

ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
 WATER QUALITY STANDARDS AND)
 EFFLUENT LIMITATIONS FOR THE)
 CHICAGO AREA WATERWAY SYSTEM)
 AND THE LOWER DES PLAINES)
 RIVER: PROPOSED AMENDMENTS)
 TO 35 Ill. Adm. Code Parts 301,)
 302, 303 and 304)

R08-09

(Rulemaking-
Water

RECEIVED
CLERK'S OFFICE

MAY 26 2011

STATE OF ILLINOIS
Pollution Control Board

REPORT OF THE PROCEEDINGS held in the

above entitled cause before Hearing Officer Marie
 Tipsord, called by the Illinois Pollution Control
 Board, taken by Steven Brickey, CSR, for the State
 of Illinois, 100 West Randolph Street, Chicago,
 Illinois, on the 16th day of May, 2011, commencing
 at the hour of 9:00 a.m.

A P P E A R A N C E S

MS. MARIE TIPSORD, Hearing Officer
MS. ALISA LIU, Environmental Scientist
MR. ANAND RAO, Senior Environmental Scientist
MR. TANNER GIRARD, Acting Chairman
MR. THOMAS JOHNSON
MR. GARY BLANKENSHIP
MS. CARRIE ZALEWSKI

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
(217) 782-5544

BY: MS. DEBORAH WILLIAMS

SNR DENTON
BY: MR. ARIEL TESHER
233 South Wacker Drive
Suite 7800
Chicago, Illinois 60606
(312) 876-2380

ENVIRONMENTAL LAW ON POLICY CENTER
BY: MR. ALBERT ETTINGER
53 West Jackson Boulevard
Chicago, Illinois 60604
(773) 818-4825

BARNES & THORNBURG, LLP
BY: FREDRICK P. ANDES
One North Wacker Drive
Suite 4400
Chicago, Illinois 60606
(312) 214-8310

MR. SCOTT BELL

REPORTED BY:

Steven J. Brickey, CSR
CSR License No. 084-004675

L.A. COURT REPORTERS, LLC. (312) 419-9292

I N D E X

THE WITNESS: SCOTT BELL

| | PAGE |
|----------------------------------|------|
| Examination by Ms. Ettinger..... | 9 |

THE WITNESS: SCUDDER MACKEY

| | PAGE |
|----------------------------------|------|
| Examination by Mr. Teshar..... | 215 |
| Examination by Mr. Ettinger..... | 224 |

E X H I B I T S

| | Marked for Identification |
|----------------------|------------------------------|
| Exhibit No. 474..... | 9 |
| Exhibit No. 455..... | 170 |
| Exhibit No. 456..... | 171 |
| Exhibit No. 457..... | 215 |
| Exhibit No. 458..... | 237 |

1 MS. TIPSORD: Good morning,
2 everyone. My name is Marie Tipsord and I've been
3 appointed by the Board to serve as Hearing Officer
4 in this proceeding entitled Water Quality
5 Standards and Effluent Limitations for the Chicago
6 Area Waterway System Lower Des Plaines River,
7 proposed amendments to 35 Ill. Admin Code 301,
8 302, 303 and 304.

9 This is Docket No. R08-9. This
10 is Subdocket C. With me today to my immediate
11 left is acting Chairman G. Tanner Girard. To his
12 left, Board Member Andrea Moore. To her left is
13 Board Member Gary Blankenship and Board Member
14 Carrie Zalewski will be joining us later on this
15 morning. To far my right is Board Member Thomas
16 Johnson. To my immediate right is Anand Rao and
17 to his right is Alisa Liu from our technical
18 staff. I don't think any of the interns have
19 joined us today.

20 Today's hearing is the fifth day
21 in the hearing of Subdocket C, but the 48th day of
22 hearing overall in this proceeding. A prehearing
23 conference was held on March 7th, 2011, and a
24 schedule was decided upon. I did not do a Hearing

1 Officer order so here is the schedule as we are
2 where we are now.

3 We will begin with Mr. Scott
4 Bell on behalf of the District. He began his
5 testimony on March 10th and I believe we completed
6 questions by the IEPA.

7 Mr. Bell's testimony was
8 admitted as Exhibit 447. After -- with Mr. Bell,
9 we will begin with Prairie Rivers and Sierra Club
10 and then go to Midwest Generation for questions.
11 After Mr. Bell is done, we will proceed with
12 Scudder Mackey who also will be testifying on
13 behalf of the District. He will be questioned
14 first by the IEPA and then Prairie Rivers and
15 Sierra Club, then Open Lands, Midwest Generation
16 and finally by Citgo.

17 Following Mr. Mackey, if we have
18 time today, nobody laugh, we will begin with
19 Jennifer Wasik who will be questioned by the IEPA,
20 then Prairie Rivers and the Sierra Club and
21 concluding with Midwest Generation. We will then
22 have David Zenz and Andrea Moore testify later on
23 this week.

24 All testimony will be marked as

1 an exhibit and entered as if read. Anyone may ask
2 a follow-up question. You need not wait until
3 your turn to ask a question. I do ask that you
4 raise your hand, wait for me to acknowledge you.
5 After I have acknowledged you, please state your
6 name and whom you represent before you begin your
7 questions. Please speak one at a time. If you
8 are speaking over each other, the court reporter
9 will not be able to get your questions on the
10 record. Please note that any questions asked by a
11 Board Member or staff are intended to help build a
12 complete record for the Board's decision and not
13 to express any preconceived notion or bias.

14 I also want to note for the
15 record the IEPA is on their way. They told us it
16 would be about 10:00 before they get there, but to
17 begin without them. Dr. Girard?

18 MR. GIRARD: Good morning. Welcome
19 to Hearing Day 48. The Board is very grateful for
20 all the time and effort that's been put into this
21 rulemaking. We look forward to your questions and
22 testimony today. Thank you.

23 MS. TIPSORD: With that, Mr. Bell,
24 I'll remind you that you have been sworn in and

1 you are still under oath and I understand there's
2 a clarification you would like to make from your
3 testimony at the last hearing?

4 THE WITNESS: Yes, that's correct.
5 At the last round of testimony, I was asked to
6 produce a table which explained how we assign
7 certain fish species to certain fish metrics and
8 this was important because it was the basis for us
9 calculating what we called our combined fish
10 metric and that was the measure of fish community
11 that we used to compare to habitat and water
12 quality in our study.

13 When we produced that table, it
14 didn't look right and several people noticed that.
15 When I returned to the office, we looked into
16 that. We found a transcription error that had
17 been made. Some of the fish species had been
18 assigned to more than one metric and they should
19 not have been.

20 We corrected the transcription,
21 reevaluated the analyses and it changed none of
22 the conclusions of the study. Some of the numbers
23 changed very, very slightly, but my testimony did
24 not change.

1 MR. ANDES: So we have a revised
2 table?

3 THE WITNESS: We have the revised
4 table.

5 MR. ANDES: With no heading on it.

6 MS. TIPSORD: I have been handed a
7 table -- Mr. Bell, do you remember which table
8 precisely this is correcting?

9 THE WITNESS: No. Actually, this
10 was something that was submitted independent of
11 our report during the last hearing. So I don't
12 know. It probably has a number. Fred, do you
13 know?

14 MR. ANDES: Not offhand.

15 THE WITNESS: It's not a table that
16 appeared on one of the reports or in the testimony
17 or attachments. It was something that was
18 specifically requested in response to one of
19 Illinois EPA's questions.

20 MR. ETTINGER: Is it an exhibit?

21 MS. TIPSORD: I'm trying to figure
22 out which exhibit this might have been just so we
23 can be clear. Does anybody recognize it right
24 away? I don't have the exhibits with me. Do you

1 guys recognize it? All right. We'll admit it as
2 an exhibit.

3 MS. MOORE: He thinks it might be
4 454.

5 MS. TIPSORD: If there's no
6 objection, we will mark it as 474.

7 MS MOORE: 454.

8 MS. TIPSORD: It might be 454.

9 MS. MOORE: Do you have it?

10 MS. TIPSORD: Exhibit 452 looks
11 similar.

12 MS. MOORE: 454.

13 MS. TIPSORD: I just want to be
14 clear so we don't use Exhibit 454 or whatever it
15 is. We're going to go ahead and admit it as
16 Exhibit 474 if there's no objection. That is the
17 correct number, isn't it? Am I remembering or am
18 I going too far? 474, if there's no objection.
19 Seeing none, it's Exhibit 474.

20 (Document marked as IEPA Exhibit
21 No. 474 for identification.)

