/1
Manitoba [1]	138/14	Mann [3]	68/16 69/6 69/9
Mann-Whitney [3]	68/16 69/6 69/9	Manual [1]	93/18
manuals [1]	96/19	map [1]	153/8
March [2]	56/23 70/14	MARCUS [22]	2/23 4/14 53/17
53/19 53/22 54/3 54/23 62/13	66/12 66/23 68/14 73/25 74/3	74/13 74/18 77/22 78/21	79/24 80/2 81/9 85/4 136/6
marked [1]	64/15	MARY [9]	2/4 5/16 56/24 66/5
73/24 76/24 139/14 177/9	177/13	match [4]	32/20 48/23 114/4
114/4	matched [2]	32/11 130/25	matches [1]
155/17	material [7]	101/2 102/4	103/17 103/22 104/23 124/17
142/1	matrix [2]	80/8 80/22	MATT [8]
2/14 6/2 70/20	70/22 136/7 151/12 151/15	159/2	matter [3]
48/6 67/25 77/18	maximum [1]	64/1	May 1st [1]
120/25	may-effect [1]	166/23	mean [63]
means [4]	68/24 147/9 147/22	170/9	meant [1]
74/15	measurable [3]	87/9 87/12	87/22
measure [7]	21/15 81/5 82/13	102/7 123/3 123/22 123/22	measured [22]
22/8 22/8 23/3	23/11 26/16 26/24 37/7 38/1	40/17 103/12 107/15 108/1	112/9 112/25 113/20 121/7
122/4 123/4 123/13 123/14	124/17 128/24	measurement [1]	176/7
measurements [23]	22/7 25/22	25/25 28/24 29/6 29/8 29/11	37/16 101/15 101/16 103/18
103/18 103/19 113/16 113/17	114/12 114/15 114/19 114/20	114/23 114/24 118/4 176/10	measures [5]
17/9 27/24 55/12	81/8 175/21	measuring [1]	39/8
mechanism [1]	70/8	mechanisms [2]	134/7 135/2
median [1]	22/13	meet [1]	16/20
meeting [26]	1/4 3/7 3/10 5/2	7/9 8/1 8/23 10/15 11/14	12/22 14/17 14/18 14/21
14/25 15/3 15/16 19/23 56/23	58/12 70/14 95/6 136/16	136/17 136/18 159/2 171/14	meetings [4]
3/14 10/25 11/1	13/4	memo [1]	132/25
memories [1]	92/21	memory [2]	90/8 90/25
mention [1]	77/7	mentioned [10]	35/20 44/3
55/1 55/7 59/23 63/21 68/3	149/20 167/4 171/13	meshes [1]	52/24
method [2]	78/16 101/4	methodological [1]	149/22
methodology [1]	27/1	methods [4]	38/13 57/10 59/24
104/3	metric [5]	120/7 123/10	164/20 165/7 167/17
metrics [4]	102/12 114/8	114/9 165/22	Mexico [3]
137/20 138/8	138/9	MICHAEL [1]	2/8
MICHELLE [2]	2/12 5/8	microphone [8]	7/17 7/21 9/12
9/13 10/10 48/15 53/9 136/10	microphones [1]	17/20	mid [2]
137/18 173/1	middle [5]	59/11 114/18	120/25 172/7 172/18
mike [3]	6/6 24/13 24/15	mile [42]	miles [23]
19/16 56/1 68/3	70/2 71/4 71/11 72/16 73/7	78/24 85/4 85/8 85/11 87/11	87/18 97/8 97/14 100/11
100/12 100/14 111/24 111/25	115/6 146/25	millimeters [2]	22/13 22/15
million [1]	166/10	mind [3]	94/3 137/12 153/2
minimum [1]	94/13	minor [4]	120/19 120/20
122/20 123/6	minute [4]	96/23 105/25	105/25 106/7
minutes [6]	88/14 88/15 88/16	106/9 135/14 135/16	missed [1]
108/24	Missouri [9]	13/20 57/23 60/6	99/13 116/5 133/20 134/24
137/24 138/2	misstate [1]	139/16	misunderstanding [1]
66/13	misunderstood [1]	155/11	mitigated [1]
156/19	mixed [2]	126/2 127/12	model [110]
model's [1]	102/3	modeled [4]	100/4 121/8
121/15 124/16	modeling [6]	26/5 107/13	109/4 134/4 155/13 155/20
models [10]	26/5 96/6 96/7	97/4 97/5 98/8 100/19 101/13	133/5 134/5
modification [2]	12/8 12/9	modifications [3]	132/7
132/22 141/14	modified [3]	132/3 132/19	175/5
modify [5]	10/19 132/12	132/13 132/15 175/9	modifying [2]
98/3 131/21	module [2]	14/3 93/14	moment [1]
100/24	monitor [2]	7/8 140/22	monitoring [1]
140/21	monkey [1]	4/20	Montana [1]
137/19	month [3]	60/15 96/20 125/5	months [5]
37/16 40/16 60/16	137/18 138/11	morning [2]	4/17 164/20
morphological [1]	148/8	morphology [14]	16/11 16/24
24/20 38/5 38/10 38/11 39/2	39/9 50/21 51/2 143/5 146/2	148/11 164/25	mouth [3]
9/16 60/5 73/7	move [16]	7/8 10/10 24/11	41/1 42/9 45/23 59/1 67/16
71/17 87/4 104/1 126/6 127/3	127/13 147/14 171/5	moved [1]	118/10
moving [41]	MR [25]	2/3 2/3 2/5 2/6 2/6	2/7 2/7 2/8 2/8 2/9 2/10
2/10 2/11 2/13 2/13 2/14	2/15 2/16 2/16 2/17 2/18	2/19 2/20 2/22 2/23	MS [8]
2/4 2/12 2/14 2/15	2/17 2/18 2/22 2/23	much in [1]	35/19
multiple [6]	16/17 67/11 79/8	80/11 80/22 116/3	music [1]
9/19	mute [1]	9/21	N
naked [1]	120/23	name [2]	3/3 4/25
narrower [2]	96/14 148/2	nationally [1]	141/1
natural [7]	2/19 5/15 32/22	48/13 49/6 143/18 143/25	nature [5]
80/9 94/18 123/15	141/18 175/13	NEAL [4]	2/16 3/4 7/14
163/19	near [5]	7/21 91/9 126/25	127/25 136/18
nearby [1]	21/20	nearest [2]	70/1 70/24
nearly [3]	107/14 108/19	115/3	Nebraska [28]
1/23 2/3 2/4	2/9 2/10 2/11 2/12 2/16 2/17	2/19 5/4 5/9 5/13 5/14 5/19	5/21 6/5 6/9 6/10 137/17
138/12 138/15 138/25 139/3	140/18 140/25 178/2 178/6	necessarily [7]	58/3 101/23
102/8 156/12 166/13 167/1	167/3	necessary [1]	172/20
need [17]	3/15 7/10 9/20	10/6 10/20 14/24 15/4 53/25	110/12 131/20 157/4 158/17
159/4 166/22 167/16 173/13	173/14	needed [4]	10/5 11/25 74/17
111/16	needs [5]	157/14 164/13	166/23 167/15 172/6
neither [1]	49/21	nest [60]	