22 MS. TIPSORD: With that, if you're
23 ready, we'll begin with Mr. Ettinger's questions.

24 THE WITNESS: Certainly.

1 EXAMINATION

2 MR. ETTINGER

3 Q. As long as we have this, I just want
4 to ask a little bit more about this.

5 A. Sure.

6 Q. I think you described it briefly,
7 and I don't want to go over everything that was
8 gone over with 454, but what is this exhibit about
9 again?

10 A. Right. So the table shows a list of
11 fish species along the left-hand side and along
12 the top are ten fish metrics that are just
13 different ways of describing the fish community.
14 Those are the ten we used to develop our combined
15 fish metric, which is the measure -- the single
16 measure of fish health that we used in our study.

17 So as you move across the table
18 for any given species, the species is assigned to
19 one or more of these metrics and that's
20 indicated -- where an assignment is made, it's
21 indicated by a darkened box. The writing in the
22 box refers to the specific technical reference or
23 in the case of the letters BPJ that means best
24 professional judgment on the part of our

1 biological staff.

2 So when we produced this table,
3 we noticed that there were -- and I don't have the
4 exact count, but there were some of the species
5 that were identified as both existing in the last
6 two columns. That's the percent insectivore
7 column and the top carnivore column and they
8 shouldn't have been double counted that way. So
9 that was an indicator to us that we had a
10 transcription error and this table is the
11 corrected version.

12 Q. Okay. So I guess we can use that
13 second to last column as percent insectivore?

14 A. That's correct.

15 Q. Okay. So if we go down, we see
16 black stripe top minnow and USGS eight is what I
17 see there in the darkened area?

18 A. Mm-hmm.

19 Q. So what does that mean?

20 A. That means that black stripe top
21 minnow as a species was assigned to the metric
22 percent insectivore. So a fish sample that
23 contained a black stripe top minnow would have its
24 percent insectivore metric calculated using black

1 stripe top minnow and the lettering means that we
2 determined that assignment from that reference and
3 I apologize. I don't have the list of references
4 in front of me.

5 Q. And the fact then that you had found
6 a black stripe top minnow would mean you counted
7 that towards the percent insectivore and that
8 would figure in your fish metric?

9 A. Yes, that's right.

10 MS. TIPSORD: Just for
11 clarification. I think I said 474. This is
12 actually Exhibit 454. We haven't gotten that far.
13 The exhibit is actually 454 for this table that
14 has come in.

15 MR. ETTINGER: I obviously don't
16 want to repeat all the testimony as to the earlier
17 exhibit. Do we know what the earlier exhibit was?

18 MS. TIPSORD: We're thinking 452,
19 but we're not positive on that.

20 MR. ANDES: I'll check.

21 MS. TIPSORD: Sorry for the
22 confusion. It is Monday morning.

23 BY MR. ETTINGER:

24 Q. You'll be happy to know that I went

1 through the last transcript and tried to eliminate
2 a number of the questions I had listed, but you'll
3 be unhappy to hear I was unable to eliminate as
4 many as I would like. So why don't we start with
5 number two which says on page 20 of the Habitat
6 Evaluation Report you mentioned inflows of storm
7 runoff deposits fine sediment from the urban
8 drainage area, how does that effect habitat?

9 A. The quoted statement refers to the
10 input of fine sediments with storm water from the
11 urban area and fine sediments are generally
12 detrimental to habitat because in areas where
13 coarse substrate, coarse sediment exists such as
14 gravel or stone, if you will, the fine sediment
15 can fill in the gaps between those and effectively
16 blanket it and lessen or even eliminate its
17 benefit to biota.

18 The other reason is, of course,
19 that it can increase turbidity because some of
20 this stuff doesn't settle out. It stays in
21 suspension in the water column and turbidity is
22 generally not a desirable condition and the last
23 is that a lot of these sediments from urban areas
24 contain chemicals that are detrimental to fish and

1 aquatic life.

2 Q. Okay.

3 MS. TIPSORD: Okay. For the record,
4 the Habitat Evaluation Report is in the record as
5 part of Public Comment 284.

6 MR. ETTINGER: I'm sorry. It's
7 public comment what?

8 MS. TIPSORD: 284.

9 MR. ETTINGER: 284.

10 BY MR. ETTINGER:

11 Q. So basically as I heard the answer
12 it fills in the gravel and it creates turbidity
13 which are two of the problems and then the third
14 problem is also the fine sediment itself contains
15 harmful substances?

16 A. That's right. And I should clarify.
17 We didn't make a specific study of this condition
18 in the cause, but I mean it's generally one that
19 is recognized in urban areas.

20 Q. I think we'll get to more of that
21 later. On page 21, the Habitat Evaluation Report
22 refers to fluvial habitat, is no such habitat
23 present in the CAWS?

24 A. The statement on page 21 refers to

1 the sequence of pools, riffles and runs that occur
2 in natural streams and rivers which are beneficial
3 to aquatic life and we did not observe these
4 conditions in the CAWS.

5 Q. Is it present in waterbodies that
6 are connected to the CAWS from which fish can swim
7 into the CAWS?

8 A. We did not study tributaries to the
9 CAWS.

10 Q. Page 28 of the report you discussed
11 a decision to develop a System Specific Index.
12 For what other waterbodies has such an index been
13 developed?

14 A. System Specific IBI's, indices of
15 biological integrity are fairly common. They've
16 been developed for several waterbodies, including
17 the Ohio River, the Wabash River and the Seine
18 River in France are some of the examples and I
19 have citations. We have papers that discuss those
20 if you'd like them. I also have a note of the
21 Willamette River Valley in Oregon.

22 Waterbody specific habitat
23 indices are less common. We have identified only
24 a few in the literature, but they are common on a

1 geographic basis, so statewide habitat indices
2 such as Michigan or Maryland, and it's notable I
3 think that where these habitat indices have been
4 developed for specific political boundaries that
5 it stands to reason it might be reasonable to
6 develop one more system, a waterbody itself,
7 because the fish are likely to be more effected by
8 conditions within a waterbody than a political
9 boundary.

10 Q. So what is the point of a
11 specific -- System Specific Index? I mean, if I
12 have a general index, I can compare the water
13 quality and say the Illinois River and the Ohio
14 River, but if I have an index that is specific to
15 the Illinois River, it won't help me compare it to
16 another waterbody, will it, or what is the point
17 of that?

18 A. The rationale for developing a
19 System Specific Index depends on the conditions
20 you're dealing with, but in our case we looked at
21 the CAWS and we looked at available indices and
22 the bases for those existing indices and decided
23 that because they were developed for systems that
24 were so different in nature from the CAWS that

1 none of them were adequate to differentiate
2 habitat within the CAWS or measure the factors
3 that were really important in the CAWS. They
4 either didn't vary or didn't exist. I mean, the
5 factors that were measured by existing indices
6 either didn't vary or didn't exist in the CAWS.
7 So, as a tool, those existing indices would be
8 very limited.

9 Now, that's not to say you
10 couldn't use in your example a fish index for the
11 Illinois River in another river if that river were
12 similar to the Illinois River.

13 Q. But you didn't do that? You were
14 working off of your own index?

15 A. That's right.

16 Q. So I can't look at any number that
17 you produced for, say, the North Branch of the
18 Chicago River and compare that to the Calumet
19 River -- I'm sorry. The Cuyahoga River. I
20 couldn't take a number from the North Branch of
21 the Chicago River that you developed and compare
22 that to the Cuyahoga River in any way?

23 A. I'm not familiar with the conditions
24 in the Cuyahoga. I will say, though, that --

1 well, I'm not as far.

2 Q. I took the Cuyahoga off the top of
3 my head because it happened to be another river
4 that most of us would agree has had some work done
5 in it?

6 A. Yes.

7 Q. But I'm just saying you can't
8 because it's a System Specific Index. There's no
9 way I can use your number to compare a water
10 within the CAWS to a water outside the CAWS?

11 A. I'd say that you'd have to make a
12 case by case determination. You'd have to look at
13 the factors that are evaluated in a System
14 Specific Index like the CAWS, habitat index, and
15 then look at the conditions that exist in the
16 waterbody that you're considering using it for and
17 then make a determination on whether the two
18 waterbodies are similar enough that it would be an
19 appropriate tool.

20 Q. So if I were, say, a chief governor
21 of Ohio I might take your index and see if I
22 couldn't take the same factors and apply them to
23 the Cuyahoga?

24 A. You might do that.

1 Q. To your knowledge, nothing like that
2 is done so we can't look at an index of your --
3 your index and compare it to any other existing
4 index for waters outside of the CAWS?

5 A. Are you talking about taking our
6 index and applying it to waters outside of the
7 CAWS and then compare the numbers?

8 Q. I'm just trying to figure out.
9 Let's say I've given a particular water within the
10 CAWS, I forget how your index works, but a 75. So
11 you got a number 75 for a particular segment of
12 the CAWS. I can't use that number to compare it
13 to some other number that's been developed in
14 another state?

15 A. No.

16 Q. Where has the Non-wadable Habitat
17 Index been used?

18 A. You're referring to the Michigan
19 Non-wadable Habitat Index I assume and protocols
20 for that are still under development by the State
21 of Michigan. So it's not being widely used right
22 now because the state hasn't determined how they
23 want to use it.

24 Q. How did you use it?

1 A. We didn't use the index itself. We
2 looked at the technical methods that were used in
3 its development and used several of the approaches
4 that were used.

5 Q. On page 31 of the Habitat Evaluation
6 Report states that the macroinvertebrates were
7 similar across the system and they were all
8 pollution tolerant. Did I interpret page 31
9 correctly?

10 A. I believe so.

11 Q. Do you have an understanding of what
12 factors caused this?

13 A. We didn't investigate the reason for
14 the similarity across the system with respect to
15 macroinvertebrates and I would defer to Ms. Wasik
16 on that question because she has made a much more
17 detailed study of that.

18 Q. You did do -- we'll do this more
19 later, but you did look at macroinvertebrates to
20 some extent?

21 A. Yes.

22 Q. So are the same pollutants in the
23 whole system that you found in the
24 macroinvertebrates or what did you do there?

1 A. Well, we didn't look for pollutants
2 in the macroinvertebrates, but what we looked at
3 were sediment pollutants across the system where
4 data were available and compared that to
5 macroinvertebrates. Similar pollutants were found
6 in a number of locations across the system. I
7 would not say that they are the same across the
8 system.

9 Q. Isn't it actually a little -- I
10 mean, not knowing anything, wouldn't it be a
11 little surprising to find that the
12 macroinvertebrates were similar across the system
13 given that they're sort of the most localized
14 critters in the system and would be most likely to
15 be effected by the sediments?

16 A. I'm sorry. Can you just repeat
17 that?

18 Q. Let me start over. I think we know
19 that the sediments vary within the system. Some
20 of the areas are more heavily industrialized than
21 others, is that correct?

22 A. Yes.

23 Q. So wouldn't you expect not knowing
24 anything else the macroinvertebrates to be more

1 dissimilar from different parts of the system than
2 the fish because the fish can swim from one part
3 of the system to the other, but the
4 macroinvertebrates are fairly localized? So I
5 would expect going in that the macroinvertebrates
6 would vary more from spot to spot than the fish
7 that can go from wherever they please?

8 A. I see what you're saying. We didn't
9 observe that to be the case and I don't know the
10 reason for it, but it may be that the conditions,
11 the benthic conditions, the sediment conditions,
12 are so uniformly poor in the CAWS that the result
13 is that the macroinvertebrate populations show
14 less variation. That's not to say they don't show
15 any variation, but they show less.

16 Q. And that gets perhaps back to the
17 fine sediment that we talked about earlier?

18 A. That would be a factor, yes.

19 Q. Okay. Let's go to eight. How did
20 macroinvertebrates figure in your conclusions in
21 your report?

22 A. We compared the macroinvertebrate
23 data to sediment contaminant data to determine
24 which sediments contaminants were most correlated

1 with poor macroinvertebrate condition and then
2 added those sediment contaminants to our habitat
3 evaluation as habitat variables.

4 Q. I'm missing something. How did the
5 macroinvertebrates effect the habitat?

6 A. The macroinvertebrates -- let me
7 start over. We weren't going to directly evaluate
8 macroinvertebrates and the relationship to fish or
9 habitat, but we recognized that poor
10 macroinvertebrate condition or poor
11 macroinvertebrate communities could have a role in
12 effecting the fish community because the fish --
13 some fish may feed on them and if there's a poorer
14 food source, that could damage the fish.

15 So we wanted to try to account
16 for that in some way. So we recognized that
17 macroinvertebrates will have a more direct
18 response to sediment contamination than fish will.
19 So we said, well, sediment contamination is a
20 habitat condition that indirectly for the most
21 part effects fish. We should try to consider that
22 and so the way we did that was we tried to
23 determine which sediment containments. We didn't
24 want to use all of them because they're hundreds

1 of chemicals that you could use. So we wanted to
2 come up with a list that we thought were the most
3 important sediment containments. So we did that
4 by comparing them to the macroinvertebrate data
5 using the macroinvertebrates as sort of indicators
6 of which chemicals were the really bad actors and
7 then those were three chemical measures that we
8 used as habitat variables.

9 Q. I thought we decided earlier that
10 the macroinvertebrates were uniformly lousy
11 throughout the system?

12 A. They are.

13 Q. So how could you use anything to --

14 A. That's not to say they don't vary,
15 though.

16 Q. Let --

17 A. I'm sorry.

18 Q. Why don't you go on. You were
19 saying something fruitful while I was asking my
20 question.

21 A. I apologize.

22 Q. How do they vary? What were you
23 about to say?

24 A. I was just going to say just because

1 they're uniformly poor doesn't mean they don't
2 vary.

3 Q. Okay. So they vary between poor and
4 very poor or what did you mean to say there?

5 A. What I meant to say was that they
6 vary to a degree that's sufficient to correlate
7 them with sediment contamination.

8 Q. So they're poor throughout the
9 system, but in some places they're poorer in other
10 places and you can use that difference to come up
11 with something you can measure?

12 A. I would agree with that except from
13 recollection I don't know that I can absolutely
14 say they're poor everywhere.

15 Q. Okay.

16 A. I would have to go back and look at
17 those data.

18 Q. The good news is while I didn't find
19 I could eliminate much because of Ms. Williams
20 question I was able to find a great deal of
21 repetition within my own questions. So I am
22 hoping to only ask this one, but in your study you
23 looked at various fish metrics, how was the fact
24 that some of the fish in the CAWS came into the

1 CAWS in the Great Lakes or the Upper North Branch
2 or other waters figure into your evaluation?

3 A. We had no way to determine which
4 specific fish came into the CAWS from outside the
5 study area obviously, but we did try to mitigate
6 the influence of fish species that had fewer
7 counts by eliminating metrics for which there was
8 less than two species identified.

9 So if a fish metric was poorly
10 represented by the species we were counting, we
11 eliminated that metric from use.

12 Q. Now, I don't have all your numbers
13 in front of me, but there are some places within
14 the system where routinely a number of Great Lakes
15 species slip in, would you agree with that?

16 A. I'd have to go back and look at the
17 data.

18 Q. Okay. So my biology certainly is
19 not as good as yours, but I think the chinook
20 salmon, for example, is unlikely to have bread
21 within the CAWS, can we agree with that?

22 A. I agree with that.

23 Q. So if we found an area in which
24 there were a number of chinook salmon, how would

1 you have taken care of that?

2 A. Again, we didn't specifically
3 eliminate species from that -- from our study just
4 based on the suspicion that they migrated in from
5 elsewhere. But if they happened to be
6 representative of a fish metric that if a fish
7 metric were considered -- that only counted those
8 and there were only one or two such species
9 considered in that metric, that metric would have
10 been eliminated from consideration.

11 Q. We'll get into something more
12 specific later. With regard to the physical
13 habitat data, how were decisions made as to what
14 was there?

15 A. We evaluated existing data for
16 suitability in the study by examining several
17 factors including whether the data existed for the
18 fish sampling stations that the district used. We
19 wanted to be able to use the existing fish data so
20 we wanted to make sure that we could characterize
21 habitat in those locations. So we considered
22 spatial coverage and also temporal coverage. We
23 wanted to make sure we had enough data for the
24 periods of when -- to the extent that we could for

1 the periods when the fish were sampled and then
2 whether or not there was enough -- a qualitative
3 enough measure of those variables.

4 Q. I was wondering about this. I'm
5 going to go off script for a while. I was a
6 little confused about qualitative versus
7 quantitative. For example, one of the factors
8 that I believe turned out to be important in your
9 study was whether or not there was a manmade
10 structure in the water. How far up and down from
11 the site did you look for such a structure?

12 A. All of the habitat data that we used
13 in comparison to the fish data were collected in
14 400 meter reaches. So that would be 200 meters
15 upstream, downstream from the central point of a
16 fish collection station.

17 Q. And what counts as a manmade
18 structure particularly when you're within a
19 manmade waterbody?

20 A. The specific structures that we
21 considered manmade structures were piers, bridge
22 abutments and dolphins, which are the large
23 structures that stick up out of the water.

24 Q. You didn't count like a sunken barge

1 or a used car?

2 A. No.

3 Q. What about a fish hotel, would that
4 be a manmade structure?

5 A. In our study, no.

6 Q. I was worried about that. Okay. We
7 went over this a little bit, but on page 41 of the
8 Habitat Evaluation Report it refers to high
9 turbidity in most of the system. I think you
10 answered this, but what exactly is turbidity?