N	<p> nest counts [1] 66/2 nesters [1] 58/3 nesting [10] 13/16 16/14 18/22 57/16 57/23 58/7 68/2 84/17 86/17 147/21 nests [38] neutral [1] 113/24 never [1] 116/8 new [13] 1/22 2/8 6/6 11/23 14/23 14/24 15/6 18/16 52/4 137/12 137/20 171/20 171/24 New Mexico [1] 137/20 Newfoundland [1] 138/16 nine [1] 110/17 Niobrara [1] 57/24 no impacts [1] 160/11 No. [6] 12/14 13/3 15/22 16/24 55/3 72/12 No. 1 [1] 13/3 No. 12 [1] 15/22 No. 2 [1] 16/24 No. 3 [1] 55/3 No. 68 [1] 72/12 No. 8 [1] 12/14 noise [1] 149/4 noisy [2] 76/5 76/13 non [3] 69/4 69/7 69/11 non-parametric [3] 69/4 69/7 69/11 nonproject [1] 161/24 nonsignificant [1] 65/3 nonutilization [1] 159/8 normal [16] 85/19 86/24 91/2 91/25 98/17 98/18 98/20 98/25 99/3 124/24 125/11 127/1 129/17 129/21 130/11 130/11 normality [1] 56/12 normalization [1] 59/8 normalized [1] 80/13 normally [3] 78/2 144/2 177/12 north [52] North Carolina [1] 138/17 northern [3] 138/13 138/21 138/22 Notary [2] 178/5 178/21 note [6] 26/9 31/5 31/8 55/8 100/21 101/20 noted [3] 44/4 62/24 75/10 noticeably [1] 33/19 November [4] 15/8 15/17 172/1 172/7 November 18th [2] 15/17 172/7 November 23rd [1] 172/1 Nowadays [1] 61/19 null [1] 77/11 number [50] numbers [7] 33/21 60/11 61/23 72/1 75/22 84/5 105/17 numerous [1] 11/1 </p>	<p> obtained [2] 26/6 120/12 obvious [3] 60/25 65/7 153/8 obviously [3] 3/13 137/14 139/20 occurred [6] 61/2 118/18 120/24 121/2 121/7 132/20 occurrence [1] 123/9 occurring [12] 102/3 112/15 118/24 119/5 120/2 120/19 121/13 121/17 132/11 144/12 144/19 160/25 October [2] 14/20 171/18 October 24th [2] 14/20 171/18 odd [1] 104/13 odds [1] 78/12 off-river [1] 75/6 offhand [1] 71/5 office [2] 53/16 104/22 official [2] 172/10 174/3 officially [1] 172/23 Oh [2] 105/22 106/16 okay [100] older [1] 38/20 on-river [1] 60/8 once [6] 18/2 23/16 39/23 39/25 58/5 60/15 one-way [1] 85/3 ones [2] 11/7 81/16 ongoings [1] 14/17 open [3] 3/14 46/8 113/7 opened [1] 159/16 operate [1] 163/16 operated [1] 92/25 operates [2] 170/22 170/23 operating [2] 92/5 131/18 operation [4] 125/5 153/14 164/2 170/16 operation-wise [1] 170/16 operational [4] 130/14 148/3 170/7 170/12 operations [43] opinion [3] 115/12 169/12 174/3 opportunity [2] 10/21 14/21 opposed [4] 81/7 91/16 92/5 93/1 opposite [2] 110/21 116/23 ops [5] 91/12 125/18 125/21 126/23 130/9 orange [2] 107/25 108/1 order [8] 15/15 16/20 27/18 27/25 71/9 72/11 95/14 98/23 ordination [1] 165/2 origin [1] 22/20 original [11] 9/6 13/17 14/7 20/19 21/12 22/23 23/2 23/5 23/13 126/18 162/17 originally [6] 21/12 21/24 22/12 51/14 53/1 162/24 our analysis [1] 155/11 out too [1] 23/23 output [6] 74/5 74/14 74/23 106/10 106/12 106/18 outputs [1] 177/9 outside [3] 59/1 86/23 135/3 overall [2] 52/23 166/6 overemphasizing [1] 149/14 overlaid [1] 48/4 overlay [1] 48/10 overstating [1] 94/4 overview [2] 8/21 11/18 </p>	<p> packet [1] 8/14 PAD [8] 13/9 51/15 51/21 51/22 52/1 52/6 52/25 139/9 Page [1] 52/13 Page 58 [1] 52/13 pages [1] 178/10 paint [1] 99/19 pallid [6] 16/17 17/15 89/18 142/15 142/16 169/2 paper [2] 44/8 48/22 parameter [1] 28/11 parameters [19] 17/6 20/10 20/18 20/25 21/3 21/4 21/7 33/2 45/6 55/5 56/6 58/24 82/15 89/25 95/8 148/4 170/8 170/13 170/17 parametric [5] 69/4 69/7 69/11 78/4 78/13 parcel [1] 140/23 PARKS [18] 2/3 2/9 2/11 2/12 2/17 5/9 5/13 5/20 5/22 5/24 17/8 55/10 56/25 57/7 60/2 86/22 161/4 174/6 part [39] partial [1] 65/22 participants [2] 4/7 136/5 participate [3] 95/11 95/12 95/23 participating [1] 171/2 particular [14] 34/24 35/4 41/19 42/21 43/10 44/4 68/11 78/23 101/11 108/11 109/23 123/9 139/22 140/23 particularly [3] 40/12 41/12 148/19 parties [1] 178/14 PARTNERSHIP [3] 2/5 5/18 57/1 parts [1] 75/7 pass [3] 7/17 7/19 39/20 PAT [21] 2/6 6/20 14/4 15/21 35/20 35/24 36/13 37/1 46/13 47/17 55/1 71/5 83/1 89/4 94/21 94/23 152/17 152/20 154/23 154/24 177/6 PAUL [13] 2/22 4/7 4/9 46/13 46/15 46/19 47/3 49/16 49/25 95/10 117/20 136/5 175/18 pay [1] 166/8 paying [1] 109/1 PDF [1] 104/9 peak [16] 56/17 79/12 79/17 80/19 81/6 81/20 81/23 82/7 82/11 84/4 84/25 87/2 87/13 118/18 122/18 127/18 people [1] 176/1 percent [25] 21/14 22/14 23/16 31/8 31/10 32/10 32/12 32/19 45/16 50/24 56/19 60/19 79/13 79/19 80/6 80/25 85/25 87/14 120/19 123/7 128/20 138/1 138/2 138/3 138/4 percentage [1] 80/18 perfect [4] 114/4 118/25 123/14 124/14 perfectly [2] 79/15 123/11 perform [3] 13/11 18/3 27/14 performance [2] 111/16 113/4 performed [9] 14/7 25/7 89/7 90/24 94/11 125/14 127/14 131/7 143/13 performing [4] 127/21 129/1 131/11 134/18 </p>
O	<p> objective [9] 16/19 16/24 17/4 17/13 55/3 55/11 89/13 89/22 89/23 objectives [7] 16/4 16/19 17/10 55/2 89/20 169/14 169/16 observations [1] 69/8 obtain [1] 25/23 </p>	<p> P p.m [2] 136/1 177/20 </p>	

P	57/23	128/1 133/15 139/6 139/14
portion [4]	55/11 68/21 69/16	142/16 147/18 147/20 151/1
period [21]	27/15 39/1 57/9	166/9 168/4
61/13 65/4 73/23 75/12 84/4		probably eight [1]
85/21 85/23 90/21 98/9 98/10		94/12
102/10 120/21 125/5 146/23		problem [2]
147/3 147/6 154/17 172/11		54/7 165/23
periods [12]	41/15 41/18	problematic [1]
75/20 76/18 116/12 116/13		80/7
117/9 117/10 120/3 120/4		problems [3]
120/5 131/13		78/3 133/4
perpetually [1]	76/4	167/23
perspective [12]	82/20 93/17	proceedings [3]
99/20 121/4 139/1 143/14		3/1 89/1
144/17 147/8 152/12 157/18		136/1
158/4 164/10		process [26]
PETR [2]	2/14 6/25	8/5 8/21 11/4
phase [1]	16/8	11/4 11/5 11/19 14/25 15/3
phone [31]		15/15 20/1 28/9 94/17 96/2
phones [1]	10/3	96/8 100/23 104/15 132/23
physical [9]	93/22 144/23	132/24 141/20 141/22 168/19
145/5 145/5 147/25 148/4		168/20 171/22 172/23 173/5
170/8 170/13 170/16		174/7
pick [7]	40/20 54/9 103/22	processes [2]
108/16 109/12 121/10 131/17		32/23 48/13
picking [2]	102/4 107/9	processing [1]
piece [5]	53/6 62/17 64/4	97/22
74/16 84/6		processor [2]
pieces [2]	11/17 84/7	131/25 132/1
pile [1]	166/15	produced [1]
PILLARD [3]	2/14 6/2 70/22	85/14
Pine [1]	6/17	produces [1]
pink [1]	52/19	87/16
piping [16]	14/9 16/14 17/7	productivity [2]
55/6 57/17 89/18 136/14		17/8 55/12
138/6 138/19 139/2 140/1		products [1]
140/6 141/11 142/9 142/17		101/25
153/24		professional [1]
place [5]	27/23 58/4 81/8	48/22
101/12 134/5		progression [1]
Plains [2]	138/14 138/22	69/17
plan [7]	17/12 18/11 24/18	project [51]
93/3 132/3 132/3 143/9		projecting [1]
planning [2]	94/1 94/22	54/19
Platte [59]		proportion [2]
play [2]	76/6 76/14	66/16 67/2
please [7]	9/18 9/23 10/3	proportionate [1]
66/24 95/12 104/25 105/1		45/17
plenty [1]	10/4	proposal [1]
plot [5]	44/20 50/7 68/22	168/15
106/9 107/25		proposals [1]
plotted [4]	38/21 46/18 47/11	10/19
50/12		proposed [2]
plover [16]	2/5 5/17 13/16	12/5 175/21
14/10 17/7 55/6 56/25 57/18		provide [9]
72/1 138/6 140/1 141/11		14/17 14/21 15/8
142/9 142/17 146/4 148/24		18/17 105/1 106/7 133/1
plowers [12]	9/3 16/15 57/17	146/4 171/16
89/18 136/15 138/19 139/2		provided [5]
140/6 141/1 141/24 145/7		17/7 99/2 105/19
153/24		172/3 173/24
plus [3]	51/25 98/23 101/16	providing [1]
point [30]		109/1
pointed [4]	47/17 78/5 150/16	proximity [3]
164/19		146/16 146/19
pointing [1]	20/15	149/13
points [13]	26/7 47/10 47/13	public [9]
47/22 47/22 49/24 71/21		2/10 2/16 6/5
102/23 102/25 105/21 115/21		6/11 133/2 176/5 177/3 178/5
115/22 115/23		178/21
popped [1]	153/2	published [1]
population [1]	138/19	104/4
populations [3]	16/15 57/21	pull [2]
		136/19 142/20
		pulled [4]
		14/10 104/8 139/7
		156/5
		pulling [1]
		103/16
		purple [5]
		102/21 107/4
		108/12 113/17 120/13
		purpose [4]
		8/1 57/12 58/10
		164/22
		put [19]
		3/9 9/18 9/20 9/23
		10/2 13/5 20/9 20/23 21/4
		21/6 23/15 27/23 52/7 55/25
		75/21 118/16 123/25 150/5
		177/2
		putting [4]
		12/1 20/25 21/2
		161/21
		puzzled [2]
		35/7 38/2
		Q
		qualify [2]
		158/9 160/16
		qualitative [7]
		111/15 114/8
		118/14 120/7 121/3 122/14
		127/14
		qualitatively [4]
		52/25 113/4
		113/13 119/2
		QUALITY [2]
		2/4 6/9
		quantify [2]
		167/8 169/6
		quantity [1]
		70/9
		question [45]

Q	reason [8] 26/14 27/20 34/13 35/14 50/22 50/24 57/25 97/7	75/13 79/4 87/3 99/17 146/15 146/18 173/23 174/1
questions [41]	reasonable [12] 74/3 79/16 114/4 118/6 122/11 122/12 123/15 124/13 124/15 124/21 129/9 129/11	relating [2] 34/11 154/2 relation [3] 14/12 67/25 84/25 relationship [68] relationships [8] 26/2 26/3 27/11 42/5 46/10 48/5 48/7 149/2 relative [6] 83/7 93/9 99/4 137/10 141/23 152/19 relatively [8] 32/2 73/10 85/10 86/5 123/12 124/15 146/23 151/6 relicensing [8] 5/5 5/7 8/5 11/4 96/2 96/8 173/23 174/1 remain [1] 148/12 remained [3] 56/17 147/2 151/6 remaining [1] 19/19 remarks [1] 151/11 remember [8] 10/13 37/13 40/15 70/16 70/21 81/19 115/23 133/14 remind [1] 175/19 reminder [1] 123/24 removal [7] 145/19 145/21 151/19 152/11 154/2 162/17 170/20 remove [4] 163/17 163/22 163/23 170/21 removed [10] 12/7 152/2 152/5 153/7 154/8 154/11 162/21 163/7 163/8 166/17 removing [3] 65/25 162/13 163/16 repeat [4] 7/23 7/23 10/9 54/24 repeatedly [1] 117/9 replicate [1] 130/6 report [62] reported [4] 32/22 35/18 39/12 164/11 reporter [2] 123/19 178/5 reports [8] 13/20 17/19 17/22 18/6 25/21 29/1 86/22 129/6 represent [5] 44/17 103/12 108/12 120/1 120/11 representation [3] 98/21 100/10 121/13 representative [1] 81/17 represented [1] 102/19 representing [3] 29/17 103/21 114/22 represents [4] 28/19 35/12 103/2 118/17 reproduction [2] 167/21 167/21 request [4] 14/1 15/5 21/2 93/3 requested [7] 11/17 13/1 13/5 14/10 171/23 171/23 176/12 requests [7] 14/22 14/23 15/4 15/9 171/19 171/21 173/12 require [3] 175/12 175/13 175/14 required [3] 97/9 97/12 169/19 requirements [1] 15/1 requires [1] 36/10 requiring [1] 176/2 research [2] 35/16 57/12 Reservoirs [1] 141/14