11 A. Turbidity is a measure of the
12 ability of light to pass through the water column.

13 Q. So it would be the same thing as
14 measured by Secchi depth?

15 A. Yes.

16 Q. You say most of the system is
17 characterized by high turbidity. Do you recall
18 what parts of the testimony are not characterized
19 by high turbidity?

20 A. In general, the parts of the system
21 closest to Lake Michigan are less turbid.

22 Q. Then, again, on page 42, you mention
23 that visibility is limited to less than 0.5 meters
24 outside of the Chicago River. What portion of the

1 Chicago River had more visibility than 0.5 meters?

2 A. So just to clarify, that statement
3 referred to our attempt to use underwater digital
4 video to examine bank conditions, submerged bank
5 conditions. So we were making those measurements
6 at several feet of depth trying to examine whether
7 there was refuge in the banks. That attempt
8 failed because the visibility at that depth where
9 it was attempted was generally less than 0.5
10 meters. We didn't do this measurement everywhere.
11 So we can't make a system-wide comparison using
12 that same measure.

13 Q. So you didn't look at Secchi depths?

14 A. We did look at Secchi depths, which
15 is a different measure. It measures the same
16 condition, but it measures it from the water
17 surface down. So the two values can't be compared
18 directly I should say.

19 Q. Okay. So is there a meter on your
20 underwater digital video equipment as to the
21 distance it can see or how did you read that?

22 A. By eye because we know how close the
23 camera is to, say, a sheet pile wall.

24 Q. Okay.

1 A. And when you start to see the sheet
2 pile wall, you know that the visibility is 0.5
3 meters if you're 0.5.

4 Q. The visibility is crumby both
5 looking down and sideways in most of the waters
6 you checked?

7 A. Yes, generally.

8 Q. You refer to the amount of data that
9 would be required to validate the technology was
10 not available. What do you refer to there? This
11 is on page 42. Besides side scan sonar was tested
12 at four reaches and although it showed promise in
13 revealing subsurface structure and bed conditions,
14 it was determined that the amount of data that
15 would be required to validate the technology in
16 the CAWS was not available. What do you mean by
17 that?

18 A. The side scan sonar was used in an
19 attempt to categorize and quantify submerged
20 structures that could be used for fish habitat or
21 by fish as habitat. And when we looked at the
22 imagery, although it appeared that it could
23 discern objects such as sunken cars or tree trunks
24 or that sort of thing, we felt that for it to be

1 -- for us to put it out there as a definitive
2 measure of habitat, we would have to do some
3 valuation and in this system that would require
4 visual inspection of what the sonar appeared to be
5 showing us to confirm that it was a car or a tree
6 or sunken tires or boulders or whatever and
7 because of the limited visibility, that would mean
8 putting divers down and we decided because of a
9 number of factors, including; schedule, budget and
10 difficulty in finding people willing to do that
11 that we weren't going to do that.

12 Q. Basically, it was -- it relates,
13 again, to our turbidity problem that we can't see
14 anything down there?

15 A. Yes.

16 Q. Question 17, what kind of data was
17 obtained from the bathymetry?

18 A. From bathymetric measurements, we
19 quantified the overall channel cross section,
20 meaning the width, the depth, and the shape of the
21 channel as well as the uniformity of those
22 conditions along the reach.

23 Q. How did that figure into your
24 conclusions?

1 A. We used that information to quantify
2 several variables that we used in our evaluation.
3 A few of them would be the maximum depth of the
4 channel, for example, or the ratio of the channel
5 width to channel depth. Even in some cases, it
6 was used to verify the steepness of the side
7 walls. And then all those were translated into
8 variables that were used in the analysis.

9 Q. So that's part of where we get our
10 eight habitat variables? The conclusion is from
11 you used this to confirm your visual observations
12 in some of those other areas?

13 A. Yes.

14 Q. So page 43, there's a really -- I
15 don't know what to say about it. It's orange.
16 I've seen waters below coal mines that actually
17 look like this, but I don't think that's the
18 Illinois River or any part of the CAWS. So could
19 you tell me what this is?

20 A. It's actually an example of the
21 site. As the caption reads, it's an example of
22 the side scan sonar imagery which is the orange
23 part that runs from the top to the bottom of the
24 figure. It was collected in the Upper North

1 Branch of the Chicago River and it's superimposed
2 on an aerial photograph. So the width of that
3 colored ban that you see, and although my copy is
4 black and white here, I think you're right that it
5 is orange. The width of that represents the width
6 of the North Branch at that location.

7 Q. Why is it orange?

8 A. I don't know the answer to that.
9 It's not a visual image. So the color is, I
10 think, an arbitrary assignment that the processing
11 software makes. The image was collected and
12 processed by Dr. Mackey and I would defer to him
13 to explain the coloration.

14 Q. Then, why do you think that's
15 possible, woody debris is in there?

16 A. Simply based on the shape of the
17 object, a possible interpretation of that is that
18 it's woody debris. You can see the difficulty in
19 using the data.

20 Q. All right. Well, we addressed the
21 orange mystery and we can go on.

22 MR. ANDES: You're free to ask
23 Dr. Mackey later why he picked orange.

24 MR. ETTINGER: That can be later,

1 but I'll have to see if Ms. Williams wants to ask
2 that first.

3 MS. TIPSORD: Excuse me. As we're
4 speaking to Ms. Williams, I just want to note that
5 although Ms. Williams is not here there are
6 representatives from the IEPA that have been here
7 since 10:00. Mr. Scalewski and Mr. Stratton are
8 both here.

9 MR. ETTINGER: Correct, they are
10 here.

11 MR. ANDES: That means you can't say
12 anything bad about them.

13 MR. ETTINGER: I didn't say anything
14 bad about them.

15 AUDIENCE: Can we say anything bad
16 about them?

17 MR. ETTINGER: I think that was a
18 question for the Hearing Officer.

19 MS. TIPSORD: I'll consider it
20 rhetorical.

21 BY MR. ETTINGER:

22 Q. To my question 19. On page 46,
23 different types of sediment are discussed; plant
24 debris, inorganic silt and organic sludge. Which

1 of these are most desirable?

2 A. Of those three, I'd say plant debris
3 is most desirable.

4 Q. But inorganic silt and organic
5 sludge are not helpful to the system?

6 A. No.

7 Q. And does that reflect the storm
8 water pollutants and other things that we referred
9 to earlier as to this turbidity problem?

10 A. The inorganic silt is likely
11 contributed by runoff from the urban area. The
12 organic sludge is less likely to be related to
13 storm water runoff, but possible.

14 Q. Where could it come from?

15 A. Past industrial activities.

16 Q. How far around each station was
17 evaluated for these substrate variables?

18 A. The district collects four samples
19 at each station, sediment samples, substrate
20 samples, and then uses polling, which is the
21 process of pushing a metal rod into the sediment
22 to manually determine consistency. They use that
23 to qualitatively assess how representative the
24 samples are that they collected.

1 Q. There's a discussion of hydrology on
2 pages 47 and 48 of your paper here. How did that
3 ultimately figure into your conclusions?

4 A. Hydrology can be very important to
5 natural systems, but I think it's much less
6 important in the CAWS. In the end, hydrology
7 really didn't factor into our conclusions.

8 Q. I think we already answered 21. You
9 explained which manmade structures counted and
10 fish hotels and sewage discharge points were not
11 manmade structures for purposes of this study.
12 Let's go to question 24. I'm sorry. I'm
13 referring to my own questions. Do you have those
14 with you?

15 A. Yes, I do.

16 Q. Page 54 of the Habitat Evaluation
17 Report refers to the Minarik report. What was
18 that or is that?

19 A. The Minarik Report 2008 is -- I
20 believe it's the annual water quality report
21 produced by the District. I don't have the exact
22 title in front of me and I don't know if it's been
23 made part of the record.

24 MR. ETTINGER: May I ask, Mr. Andes,

1 whether it has been made part of the record?

2 MR. ANDES: I don't believe so. It
3 is available on the District website. Ms. Wasik
4 is one of the authors. So we can certainly
5 provide the document.

6 MR. ETTINGER: I would ask that. I
7 attempted to get it off of the District website
8 and I needed a password I think that you somehow
9 neglected to give me.

10 MR. ANDES: I don't know how that
11 happened.

12 MR. ETTINGER: I don't know either.
13 It's surprising. We're such good friends. I
14 think that would be helpful.

15 BY MR. ETTINGER:

16 Q. Was that data one of the documents
17 that you used to determine what the dissolved
18 oxygen levels have been that underlie your overall
19 conclusions comparing habitat and dissolved
20 oxygen?

21 A. The hourly CDOM data was what we
22 used. It was made available to us by the
23 District. I don't know if that report presents
24 all the data. It summarizes the data, but the

1 data was provided electronically to us and we used
2 that hourly data.

3 Q. All right. I'll just -- you refer
4 to this as CDOM data?

5 A. Yes. Continuous dissolved oxygen
6 monitoring.

7 Q. I had seen various District reports
8 that had summaries of that data. I don't believe
9 I've ever actually seen the underlying hourly
10 data, but that's what you looked off of?

11 A. That's correct.

12 Q. I'll ask Ms. Wasik about that later.

13 MS. FRANZETTI: If I can just add,
14 Albert. I know there's dissolved oxygen hourly
15 data on Exhibit 46, a CD ROM, that's been admitted
16 in this proceeding.

17 MR. ETTINGER: Exhibit 46?

18 MS. FRANZETTI: I'm pretty sure
19 that's the number, but the District a while ago
20 produced a CD that had both at least temperature
21 and dissolved oxygen data and it included certain
22 stations where they take continuous DO and
23 temperature data as well as stations where they
24 monitor less frequently and I think it's Exhibit

1 46.

2 MS. TIPSORD: For the record, that
3 was -- your name?

4 MS. FRANZETTI: Susan Franzetti,
5 counsel for Midwest Generation.

6 BY MR. ETTINGER:

7 Q. I saw some DO data, but it all
8 looked like -- there were graphs and numbers, but
9 they weren't sufficient to see hourly figures.
10 They were sufficient to see daily or they looked
11 like this.

12 A. Right. That's not what I'm talking
13 about, but the exhibit I've reviewed is -- goes on
14 for hundreds of Excel spreadsheets tabbed by
15 station and it's the actual individual data
16 results either by the hour or by date at each of
17 the various Midwest -- I'm sorry. MWRD stations.

18 MR. ETTINGER: That seems very
19 exciting so I will have to look at that.

20 MS. FRANZETTI: It's not that
21 exciting, but it is there.

22 MR. ETTINGER: There's nothing more
23 exciting than continuous DO data.

24 MS. TIPSORD: Could we go off the

1 record for just a second?

2 (Whereupon, a discussion was had
3 off the record.)

4 MS. TIPSORD: Back on the record. I
5 would note that Ms. Williams from the IEPA is
6 here. So the EPA is represented fully.

7 BY MR. ETTINGER:

8 Q. Now, we're on page 62. It says
9 please explain Figure 4-1. What does the X -- I'm
10 sorry. What does the Y axis mean in terms of
11 habitat quality?

12 A. The Y axis of Figure 4-1 is a
13 numerical scale representing substrate quality. A
14 key to the meaning of the numbers is given beneath
15 the figure title and by themselves these numbers
16 don't necessarily say anything about habitat
17 quality.

18 Q. That's what kind of confused me
19 here. You've got numbers for plant debris is one
20 and two is clay and three is inorganic silt, but
21 those don't represent any sort of qualitative
22 judgment or judgment as to how good the area is as
23 habitat quality?

24 A. Those numbers represent

1 classifications of the sediment measured at each
2 station, but they don't necessarily -- if I follow
3 your question, they don't necessarily translate to
4 something like one is bad, ten is good.

5 Q. Right. So, actually, we believe the
6 cobble is better than inorganic silt, right?

7 A. Generally, yes.

8 Q. So if I went into a stretch of river
9 and found cobble, I would get a better number for
10 habitat than if I found inorganic silt?

11 A. You would get a different number for
12 the sediment metric and you may get an overall
13 better habitat number.

14 Q. Right. So I guess to get back to
15 this one through ten here on the Y axis, how do I
16 assign a one through ten number based on my
17 findings?

18 A. So you would collect a measure or a
19 sample of sediment and if you observe that -- you
20 would observe what the dominant characteristic of
21 the sediment was. So if it's mostly organic
22 sludge, you would give it a four.

23 Q. Okay.

24 A. Then you would know that that's

1 different than another sample that has a seven
2 because you'll know that sample is predominantly
3 cobble.

4 MR. ANDES: But let me clarify.
5 You're not saying that ten is better than one
6 here?

7 THE WITNESS: No.

8 BY MR. ETTINGER:

9 Q. That's how I don't understand you
10 get from your numbers -- I understand giving
11 things in number for denotation purposes. I don't
12 understand how we get from our findings as to what
13 is down there to our qualitative reading that I
14 think your Y axis is there?

15 A. What we measure in the field has to
16 be translated. For our study, what we measured in
17 the field had to be translated into numerical
18 values because we were using statistical
19 techniques to compare that to fish. So we're
20 looking for variables that vary and that can be
21 compared to the fish data, but the numbers don't
22 necessarily have to run from what is considered
23 poor to good or poor to excellent. They just have
24 to differentiate.

1 Q. Okay. So I get it now. The zero to
2 ten doesn't represent any sort of quality reading,
3 it's just all we know from this is that in the
4 Chicago River it's inorganic silt throughout that
5 entire stretch?

6 A. That that's the dominant
7 characteristic.

8 Q. Okay. So if I can find one that is
9 uniform. The South Branch it's entirely number
10 three, which is inorganic silt?

11 A. That would be the dominant sediment
12 characteristic.

13 Q. Okay. I see. Whereas the Sanitary
14 and Ship Canal varies between other inorganic silt
15 and sand?

16 A. Yes.

17 Q. So we can use this table, though, to
18 determine what is the predominant surface or
19 substrate as to each of the stretches in the water
20 that you measured?

21 A. Yes. Let me clarify. This refers
22 to what we call the dominant deep substrate which
23 was the substrate at the deepest part of the
24 channel. There was also dominant shallow

1 substrate which was measured near the bank. So
2 that might be a different substrate quality.

3 Q. Skip 26 and go to 27. Did you look
4 at the potential effects of endocrine disrupting
5 chemicals in the system?

6 A. No.

7 Q. I have a reference here, but I don't
8 know where I'm referring to. Okay. On page 64 of
9 the report states referring to certain head
10 capsule deformities of macroinvertebrates using
11 sonar particulars, these observations suggest that
12 anthropogenic chemicals in CAWS sediments are
13 effecting macroinvertebrate populations directly
14 and suggest an indirect effect on fish as well.
15 What's the suggested indirect effect upon fish of
16 anthropogenic chemicals?

17 A. The fact that certain chemicals
18 appear to be directly effecting macroinvertebrates
19 suggests that they can indirectly effect fish. As
20 I stated before, some fish species rely on the
21 macroinvertebrates for food sources and if the
22 chemicals diminish quality or abundance of
23 macroinvertebrates, that can diminish the food
24 source. They can also -- the chemicals in some

1 cases can reside in the tissue of the
2 macroinvertebrates which are then ingested by the
3 fish and in some cases those can accumulate in the
4 fish tissue and have undesirable fish effects.

5 Q. So by indirect effect, you mean it
6 effects the fish through its effect on the
7 macroinvertebrates?

8 A. Yes.

9 Q. I think we've done this, but I'm not
10 sure. On page 65, the Habitat Evaluation Report
11 identifies a habitat limitation, quote, suspended
12 sediments that result from a combination of urban
13 surface runoff discharges, CSO's, treated
14 discharges and navigation resuspension. Did you
15 measure the suspended sediment levels?

16 A. No.

17 Q. Are suspended sediment levels
18 uniformly high throughout the system or are they
19 worse in some areas than others?

20 A. Although we didn't measure them, the
21 District routinely measures total suspended solids
22 and they also have turbidity measurements and the
23 levels are not the same throughout the system.

24 Q. Do you have an understanding of what

1 parts are better than others?

2 A. Generally, if I recall from the
3 data, the TSS or total suspended solids data are
4 typically much better in the Chicago River than
5 other parts of the system.

6 Q. The Chicago River, you mean the part
7 of the river that is closest to the lake?

8 A. Yes.

9 MS. TIPSORD: Mr. Harley, you have a
10 follow up?

11 MR. HARLEY: Keith Harley, attorney
12 for the Southeast Environmental Task Force. In
13 these four categories that you identified; urban
14 surface runoff, second, CSO's, third, treated
15 discharges, poor navigation resuspension, for the
16 record, did you try to evaluate the relative
17 contributions among these four sources of
18 sediment?

19 THE WITNESS: No, we did not attempt
20 to measure the relative contribution among them
21 nor did we confirm that each of those is
22 contributing. It's simply a general statement
23 about what is typically contributing to suspended
24 sediments in urban systems.

1 MR. HARLEY: Those suspended
2 sediments that you identify, are those ultimately
3 faded to become the fine sediments that you
4 described earlier in your testimony that would
5 effect habitat as they settle?

6 THE WITNESS: I would say that in
7 part they may contribute to sediment solids on the
8 bottom of the channel, but we have no way of
9 knowing if something is in suspension right now.
10 We have no way of knowing without further study
11 whether it is going to settle eventually. So I
12 can't exactly answer your question.