quick [12] 9/2 18/23 19/22 20/5 53/22 65/11 78/18 88/8 90/1 102/1 102/2 142/18	reasonableness [1] 113/3 reasonably [2] 127/22 129/1 reasons [2] 71/16 98/15 recall [9] 25/20 45/2 47/7 50/15 101/22 104/8 120/15 124/24 127/8 received [3] 15/10 173/1 175/10 receiver [2] 54/5 54/10 receiving [2] 38/16 38/17 Recess [2] 88/18 135/18 recognize [1] 166/11 recognizing [1] 102/9 recommend [3] 96/16 165/11 175/20 recommendations [1] 173/18 reconvene [3] 88/14 88/16 135/17 record [1] 177/3 recorded [2] 77/8 85/21 records [2] 41/12 176/5 recovery [2] 118/23 169/14 recreation [1] 147/22 recreational [2] 2/14 141/9 recruited [1] 53/16 red [8] 11/21 12/20 21/13 21/25 23/4 119/13 128/7 138/1 reduce [1] 71/9 reduced [3] 60/22 77/1 178/8 reduces [1] 65/23 reducing [1] 50/24 reduction [12] 30/23 30/25 31/8 31/10 31/20 31/21 32/10 32/12 32/13 32/14 32/21 69/17 refer [1] 97/23 reference [4] 33/11 93/18 177/2 177/7 references [3] 176/2 176/3 176/23 referring [1] 154/24 refined [1] 58/14 reflected [2] 49/8 49/10 refresh [3] 90/7 90/25 92/21 refresher [1] 19/22 regarding [2] 148/19 173/18 regime [3] 131/6 142/2 143/6 region [1] 155/3 regional [5] 6/1 93/25 94/6 96/5 169/15 regions [2] 138/22 138/23 regression [22] 20/13 23/3 23/7 23/14 23/21 24/4 56/2 59/8 66/9 66/14 67/9 67/10 67/11 76/25 77/25 78/9 78/14 79/9 79/11 80/6 80/12 80/13 regularly [1] 140/21 Regulatory [2] 4/1 12/4 rehash [1] 171/9 reinstalled [2] 29/4 29/5 reiterate [3] 25/12 28/20 41/10 reiterating [1] 145/16 relate [3] 24/24 25/16 89/21 related [15] 11/24 13/15 14/11 15/15 56/15 56/21 59/3	
quickly [5] 8/20 26/15 28/20 100/3 113/9 quiet [1] 54/16 quite [18] 23/25 37/23 50/16 55/15 71/8 85/15 95/16 96/15 97/21 104/11 104/18 104/22 110/5 115/15 118/25 132/20 173/14 177/12 quoted [1] 24/22		
R		
rainfall [2] 134/16 135/6 raised [1] 35/8 ran [2] 98/9 112/19 range [9] 21/19 22/2 39/6 42/23 94/10 115/15 137/19 137/23 138/13 ranged [2] 22/4 22/14 ranges [2] 21/17 121/19 rank [1] 69/8 RAS [15] 14/3 26/5 26/5 26/20 36/10 37/4 37/20 93/5 93/6 93/14 93/16 96/7 131/12 132/4 134/5 rate [27] 36/20 36/21 39/4 52/12 52/17 52/22 108/12 108/13 108/15 109/2 109/13 109/20 111/6 112/9 114/24 115/2 116/20 116/22 121/15 124/2 124/4 124/6 126/24 129/3 130/9 130/25 145/23 rates [5] 50/8 52/2 112/14 118/3 118/7 rating [17] 13/6 18/18 20/4 20/7 20/12 20/20 20/21 23/1 24/10 27/3 27/7 27/16 28/1 28/2 108/3 108/7 124/9 ratio [1] 55/13 rationale [1] 171/22 rationalize [1] 36/7 ratios [1] 78/12 re-discussion [1] 137/9 reach [18] 16/12 16/21 16/25 28/15 28/22 28/23 30/18 39/25 40/24 112/1 113/13 114/18 115/8 118/1 142/12 142/25 157/24 163/5 reached [1] 154/18 reaches [3] 112/8 130/18 165/24 read [3] 28/6 93/19 160/5 reading [4] 37/13 37/24 66/13 101/17 ready [4] 89/4 173/8 173/9 173/14 real [3] 53/22 79/22 100/3 realize [1] 9/13 really [29] 30/16 31/16 33/15 35/8 36/25 46/2 50/17 55/12 55/21 56/19 57/18 61/1 61/3 73/17 80/1 82/22 95/3 121/16 135/2 138/25 145/4 150/25 163/15 163/17 169/18 171/9 171/12 176/2 176/16 realtime [3] 97/10 98/25 106/7 rearranged [1] 52/7		

R		
residuals [1] 80/14	sandbars [7] 40/3 139/6	senior [1] 69/2
residuary [1] 80/19	141/17 142/6 145/15 145/23	sense [5] 64/25 79/23 112/1
RESOURCES [2] 2/19 5/15	153/10	153/25 157/8
respect [7] 148/4 159/7	sandpit [2] 73/5 73/22	sensitive [1] 93/22
159/17 170/8 170/13 171/11	sandpits [1] 140/18	sentences [1] 150/19
171/12	saw [43]	separate [4] 64/9 117/19
respective [1] 16/15	saying [12] 36/25 64/22 71/15	137/1 152/23
respond [3] 10/5 47/3 155/23	158/6 158/7 159/20 160/13	SEPTEMBER [12] 1/11 11/8 11/8
responding [8] 111/17 112/5	162/8 165/19 165/20 170/14	11/14 12/10 12/17 14/16
112/13 112/21 118/19 119/3	177/1	14/18 95/5 95/20 171/13
121/4 127/16	says [2] 54/24 170/7	178/18
response [8] 83/11 102/3	scale [7] 55/22 58/15 58/16	September 14th [1] 95/5
112/16 118/22 119/2 122/19	71/10 114/15 115/11 165/24	September 23rd [2] 14/18
124/12 129/8	scattered [1] 73/11	171/13
responses [4] 15/9 122/2	scenario [16] 93/1 99/17	September 8th [1] 14/16
122/20 172/2	99/20 125/1 126/1 127/11	sequential [1] 25/7
rest [5] 3/12 4/21 73/1 73/3	129/16 129/20 143/17 157/22	series [3] 95/25 113/5 147/4
73/11	160/12 161/8 161/9 161/22	served [1] 135/17
restate [1] 152/3	161/24 162/23	serves [3] 100/1 100/2
restraints [1] 49/18	scenarios [4] 131/18 144/6	147/11
restrictions [1] 161/22	156/17 159/12	service [13] 2/6 2/8 2/15
result [7] 20/25 69/1 125/19	science [1] 168/5	5/11 6/22 6/24 29/4 33/10
143/15 143/16 143/25 146/6	scoping [1] 141/20	91/3 93/11 141/3 169/11
resulted [1] 114/14	scores [1] 80/15	175/2
results [73]	screen [2] 28/18 72/14	Services' [1] 175/12
results for [1] 113/21	se [1] 155/25	set [11] 3/18 7/11 8/3 18/3
retired [1] 6/16	seal [1] 178/18	28/10 30/7 36/9 36/10 95/4
retroactively [1] 167/13	seasonal [1] 143/18	106/11 137/13
return [15] 19/13 19/14 27/24	seated [3] 143/2 146/7	sets [3] 37/3 47/2 171/15
67/23 91/6 91/7 91/13 99/12	152/19	seven [5] 15/1 38/25 111/24
99/19 146/16 155/8 156/22	second [32]	127/24 178/10
156/23 158/1 158/1	Secondly [1] 103/10	seven-year [1] 38/25
returns [1] 99/15	secretary [1] 176/4	seventy [1] 178/10
revalidated [1] 144/10	section [18] 34/20 36/11	seventy-seven [1] 178/10
reverse [1] 125/6	36/17 37/7 38/1 40/16 100/6	severe [1] 167/12
reverses [1] 125/22	109/8 109/9 109/9 109/11	shade [2] 125/7 125/8
review [11] 16/4 16/7 18/23	109/13 109/23 110/1 110/4	SHADLE [2] 2/16 6/10
81/14 89/11 89/15 90/1 141/2	110/12 172/23 175/3	shaking [1] 123/20
141/12 141/19 172/19	section's [1] 108/9	shallow [3] 31/17 35/22 45/15
reviewed [1] 173/1	sectional [2] 17/3 96/12	shape [1] 50/2
reviewing [1] 17/1	sections [18] 26/6 36/10	shaping [1] 50/1
revision [1] 14/1	36/18 36/20 37/13 39/25	shared [1] 66/1
RICHARD [1] 2/9	40/19 96/14 100/5 100/8	shores [1] 139/5
RICHARDSON [3] 2/15 3/11 5/3	102/16 105/1 105/5 109/6	short [4] 34/24 35/1 47/1
Rick [3] 5/19 161/1 161/3	110/16 126/10 126/12 126/18	166/4
right [39]	sediment [161]	shorter [2] 41/15 41/18
rigid [3] 36/16 37/4 37/20	sediment transport [1] 122/6	shorthand [1] 178/7
Rive [1] 30/21	sedimentation [17] 9/1 12/11	show [14] 20/11 23/15 24/21
river [190]	12/21 13/3 13/10 15/21 16/2	30/20 35/16 52/7 70/11 100/3
rivers [3] 50/11 139/5 143/5	16/5 16/11 17/23 18/6 18/19	115/21 116/12 116/15 125/24
ROBERT [2] 2/5 2/8	55/2 89/11 90/18 136/24	155/19 155/20
rock [1] 9/14	142/24	showed [24] 29/19 37/14 43/13
role [1] 169/10	sediments [2] 116/3 152/2	45/21 50/15 52/15 52/20 56/4
RON [2] 2/20 7/2	see [98]	60/19 85/6 91/10 106/15
room [2] 7/21 10/24	seeing [9] 35/2 45/23 66/11	112/10 113/24 113/25 123/13
rules [3] 7/11 9/8 9/9	67/23 80/23 83/11 85/10	124/25 127/9 128/19 130/6
run [40]	110/19 120/5	130/21 130/22 155/19 171/10
run-of-river [34]	seen [7] 11/19 16/6 44/6	showing [26] 3/6 21/10 21/22
RUNGE [3] 2/15 6/21 33/9	50/5 94/14 122/21 125/13	22/24 23/10 30/4 41/6 44/18
running [4] 97/23 131/16	segment [6] 55/24 56/1 58/16	52/1 73/9 73/21 79/21 79/25
133/4 133/7	68/11 75/9 97/15	85/10 102/14 113/16 113/18
runoff [1] 134/16	segments [2] 75/7 81/6	114/11 115/2 117/24 118/2
runs [2] 91/18 110/15	select [2] 69/21 101/4	125/3 128/1 128/5 128/15
	selected [3] 27/15 81/7 128/9	131/7
	selecting [1] 150/2	shown [9] 12/20 86/3 103/9
	selection [4] 146/20 149/19	146/3 146/9 151/4 151/24
	149/21 149/23	154/7 155/11
	selections [1] 150/4	shows [13] 20/19 26/11 26/15
	semi [1] 65/22	26/18 33/2 34/2 46/2 49/18
	semi-partial [1] 65/22	72/12 82/16 102/21 108/18
	send [8] 74/1 95/12 95/14	129/18
	95/22 95/22 104/14 132/25	SHUHAI [2] 2/19 5/14
	176/12	side [4] 29/18 49/21 72/14
S		
sacrificed [1] 78/6		
sand [4] 140/20 166/15		
166/16 167/4		
sandbar [9] 16/13 40/13 139/4		
140/3 145/14 145/16 145/20		
146/10 147/11		

S	116/20 144/21 156/23 163/7	state [22] 22/19 33/2 95/18
side... [1] 72/15	sort [29] 62/11 63/4 64/22	99/13 130/20 143/2 143/2
sides [1] 49/19	69/13 75/17 75/17 75/25	146/1 151/1 151/25 152/8
sightly [1] 119/24	80/20 104/15 104/16 148/20	152/9 153/4 153/14 153/20
signature [1] 178/18	149/7 150/20 150/24 151/6	154/18 156/24 160/21 160/23
significance [2] 69/10 169/8	153/2 153/9 156/9 156/14	162/6 178/2 178/6
significant [15] 65/6 65/8	157/3 157/4 157/5 158/7	stated [2] 29/1 103/16
68/6 69/1 69/1 70/19 82/14	159/25 160/6 160/16 160/19	statement [8] 64/15 76/5
85/7 86/12 87/17 96/19	167/10 167/25	149/18 150/13 151/3 154/12
122/21 149/2 149/6 154/17	sounded [4] 48/1 152/22	154/18 170/6
significantly [2] 61/9 68/12	161/20 161/23	statements [2] 150/19 160/17
silence [1] 158/21	souped [2] 97/21 98/6	states [4] 22/18 93/19 138/8
silent [1] 10/3	souped-up [2] 97/21 98/6	138/21
similar [40]	source [2] 103/16 107/14	static [2] 39/19 146/24
similarly [8] 45/1 45/9 45/12	sources [1] 95/25	stating [3] 83/2 147/14
112/2 112/6 112/21 113/23	south [3] 133/24 137/17	159/21
129/22	138/14	station [1] 39/6
simplified [1] 77/14	southern [2] 137/20 138/6	statistical [14] 13/15 53/7
simplifying [1] 139/15	spacing [6] 96/5 96/12 96/16	53/13 53/17 56/7 59/4 59/9
simply [2] 137/8 170/14	96/16 110/13 126/19	63/14 74/20 143/10 146/14
simulated [2] 114/25 115/7	spacings [1] 100/6	146/21 177/8 177/10
simulation [18] 95/8 96/18	spatial [16] 13/13 18/19	statistically [3] 68/6 85/7
97/4 97/10 97/12 98/14	24/11 24/19 25/3 27/2 27/14	86/12
105/13 105/18 106/15 106/20	32/17 40/24 44/13 44/18	statistics [10] 18/22 66/8
112/20 123/2 125/12 128/16	45/21 46/7 58/14 71/10 78/19	66/10 66/11 74/1 74/8 75/2
131/24 132/14 132/16 132/18	speak [9] 7/18 7/22 10/9	137/10 143/7 143/12
simulations [2] 96/25 131/20	54/13 54/17 66/20 66/24	stays [1] 40/7
single [12] 36/9 52/8 83/12	80/21 158/21	steady [2] 68/12 98/10
106/9 109/14 110/4 110/4	speakerphone [2] 54/4 54/6	steeper [1] 48/18
115/24 168/24 168/25 169/1	speaking [1] 54/14	step [26] 9/20 9/21 10/6
169/2	specialist [1] 6/18	14/14 28/9 42/7 42/17 43/16
SISR [1] 124/10	species [31]	43/25 44/14 69/18 96/12 97/3
site [163]	species' [1] 141/8	101/10 101/11 105/16 106/1
sites [54]	specific [14] 14/12 18/20	109/7 109/14 110/5 115/24
situation [1] 166/23	51/13 51/15 51/24 57/12 58/4	117/19 149/12 165/9 168/10
situations [1] 118/23	63/15 63/17 63/25 142/16	168/16
six [8] 12/8 96/20 98/18	150/3 174/18 177/1	STEPHANIE [7] 2/18 5/1 7/7
98/19 98/19 98/19 125/5	specifically [9] 52/12 58/10	7/10 9/8 10/12 88/7
127/24	64/21 76/24 84/20 141/9	stepped [1] 72/23