13 MR. HARLEY: Based on your general
14 knowledge, if you were to eliminate CSO overflows,
15 would that improve suspended sediment conditions
16 in the waterbody?

17 THE WITNESS: I can't answer that.

18 MR. HARLEY: Why can't you answer
19 that?

20 THE WITNESS: I don't know the
21 answer to that. I haven't made a study of whether
22 that would be the case.

23 MR. HARLEY: Thank you.

24 MS. TIPSORD: Mr. Ettinger?

1 BY MR. ETTINGER:

2 Q. Okay. I think my next question is
3 what is the import of Figures 4.3 and 4.4 on page
4 67 here? I'll ask a slightly different question.
5 Here, the Y axis actually means something as a
6 percentage as opposed to a grading, right?

7 A. Yes.

8 Q. So -- I take that back. What does
9 the Y axis mean here on the submerged aquatic
10 macrophyte cover? Is that a percentage of how
11 much macrophyte cover there is?

12 A. It's a percentage of macrophyte
13 cover within a sample reach.

14 Q. Okay. So just to look on the bright
15 side here. We've got the North Shore Channel at
16 Touhy Avenue. That looks to be somewhere maybe
17 about 13 percent, is that correct?

18 A. It looks like it's about right.

19 Q. So that means there's like something
20 like 13 percent submerged aquatic macrophyte cover
21 in that particular stretch of the North Shore
22 Channel?

23 A. Yes. For the 400 meter sample
24 reach.

1 Q. And then these other stretches that
2 have nothing or show no bar, they have no
3 macrophyte cover that you could find?

4 A. None were observed.

5 Q. Then, on 4-4 it says overhanging
6 cover and, again, this represents a percentage.
7 The Y axis represents a percentage figure of how
8 much overhanging coverage you found?

9 A. Yes.

10 Q. I'll skip 31. On page 78, you have
11 data on summary of major flows into and out of the
12 CAWS. Here you do look at flows of tributaries.
13 I guess I think I asked this question before, but
14 I just want to make sure. What did you look at as
15 to the tributaries of the CAWS? Just flows or
16 what?

17 A. I should clarify. That table is
18 meant to describe sort of the inputs to the
19 system, but we didn't use the data in that table
20 quantitatively in our evaluation. So we didn't
21 use flows from tributaries as a metric in our
22 quantitative analysis.

23 Q. So this is just background
24 information?

1 A. Yes.

2 Q. Did you look at the tributaries at
3 all?

4 A. No.

5 Q. So no more tributary questions. So
6 also my next question had to do with 4-8 and 4-9,
7 but we'll skip them because you didn't actually do
8 anything with the flow data, is that correct?

9 A. Tributary flow data, no.

10 Q. What about the flow at the CAWS
11 sampling stations in Figure 4.8 and Figure 4.9, is
12 that just background information or did that
13 figure into our conclusions in some way?

14 A. It is not background information.
15 Well, it is not just background information and
16 although it didn't ultimately figure into the
17 conclusions, we -- flow is not measured at all of
18 the sampling stations, but computer models have
19 been developed to calculate flows and we attempted
20 to use some of the output from one of those models
21 to characterize flow conditions at fish sampling
22 stations. Ultimately, though, we didn't see that
23 it was a good indicator of fish. It wasn't
24 statistically related in anyway and we ended up

1 not using it.

2 Q. Now, some of the reaches of the CAWS
3 are rather stagnant. No flow basically. But you
4 couldn't find any difference between those reaches
5 and other reaches in terms of habitat quality?

6 A. In terms of fish quality?

7 Q. Could it be that some of the
8 stagnant areas have other factors that counter
9 their stagnant nature?

10 A. I'm not sure I understand your
11 question.

12 Q. That's all right. I'll move on to
13 other questions. I'll go back. The North Shore
14 Channel above the north side sewerage treatment
15 plant, that's one of the stagnant areas, right?

16 A. I don't recall.

17 Q. Then, we'll drop it.

18 MS. FRANZETTI: Albert, if I could
19 just have a follow up question? Did you consider
20 at all whether sudden significant changes in flow
21 was a factor effecting the fish?

22 THE WITNESS: We attempted to do
23 that. One of the measures of hydrology that we
24 tried to look at was what is called flashiness

1 which is what I think you're referring to which is
2 an abrupt change to flow, short lived rapid
3 acceleration and then deceleration of quality of
4 flow, but we just -- we didn't observe it to be a
5 strong factor.

6 BY MR. ETTINGER:

7 Q. I have --

8 MS. FRANZETTI: I'm sorry. Can I
9 ask one more?

10 MR. ETTINGER: Sure.

11 MS. FRANZETTI: When you say you
12 looked at it, can you give us a little bit of a
13 description as to what extent you looked at it.

14 THE WITNESS: We, as I said, used
15 modeling output and calculated -- and I can't
16 recall the exact calculation we made, but we tried
17 to calculate a representation of that flashiness
18 at each sampling location and use that as a
19 quantitative measure of the flashiness and then
20 use that measure as a habitat available.

21 MS. FRANZETTI: Okay. Albert, I'm
22 sorry. Can I go one more? Am I right that
23 generally in your approach to coming up with your
24 index, that as you went along you had a number of

1 variables that you were looking at, correct?

2 THE WITNESS: Yes.

3 MS. FRANZETTI: So when you speak
4 about a variable like this, the flashiness
5 dropping out, that you're referring to your
6 process of culling down the large number of
7 variables you had to the smaller number that you
8 actually used due in your index?

9 THE WITNESS: Yes, that's correct.

10 MS. FRANZETTI: So the one that you
11 saw or determined had a more significant
12 correlation between the variable and the quality
13 of the fish community, those were more likely to
14 survive the cut and wind up among those variables
15 you did use to come up with your index?

16 THE WITNESS: Yes, that's correct.

17 MS. FRANZETTI: Thank you.

18 THE WITNESS: I should also point
19 out on page 112 of our report, the Habitat
20 Evaluation Report, one of the issues we
21 encountered with flashiness was flashiness is
22 generally considered to be a bad thing for fish,
23 but what we observed was when we compared it to
24 the fish data it appeared to have the opposite

1 effect, that it was -- where flashiness was more
2 prevalent, the fish quality appeared to be better.

3 So this was a counter intuitive
4 result and we saw some other examples of this and
5 sometimes they're explainable. In this case, we,
6 I think, attributed it to a numerical anomaly.
7 That it was one of those things that wasn't
8 strongly enough defined as to relationship to fish
9 that we couldn't draw conclusions from it.

10 BY MR. ETTINGER:

11 Q. Let's continue this flashy
12 discussion on our dull lives. Where did you find
13 more flashiness?

14 MR. ANDES: You're talking about
15 your life?

16 MR. ETTINGER: You're right. I
17 should speak for myself.

18 BY MR. ETTINGER:

19 Q. Let's discuss flashiness. Where did
20 you find things were particularly flashy?

21 A. I don't recall. I'd have to look at
22 the data.

23 Q. Michigan Avenue or something?

24 A. As I said, I don't recall.

1 Q. Okay. So you don't recall and it
2 doesn't seem to have had an effect?

3 A. Right.

4 Q. We'll get back to these pretty
5 charts which are flashy to me. On page 85, bank
6 pocket areas in CAWS sampling reaches and off
7 channel bays and parts of some reaches.

8 First of all, what is the
9 difference between a bank pocket area and an off
10 channel bay?

11 A. A bank pocket area is a small
12 depression in the bank that can serve as temporary
13 refuge for fish and we had some -- off the top of
14 my head, I don't recall the dimensions, but we had
15 certain dimensions that we applied that had to be
16 larger than a certain size to count. So when we
17 did our habitat evaluation, we counted these in
18 each sampling reach and that would be the measure
19 that we used.

20 Q. Now, if a bank pocket area got
21 really big, it became an off channel bay or what
22 would be the distinction?

23 A. An off channel bay refers to
24 something different. An off channel bay in a

1 natural system would be an abatement off the main
2 body of the channel so fish could swim into a
3 larger area and they would seek refuge. Those
4 don't really exist in the CAWS, but there are
5 areas that are created by some of the uses and
6 structures in the CAWS that effectively shield --
7 provide an opportunity for fish to seek refuge off
8 the main channel so that they can kind of get away
9 from passing boats or something like that.

10 Q. Okay. Again, I keep having problems
11 with this Y axis. What does the Y axis represent
12 in the back pocket areas in Figure 4-11?

13 MR. ANDES: This is, by the way,
14 bank pocket areas.

15 MR. ETTINGER: I'm sorry. Bank
16 pocket areas.

17 BY THE WITNESS:

18 A. In both Figure 4-11 and 4-12, the
19 number of the Y axis represents the counted
20 quantity of these variables in each sampling
21 reach.