six-month [1] 125/5	149/19 176/23 177/6	steps [10] 9/4 102/1 168/12
Sixty [1] 173/17	speed [1] 97/22	168/14 171/6 171/9 173/4
size [9] 139/5 139/9 139/11	spend [2] 137/18 138/11	173/6 174/11 174/15
139/18 139/22 140/2 140/6	spoke [1] 17/11	stirred [1] 101/3
140/7 140/10	spot [1] 71/10	stop [1] 131/22
skip [1] 168/12	spring [1] 144/2	stopped [1] 65/11
slide [100]	SPSS [3] 74/4 74/14 74/23	stopping [1] 115/10
slides [5] 30/8 53/19 59/18	square [1] 65/22	storing [1] 91/17
87/5 115/20	squared [7] 65/12 65/14 65/15	strange [1] 54/18
slight [40]	66/9 66/14 66/15 67/1	stream [13] 16/11 16/24 20/7
slightly [20] 41/18 90/5	squares [2] 107/25 108/1	20/16 22/16 22/22 23/6 23/13
102/7 114/13 114/14 114/25	ss [1] 178/2	23/19 24/19 32/23 101/6
119/23 121/8 122/24 125/4	stability [2] 100/6 120/6	129/4
127/2 127/3 127/23 127/25	stabilize [1] 131/15	Street [1] 27/23
128/2 128/4 129/19 129/22	stabilizing [1] 119/6	strengthened [1] 151/4
130/1 144/8	stable [9] 32/7 96/22 113/19	stress [1] 76/13
slope [2] 48/18 49/9	113/20 113/24 119/22 124/22	stretch [13] 8/5 59/17 68/25
small [3] 112/7 123/12	130/19 130/23	71/22 111/20 111/21 113/21
123/13	stage [4] 15/3 143/17 143/22	151/5 165/4 165/5 166/2
smaller [2] 70/15 90/6	147/10	166/5 166/7
snapshot [1] 119/8	stages [1] 40/2	strong [5] 44/23 45/10 45/12
so that [1] 176/4	standardized [1] 85/19	46/3 80/18
so what [1] 136/22	standpoint [2] 149/22 156/9	stronger [2] 45/2 64/16
software [2] 14/4 133/2	stars [1] 9/15	strongly [2] 87/8 96/15
solely [1] 166/14	start [13] 3/19 3/24 4/24	structures [1] 175/12
solid [3] 23/1 102/21 113/17	53/5 70/3 74/16 131/22	stuck [1] 15/16
some balancing [1] 115/25	132/12 132/17 136/12 153/6	studied [2] 12/1 140/16
somebody [2] 7/22 50/23	162/2 162/2	studies [51]
somewhat [4] 49/10 71/20	started [8] 41/16 41/16 54/23	study [154]
81/13 85/16	99/1 106/22 106/25 141/22	study result [1] 125/19
sorry [15] 4/3 22/7 23/24	168/8	study-wise [1] 172/6
27/19 41/17 47/18 47/20	starting [6] 8/24 11/2 25/5	stuff [1] 15/19
51/18 52/13 66/18 66/19	41/8 41/24 53/11	sturgeon [7] 16/17 17/15
	starts [2] 102/5 172/22	89/19 142/15 142/16 168/23

S	surveys [4] 49/12 49/17 49/20 65/1	test [13] 13/11 66/10 66/11 68/16 68/23 69/4 69/5 69/6 69/7 69/13 74/1 74/9 75/2
sturgeon... [1] 169/2	suspended [8] 22/6 22/8 23/3 23/11 101/15 108/2 114/22 118/4	tested [1] 78/11
subbasins [1] 134/8	swings [1] 124/15	tests [2] 68/15 69/12
subcontracting [1] 6/18	switch [1] 125/8	Texas [1] 137/20
submit [2] 14/22 172/24	switching [1] 17/20	thank [13] 3/5 3/10 7/6 8/8 10/11 39/17 51/6 117/22 151/11 164/3 170/18 170/25 177/19
submitted [8] 13/22 13/23 74/17 74/21 172/24 173/10 176/3 176/24	syllogism [1] 75/17	thanks [4] 7/12 15/23 47/25 151/13
submitting [1] 172/8	sympathy [1] 133/6	the bed [1] 123/17
successful [1] 167/21	system [51]	the contractors [1] 166/17
successfully [1] 101/7	system within [1] 153/13	theory [2] 85/14 93/21
successive [1] 120/17	systems [2] 143/3 144/20	there -- I [1] 151/3
SUESS [3] 2/16 3/4 163/19	T	thereof [1] 178/16
sufficient [1] 100/16	T-test [4] 68/16 68/23 69/7 69/13	THERESA [2] 2/14 6/25
suggest [7] 96/11 96/24 116/19 116/22 120/18 120/20 127/21	table [2] 8/14 33/12	these physical [1] 145/5
suggested [1] 69/3	tables [3] 28/8 104/7 104/9	they range [1] 137/23
suggesting [1] 155/7	tack [1] 98/24	thing [20] 18/13 18/20 24/23 26/9 31/5 35/25 38/2 56/9 71/24 93/19 99/11 101/20 112/6 113/12 113/12 118/15 124/20 137/7 168/21 177/7
suggestion [1] 75/25	tailrace [37]	things [33]
suggests [2] 96/19 124/6	take [7] 35/21 84/3 88/7 88/13 107/7 131/19 136/23	think [74]
suitability [5] 142/1 142/5 142/11 167/19 167/19	taken [16] 29/4 88/18 97/16 101/15 101/16 103/19 103/20 108/2 114/13 114/16 114/19 114/23 118/4 124/1 135/18 178/7	thinking [4] 9/7 152/7 158/4 167/18
suitable [4] 146/12 147/18 147/23 148/22	takes [2] 101/8 171/5	third [5] 16/8 17/4 18/20 87/21 121/3
summarize [5] 93/3 117/6 141/19 141/23 142/20	talk [12] 15/21 20/8 24/12 31/14 51/12 53/7 59/18 68/14 89/7 94/23 94/24 98/2	THOMPSON [1] 2/17
summarized [2] 148/13 159/3	talked [12] 8/22 10/7 35/4 57/5 58/12 58/14 76/24 85/15 90/17 158/12 174/6 177/8	thought [9] 16/6 44/16 46/11 57/2 67/14 70/13 99/1 155/3 160/22
summarizing [3] 95/1 95/19 140/24	talking [20] 19/1 40/7 54/4 63/3 122/23 134/11 136/18 139/18 149/20 149/23 149/24 151/19 153/3 161/21 162/7 162/21 163/1 165/24 168/8 176/10	threat [2] 141/7 141/8
summary [28] 9/3 14/9 14/17 14/22 24/21 31/25 43/10 44/12 45/10 45/20 52/14 75/4 87/5 121/24 124/11 126/23 129/7 130/8 136/14 137/8 139/8 142/18 142/23 143/15 145/8 145/9 171/14 171/16	Tau [6] 13/11 18/21 51/17 52/14 52/15 68/17	threats [3] 140/24 141/4 169/17
summed [2] 72/13 72/22	team [1] 3/12	three [32]
summer [2] 26/7 144/3	technical [1] 133/2	three feet [1] 21/21
sums [1] 86/9	TELEPHONE [1] 2/21	three-tenths [1] 123/1
supplemental [7] 13/13 18/19 27/2 40/24 46/6 51/9 56/8	tell [2] 61/18 121/11	three-year [2] 98/9 98/10
supplemented [1] 96/6	telling [2] 61/8 109/23	throw [1] 105/17
supply [20] 17/24 82/25 116/8 117/14 131/5 134/12 135/7 143/1 145/18 145/20 146/7 146/9 151/20 154/9 154/10 156/1 156/2 156/3 156/24 162/19	tells [5] 44/23 45/7 103/20 108/22 132/4	tight [2] 108/22 111/6
supply-limited [2] 146/7 162/19	temperature [1] 12/12	tilted [1] 9/16
support [1] 133/2	ten [7] 77/17 88/15 88/16 94/12 94/12 94/14 135/14	time [58]
supporting [1] 169/16	ten-year [2] 94/12 94/12	times [11] 11/20 35/21 55/19 60/10 62/4 62/25 77/7 97/17 119/17 131/14 150/4
suppose [1] 140/12	tend [1] 61/1	timing [1] 65/1
sure [23] 9/10 16/5 68/18 80/4 83/18 95/14 99/23 104/18 105/22 110/21 123/15 131/14 132/2 132/20 132/21 132/22 139/14 148/14 157/11 157/16 158/14 167/1 176/13	tenth [1] 123/11	title [2] 168/22 168/22
sure that [1] 176/13	tenths [3] 121/9 122/23 123/1	to-wit [3] 3/2 89/2 136/2
surface [2] 36/23 40/18	tenuous [1] 150/13	today [23] 3/6 3/10 3/13 3/16 3/19 5/2 7/6 7/9 7/11 8/1 8/12 10/1 10/4 14/15 94/23 95/2 95/17 136/13 146/5 158/12 171/2 177/8 177/18
surprise [3] 65/7 79/16 149/3	term [64]	told [2] 103/7 119/2
surprised [1] 50/5	terminology [1] 174/19	TOM [5] 2/6 2/13 6/12 6/23 98/2
surprising [1] 31/17	terms [4] 36/13 156/12 166/3 173/19	tomorrow [1] 14/19
survey [14] 18/2 29/8 120/9 120/12 120/17 121/2 121/3 122/3 124/13 128/17 128/19 129/9 155/12 155/18	tern [20] 2/5 5/17 13/16 14/9 17/7 55/6 56/25 57/16 57/18 65/21 67/6 72/1 79/10 136/14 138/10 141/1 142/9 142/17 146/4 148/24	tons [5] 99/16 121/19 121/20 133/22 134/1
surveyed [8] 34/19 36/17 36/19 41/20 110/17 112/22 126/18 129/10	tern/plover [1] 72/1	top [4] 71/6 119/10 148/23 164/8
	terns [15] 9/3 16/14 58/3 75/19 76/17 87/9 89/18 137/15 137/22 139/2 139/10 141/3 141/23 145/7 153/24	total [8] 84/5 90/15 90/19 91/3 91/11 91/14 92/8 92/24
		totally [1] 117/3
		track [1] 177/6
		TRAILS [1] 2/14
		transcription [2] 178/9 178/11

T			
transform [3] 79/9 80/12 80/14	understand [5] 18/24 36/2 57/11 71/22 176/18	unconstrained [2] 49/5 49/23	variation [4] 66/1 66/16 67/2 80/21
transformed [1] 59/7	understanding [2] 135/4 164/5	understand [5] 18/24 36/2 57/11 71/22 176/18	variation [7] 23/25 37/14 37/15 65/1 65/2 76/2 165/17
transition [2] 39/9 99/2	ungaged [20] 18/4 18/9 19/1 19/2 25/2 25/8 25/9 25/10 26/1 26/4 27/19 27/21 27/25 28/16 28/16 29/7 41/7 41/19 121/14 127/15	understanding [2] 135/4 164/5	varied [1] 22/17
transitional [1] 38/9	uniform [1] 32/2	ungaged [20] 18/4 18/9 19/1 19/2 25/2 25/8 25/9 25/10 26/1 26/4 27/19 27/21 27/25 28/16 28/16 29/7 41/7 41/19 121/14 127/15	varies [1] 38/24
transitioned [1] 34/1	unit [10] 20/7 20/16 22/16 22/22 23/6 23/13 23/19 23/19 101/6 129/4	uniform [1] 32/2	variety [1] 59/24
translate [1] 50/18	United [1] 138/21	unit [10] 20/7 20/16 22/16 22/22 23/6 23/13 23/19 23/19 101/6 129/4	various [4] 57/25 84/8 93/7 98/4
transport [68]	Unites [1] 138/8	United [1] 138/21	vary [4] 40/8 139/10 140/10 157/15
transported [25] 90/16 90/20 91/4 91/11 91/15 91/23 92/4 92/8 92/13 92/16 92/24 101/3 108/19 116/4 125/4 125/9 125/11 129/2 129/19 129/23 130/1 133/22 134/2 135/3 164/22	unknown [1] 58/1	Unites [1] 138/8	varying [1] 20/17
transporting [12] 108/13 108/23 122/7 122/7 124/7 124/25 125/20 125/25 127/9 129/14 130/10 144/10	unstable [1] 80/8	unknown [1] 58/1	vegetation [2] 141/16 141/17
treated [1] 77/11	unusual [1] 9/13	unstable [1] 80/8	velocities [3] 29/23 30/6 36/3
trend [62]	updated [17] 1/4 3/6 8/25 10/17 16/2 17/11 17/13 18/12 51/16 51/21 89/8 89/13 89/22 90/7 93/5 96/3 143/8	unstable [1] 80/8	velocity [19] 21/7 21/11 21/17 24/25 25/15 27/10 29/17 29/19 29/20 30/2 32/1 32/3 33/18 35/19 41/23 42/5 42/8 42/12 43/13
trended [1] 113/15	updates [1] 11/16	unusual [1] 9/13	version [1] 69/7
trending [5] 102/13 103/8 112/2 112/3 113/14	upmost [1] 25/5	updated [17] 1/4 3/6 8/25 10/17 16/2 17/11 17/13 18/12 51/16 51/21 89/8 89/13 89/22 90/7 93/5 96/3 143/8	versus [37]
trends [10] 13/12 93/25 94/6 97/1 101/23 118/7 122/12 130/21 130/22 155/19	upper [8] 21/14 21/25 22/14 22/20 23/10 23/17 23/18 49/1	updates [1] 11/16	vertical [2] 39/24 118/17
tribes [1] 43/25	uppermost [1] 22/25	upmost [1] 25/5	view [1] 155/22
tributaries [2] 70/3 133/23	upstream [25] 19/2 19/10 19/12 38/5 48/14 49/20 90/4 91/6 91/13 99/6 100/1 100/16 100/21 102/18 109/11 109/17 110/8 111/24 111/25 112/3 115/7 119/24 147/12 154/15 155/8	upper [8] 21/14 21/25 22/14 22/20 23/10 23/17 23/18 49/1	visits [18] 59/23 60/14 60/17 60/21 61/2 61/12 61/14 62/11 62/15 64/17 65/5 65/13 65/16 65/23 66/3 67/5 77/8 87/7
tried [2] 136/23 165/18	use [25] 24/12 24/15 29/1 36/16 38/13 38/20 48/7 55/12 57/14 62/9 62/10 100/22 107/1 132/5 132/5 132/6 139/3 145/6 145/15 157/20 158/17 165/7 165/8 165/9 178/8	uppermost [1] 22/25	visually [2] 68/19 121/11
trivial [1] 81/1	useful [1] 57/19	upstream [25] 19/2 19/10 19/12 38/5 48/14 49/20 90/4 91/6 91/13 99/6 100/1 100/16 100/21 102/18 109/11 109/17 110/8 111/24 111/25 112/3 115/7 119/24 147/12 154/15 155/8	voice [1] 54/19