22 BY MR. ETTINGER:

23 Q. So is it number of bank pocket areas
24 per mile or per segment?

1 A. It would be for in the 400 meter
2 sampling reach.

3 Q. So is that an average for the
4 segment? Some of the segments are bigger than 400
5 meters?

6 A. No. When I say 400 meters, I mean
7 the 400 meter sampling reach.

8 Q. Okay.

9 A. So if the number is 30, the field
10 crew counted 30 in the 400 meter sampling reach.

11 Q. And then each of these segment boxes
12 here actually represents a 400 meter sampling
13 reach?

14 A. That's correct, and they correspond
15 to the District's annual water quality monitoring
16 stations. So those are -- the numbers along the
17 bottom are numeric designation of that and then
18 those numbers correspond to that as well.

19 Q. So some of these areas are
20 actually -- I guess a lot of them are longer than
21 400 meters, right? So your sampling reach is not
22 as large as the whole segment?

23 A. That's right.

24 Q. So, actually, when we say Cal-Sag

1 Channel at Alsip, what we mean by that is that is
2 not the whole segment, that's the 400 meters
3 around that particular sampling station?

4 A. Yes.

5 Q. Okay. Just to confirm. On page 89,
6 Figure 4.13, here the Y axis is tonnage of
7 navigation traffic, is that correct?

8 A. It's commercial tonnage. Commercial
9 tonnage as reported by the Corps of Engineers.

10 Q. So those are just figures you got
11 from the Corps?

12 A. That's correct.

13 Q. And there's basically no commercial
14 traffic on the North Shore Channel or the North
15 Branch above Goose Island?

16 A. Not that the Corps of Engineers
17 knows of.

18 Q. You used the ship traffic for 2001
19 and 2004?

20 A. Yes.

21 Q. Do you know whether the ship traffic
22 has changed any since 2004?

23 A. No.

24 Q. On page 95 of the Habitat Evaluation

1 Report, MWR fish collections is discussed. To
2 your understanding, was all of the data collected
3 through electrofishing?

4 A. Yes, all the data in our study was
5 collected through electrofishing.

6 Q. Okay. On page 97, we have Figure
7 5-1 nonhybrid fish observation in the CAWS study.
8 We have a number of fish here. Which of the ones
9 that are listed here are present in such a small
10 quantity that they would have been filtered out
11 from your calculations?

12 A. I don't recall the answer to that.
13 I'd have to go back and look at the data.

14 Q. So, presumably, the Nile tilapia
15 didn't have a great deal of weight here in your
16 final conclusions, but we don't know whether the
17 yellow perch got into the diversity study or not?

18 A. Actually, I do recall because I
19 think one of your questions specifically asked
20 about that in the Coho. So I checked on that and
21 I do know the yellow perch was kept in.

22 Q. The yellow perch was kept in?

23 A. But it's likely true that they had
24 little effect because of the small number of

1 samples that it occurred in.

2 Q. Alewife, chinook salmon, these all
3 would have figured into the count as far as the
4 diversity figures go?

5 A. Again, the only two that I checked
6 recently were the coho and the yellow perch
7 because you or another person asked about them. I
8 didn't look at those other species.

9 Q. Okay. Yellow perch as shown by this
10 chart there were fewer of them than alewives, so
11 presumably you counted everything to the right at
12 least of the yellow perch?

13 A. Again, the number of individuals
14 wasn't the measure we used. We looked at how much
15 metrics -- let me say this differently. When we
16 were evaluating fish metrics, we eliminated
17 metrics that were representing two or fewer
18 species, but the number of fish caught wasn't a
19 determining factor to whether the data was kept or
20 not.

21 Q. Skip 40 and did Limnotech create any
22 new fish metrics for its analysis or did it use
23 established tests for the health of the fishery?

24 A. On pages 19 and 20 of Appendix A of

1 the Habitat Evaluation, we report the metrics that
2 we used and there were 39 fish metrics that we got
3 from other established indexes and studies and
4 then we created seven additional metrics for use
5 in this study.

6 Q. What is the five ecological function
7 categories mentioned on page 99?

8 A. Ecological -- the five ecological
9 function categories are described on page 99 and
10 listed in Table 5.2 on page 100. They are
11 abundance and condition, reproductive function,
12 trophic function, indicator species, and species
13 richness and composition.

14 Q. So you said they were listed where?

15 A. Table 5.2 on page 100.

16 Q. Okay.

17 A. In this second category, it lists
18 the correspondence of the five categories to the
19 fish metrics we looked at or we used, but you'll
20 see there are only five variations in the second
21 column and those are the ecological function
22 categories.

23 Q. On -- skip down now to question 45.

24 On page 107 regarding Table 6.2, which attributes

1 are positive and which are negative?

2 A. In that table, the attributes that
3 we've considered negative would be percent
4 diseased or with eroded fins, lesions or tumors
5 and the proportion of Illinois tolerant species
6 and the Illinois ratio of generalist feeders and
7 the others would be considered positive.

8 Q. We've done the perch and coho
9 enough.

10 MR. ANDES: Would it be possible to
11 take a break soon?

12 MR. ETTINGER: Yes.

13 MS. TIPSORD: All right. Let's take
14 ten minutes right now then.

15 (Whereupon, a break was taken
16 after which the following
17 proceedings were had.)

18 MS. TIPSORD: I think we're ready to
19 go back on the record. Whenever you're ready,
20 Mr. Ettinger.

21 BY MR. ETTINGER:

22 Q. All right. Let's go down to --
23 let's go down to question 49, which refers to a
24 statement made on page 109, which summarizes some

1 discussion of Secchi depth and macrophytes. It
2 says in this study a metric reflecting macrophyte
3 growth was already included so Secchi was in this
4 sense redundant. Could you explain that a little
5 better as to what it would mean for Secchi to be
6 redundant in this case?

7 A. Yes, Secchi is a measurement of
8 turbidity. The ability of light to penetrate the
9 water column as I said previously and
10 macrophytes -- submerged macrophytes, large
11 plants, need sunlight to grow. So we were
12 directly measuring those plants and so the use of
13 Secchi as a measure of the ability of plants to
14 grow was unnecessary.

15 Q. Are there potential problems with
16 macrophytes in addition to lack of sunlight?

17 A. Yes.

18 Q. What would those be?

19 A. In some cases, you could have
20 substrates that are unfavorable to the
21 macrophytes. You could have active clearing of
22 macrophytes by some human activity, for example.

23 Q. Skip down now to page 112. In
24 general, is large substrate good or bad?

1 A. In general, we expect large
2 substrate to be a good thing --

3 Q. Why is that?

4 A. -- for fish.

5 Q. Why is that?

6 A. Large substrate refers to cobbles,
7 boulders. Boulders can provide refuge and shelter
8 for fish. Cobbles and gravel can provide habitat
9 for spawning for fish and for forging. So those
10 conditions are generally believed to be more
11 favorable than, for example, fine silt.

12 Q. I was a little confused by this
13 statement on page 112. The percent large
14 substrate in deepwater appeared as both negatively
15 and positively correlated and positively
16 correlated variable of fish depending on which
17 other habitat variables were used in a particular
18 regression. What is that about?

19 A. It refers to the multiple linear
20 regression where we compared many habitat
21 variables at once with fish data and what we
22 observed with that metric, that percent large
23 substrate in deep water was that sometimes it
24 appeared to be positively related to fish

1 condition and sometimes it appeared to be
2 negatively related to fish condition depending on
3 what other variables were used in the regression.

4 This sometimes happens because
5 of the data and it happens where the data aren't
6 strongly enough differentiated. So we call
7 that -- I call that an unreliable variable.

8 Q. We're not discussing that there's
9 some change over time, the boulders aren't moving?

10 A. No.

11 Q. It's just -- is it a statistical
12 problem or do you think there's something
13 underlying we're not getting the results we would
14 normally generally expect from the size of the
15 gravel?

16 A. I think it reflects the interplay
17 between variables and habitat studies because it
18 reflects on the difficulty of focusing on a single
19 variable. It shows you that in some cases a
20 variable that reflects a condition that we expect
21 to be a positive factor in fish health can, in
22 fact, because of other things going on be positive
23 or negative. So I think that's what is going on.

24 MR. ANDES: To expand on that a

1 little bit. Are you saying that -- I want you to
2 explain two things. One is, was it used or not
3 used in the regression analysis and I think part
4 of your discussion is why you couldn't use it in
5 the regression analysis, but you did factor it in
6 later, correct?