true [2] 115/17 178/11	USGS [19] 20/13 21/15 22/6 23/3 23/11 25/22 26/24 44/4 48/22 92/11 103/20 104/2 108/2 114/20 114/23 118/5 176/7 176/10 177/6	use [25] 24/12 24/15 29/1 36/16 38/13 38/20 48/7 55/12 57/14 62/9 62/10 100/22 107/1 132/5 132/5 132/6 139/3 145/6 145/15 157/20 158/17 165/7 165/8 165/9 178/8	volunteers [1] 60/1
truly [4] 29/10 46/25 49/5 94/5	USGS had [1] 22/6	useful [1] 57/19	W
trust [1] 139/24	utilization [2] 159/8 159/18	USGS [19] 20/13 21/15 22/6 23/3 23/11 25/22 26/24 44/4 48/22 92/11 103/20 104/2 108/2 114/20 114/23 118/5 176/7 176/10 177/6	wait [2] 62/11 111/2
try [13] 9/22 10/12 10/12 40/20 54/12 54/24 58/17 67/19 76/20 136/10 152/3 165/14 169/6	utilize [1] 93/23	utilization [2] 159/8 159/18	WALDOW [4] 2/18 5/6 117/2 157/10
trying [13] 24/2 36/7 48/23 55/11 60/12 66/25 85/17 132/10 133/17 145/1 149/12 163/13 167/25	utilized [1] 93/19	utilize [1] 93/23	walk [5] 8/1 13/1 19/25 20/5 28/10
Ts [1] 74/2	V	utilized [1] 93/19	want [20] 3/5 3/9 3/24 4/23 7/5 7/17 12/25 29/9 46/11 77/22 88/7 100/3 100/18 133/3 152/13 154/22 158/14 168/11 168/12 174/23
Tuesday [2] 74/21 177/10	validation [3] 111/14 113/2 114/7	USGS had [1] 22/6	wanted [21] 16/3 17/18 25/1 26/8 29/14 41/10 44/13 50/23 55/8 70/17 90/7 90/25 92/21 99/21 99/23 100/20 112/1 118/19 120/1 127/16 137/15
TUNINK [2] 2/17 5/21	Valley [1] 6/17	utilization [2] 159/8 159/18	wants [2] 159/14 166/8
turn [6] 7/7 7/11 15/20 19/24 51/11 136/7	value [8] 22/13 22/20 22/20 22/23 23/21 69/9 85/24 154/9	utilize [1] 93/23	warm [4] 96/20 96/20 98/9 98/10
twenty [1] 94/15	values [10] 21/9 22/6 27/13 65/12 66/11 74/2 74/12 77/11 83/10 101/24	utilized [1] 93/19	warm-up [4] 96/20 96/20 98/9 98/10
twenty-year [1] 94/15	variability [13] 34/22 35/2 40/3 120/2 121/18 128/6 128/15 143/11 143/18 146/15 146/17 147/16 149/3	V	warmed [1] 101/25
two [43]	variable [11] 39/20 66/16 66/18 67/3 67/4 76/1 76/3 77/2 77/15 79/10 80/7	validation [3] 111/14 113/2 114/7	wash [2] 166/19 169/1
two feet [2] 21/18 21/20	variables [19] 22/17 22/18 33/18 56/3 56/10 56/14 56/16 56/20 56/21 67/12 72/1 72/5 76/6 76/13 78/11 79/12 79/17 81/15 93/22	Valley [1] 6/17	water [14] 12/11 36/22 91/17 93/11 139/12 139/24 140/3 140/8 140/11 157/22 162/9 162/10 163/21 163/25
two-year [1] 167/8		value [8] 22/13 22/20 22/20 22/23 23/21 69/9 85/24 154/9	way [36]
type [3] 79/7 79/23 156/17		values [10] 21/9 22/6 27/13 65/12 66/11 74/2 74/12 77/11 83/10 101/24	ways [2] 48/23 84/8
types [4] 57/1 59/4 95/8 134/13		variability [13] 34/22 35/2 40/3 120/2 121/18 128/6 128/15 143/11 143/18 146/15 146/17 147/16 149/3	we've [2] 8/22 20/9
typewriting [1] 178/8		variable [11] 39/20 66/16 66/18 67/3 67/4 76/1 76/3 77/2 77/15 79/10 80/7	weak [1] 80/16
typical [5] 69/13 91/1 91/1 91/1 92/14		variables [19] 22/17 22/18 33/18 56/3 56/10 56/14 56/16 56/20 56/21 67/12 72/1 72/5 76/6 76/13 78/11 79/12 79/17 81/15 93/22	weakly [1] 87/6
typically [4] 94/11 100/7 112/15 133/1			Web [5] 8/15 176/14 176/20 177/3 177/11
U			Wednesday [3] 95/5 95/20 133/14
U.S [1] 138/7			weeds [2] 95/4 95/16
Uh [2] 107/18 177/15			week [2] 74/18 94/22
Uh-huh [2] 107/18 177/15			weekly [1] 65/5
ultimately [2] 168/17 168/18			weeks [2] 14/18 174/7
uncertain [1] 93/20			weir [12] 19/2 19/4 144/25
uncertainty [2] 57/13 58/11			
unchanged [1] 75/11			
unclear [1] 158/22			

W
weir... [9] 145/3 148/1 148/7
154/6 154/14 154/15 155/8
155/17 170/17
weird [1] 37/13
welcome [1] 95/11
WENDY [1] 2/17
went [7] 11/13 18/4 27/9
39/7 64/5 86/11 143/21
wet [15] 91/1 92/2 92/7
98/16 98/18 98/19 98/24 99/2
124/23 125/23 127/7 129/17
129/25 130/11 130/11
wetter [4] 56/18 147/10
147/20 167/4
WHEREOF [1] 178/17
whichever [1] 90/21
WHITE [2] 2/18 5/1
Whitney [3] 68/16 69/6 69/9
wide [6] 31/17 35/21 39/6
45/3 45/15 93/22
wider [1] 148/2
width [56]
widths [10] 31/4 34/10 34/11
34/13 36/3 42/22 50/7 50/14
50/16 148/1
WILDLIFE [10] 2/6 2/8 2/15
5/11 6/22 6/24 33/10 169/11
175/2 175/11
window [3] 34/24 35/1 86/24
winter [3] 137/16 138/6
138/7
wintering [1] 141/13
wise [2] 170/16 172/6
wit [3] 3/2 89/2 136/2
WITNESS [1] 178/17
wonder [1] 81/6
wondering [6] 66/7 66/10
73/25 156/10 162/19 163/3
work [12] 5/1 12/18 12/19
13/19 42/24 44/3 44/3 48/13
72/5 78/1 109/17 143/7
worked [5] 32/24 140/13
156/14 166/17 166/18
working [3] 7/18 7/19 41/8
world [3] 1/22 75/20 76/17
worse [1] 158/3
worst [2] 99/16 99/19
worth [3] 25/24 26/24 106/13
write [3] 50/19 74/22 134/21
write-up [2] 50/19 74/22
written [3] 51/22 149/18
158/23
wrong [1] 105/25
wrote [1] 44/8

Y
Yang [8] 20/7 20/20 22/16
22/22 23/5 23/13 23/19 23/19
Yang's [3] 20/16 101/6 129/4
yeah [15] 33/9 35/6 48/16
49/11 53/23 71/22 78/18
104/9 105/11 106/24 110/25
111/7 117/7 134/22 150/17
year [78]
year-to-year [1] 147/19
years [32]
yesterday [1] 35/5
yield [1] 116/3

Z
zero [4] 77/5 77/13 77/18
78/13

ZHENG [2] 2/19 5/14
Ziewitz [1] 140/4
ZIOLA [2] 2/20 7/2