7 THE WITNESS: That's right. We
8 attempted to use it in the regression analysis and
9 that -- those results were where we saw it being
10 both positive and negative. So, ultimately, we
11 decided it was unreliable and removed it from the
12 analysis, but because it's generally believed to
13 be something that's desirable for fish, we added
14 it into the index ultimately as a measure with the
15 expectation that it should be accounted for in
16 some way because it is generally believed to be a
17 positive factor.

18 BY MR. ETTINGER:

19 Q. So what does adding it into the
20 index do?

21 A. When we built the index, we started
22 with six habitat variables that were based on the
23 statistics which we believe were the strongest
24 indicators of habitat condition, but when we

1 looked at those, we recognized there was, for
2 example, no indication of substrate quality and we
3 said, well, it's a good thing to have some measure
4 of substrate quality when you're going out and
5 comparing sites or that might be something that
6 someone would ultimately want to try to improve
7 and you'd want to have a measure of that
8 ultimately. So we added some variables into the
9 index that weren't present in the statistical --
10 the multiple linear regression.

11 MS. FRANZETTI: Susan Franzetti for
12 Midwest Generation. So did you add back into the
13 index the large substrate variable?

14 THE WITNESS: Yes.

15 MS. FRANZETTI: Okay. When you
16 said that including the large substrate variable
17 in the multiple linear regression gave you both
18 positive and negative correlations, were you able
19 to pinpoint the cause of getting both positive and
20 negative correlations to the inclusion of the
21 large substrate variable?

22 THE WITNESS: No.

23 MS. FRANZETTI: So how do you
24 know -- Strike that. Do you know that the

1 inclusion of the large substrate variable was a
2 factor in getting both positive and negative
3 correlations in your multiple linear regression?

4 MR. ANDES: If you need to explain
5 it in two steps.

6 MS. FRANZETTI: That is what is
7 getting confusing here. I can't tell how you knew
8 that large substrates was causing that apparent
9 inconsistency in terms of getting positive and
10 negative correlation.

11 THE WITNESS: When we conducted the
12 multiple linear regression, we looked at a wide
13 range of numbers of variables and types of
14 variables. We didn't just plug in a set of
15 numbers and look and then plug in another set. We
16 ran dozens of them with different combinations and
17 then we tried to identify which variables seem to
18 be giving the most consistent results and that's
19 when we observed this large substrate variable
20 sometimes appeared as a negative and sometimes
21 appeared as a positive. Why it was doing that
22 specifically we didn't drill down and figure out,
23 but we could identify that it was having that
24 effect or that it was having that response I

1 should say. That's a better way to say it. A
2 response in the regression. And it didn't --
3 because of this sort of vacillating between
4 positive and negative depending on what other
5 variables were in the regression we decided that
6 from a statistical standpoint it was an unreliable
7 variable.

8 MR. ANDES: In your statistical
9 analysis resulting in you selecting six variables
10 to focus your index on?

11 MS. FRANZETTI: That's right.

12 MR. ANDES: Later, you added five
13 more variables into the ultimate index that you
14 thought for a variety of qualitative reasons were
15 important?

16 THE WITNESS: That's right.

17 MR. ANDES: And that included the
18 large substrate?

19 THE WITNESS: Yes.

20 MS. WILLIAMS: Would you mind for
21 the record now just listing which five were added
22 in for qualitative reasons?

23 MS. TIPSORD: You need to identify
24 yourself for the record, please.

1 MS. WILLIAMS: I'm Deborah Williams
2 from Illinois EPA.

3 THE WITNESS: The five variables
4 that we included in the index that didn't come
5 from the statistical analysis were; percent
6 overhanging vegetation, bank pocket areas, large
7 substrate in shallow parts of the channel, large
8 substrate in deep parts of the channel and organic
9 sludge.

10 MS. WILLIAMS: Thank you.

11 MS. TIPSORD: Mr. Ettinger?

12 BY MR. ETTINGER:

13 Q. Okay. I'm going to skip down to 56
14 now and say and also call your attention to Table
15 6.4 on page 114 of the Habitat Evaluation Report.
16 And Table 6.4 says summary of regression model for
17 system-wide comparison of fish and habitat data
18 for 2001 to 2007. As I understand this, you have
19 various calculations showing the importance of
20 those various habitat factors for fish metric, is
21 that correct?

22 A. Yes, essentially that's correct.

23 Q. Now, I'm going to read the question.
24 It's kind of a runon question. So I'm going to

1 read the whole thing for purposes of the record
2 and then you can respond to it however you think
3 is most rationale. Was any effort made to break
4 down -- break the data down by segments of the
5 CAWS, is it thought that all of the factors are
6 equally important to each segment and is there
7 enough data to breakout R squared numbers for
8 particular segments?

9 A. We did not evaluate the CAWS on a
10 reach by reach basis because there wasn't enough
11 data to do so and we don't have enough data to
12 know whether all the factors are equally important
13 in each segment of the CAWS.

14 Q. So it's possible that there are some
15 segments in which changing one factor would be
16 more important than other segments?

17 A. Yes.

18 Q. Were you able to break that down as
19 to any of the water quality factors?

20 A. No.

21 Q. So we're really looking at the
22 effect of habitat versus the effect of dissolved
23 oxygen on the system as a whole?

24 A. Yes.

1 Q. On question 57, I made a mistake and
2 misquoted you. The question should be -- it says
3 what does it mean on page 117 that it is assumed
4 the residuals are independent?

5 A. The test for residual independence
6 is a test to determine -- it's a test of the
7 regression. The residuals are the difference
8 between the predicted and measured values and what
9 you want to determine is that there is no pattern
10 among those things that you're not accounting for
11 in your regression and that's why in Figure 6.5 we
12 show a scatter plot of these residuals that is
13 essentially random. There's no evident pattern to
14 it.

15 What that means is that if there
16 were a pattern, that could indicate that there is
17 something that you haven't accounted for in your
18 regression or there's some other maybe a
19 co-dependance of variables that you haven't
20 included. So you don't want to see a pattern.
21 You don't want to see a straight line in that
22 analysis.

23 Q. Then, we get back to -- I kind of
24 touched on this. Was the effect of dissolved

1 oxygen broken down for any particular segment?

2 A. No, it wasn't.

3 Q. Now, when you had the dissolved
4 oxygen data in front of you, did you have a
5 profile of the site or is that just one data point
6 for each site?

7 A. The --

8 Q. Was the DO taken at different depths
9 within the site or across the stretch of the river
10 or was it just one data point?

11 A. We used the District's CDOM, or
12 CDOM, data and if I recall correctly those
13 measurements are taken at fixed depths at specific
14 points in the system. So I don't believe -- I
15 think that the depth at which the measurements are
16 taken may vary from station to station, but we
17 didn't use profile data if you want. I think
18 that's what you're getting at.

19 Q. Depth profiling?

20 A. Depth profiling, no.

21 MR. ANDES: We can certainly when
22 Ms. Wasik is here she can answer more questions
23 about the District's data.

24 MR. ETTINGER: That is important,

1 but I'm asking Mr. Bell what he saw.

2 BY MR. ETTINGER:

3 Q. So is it your understanding that the
4 depths vary from site to site? I believe you said
5 that.

6 A. My recollection is that's the case.

7 Q. Do you know whether it's -- did you
8 look at how the dissolved oxygen data related to
9 the effectiveness of your electrofishing gear?

10 A. No.

11 Q. Let me -- it's not your
12 electrofishing gear. It was the District that did
13 the electrofishing again?

14 A. The District did the electrofishing
15 for the data from 2001 to 2007 and then in 2008 we
16 collected some of our own in conjunction with our
17 activities. So we both electrofished.

18 Q. Did you do any of the electrofishing
19 personally?

20 A. Personally, no.

21 Q. Are you knowledgeable about
22 electrofishing?

23 A. I'm not an expert in electrofishing.

24 Q. Do you know at what depths it's

1 effective?

2 A. I've read that it's effective to
3 depths of three or four meters.

4 Q. Three or four meters. Do you know
5 how the dissolved oxygen levels related to the
6 depths at which your electrofishing is effective?

7 A. I don't.

8 MR. ANDES: I think both Dr. Mackey
9 as well as Ms. Wasik can answer further questions
10 about the electrofishing in the District's data.

11 MR. ETTINGER: Good.

12 BY MR. ETTINGER:

13 Q. I think we'll skip to 62 which
14 refers to page one, statements on page 21 in which
15 you discuss the fish variability at the various
16 sites. I guess the question I want to ask is
17 would you expect to see similar levels of fish
18 variability in data taken in other waterbodies?

19 A. I'd say it's not unusual to see
20 substantial variation in fish over time. In
21 general, I would add, though, that the factors
22 that contribute to that may differ from waterbody
23 to waterbody, but the variability is not unusual
24 to observe.

1 Q. We're not able to -- on page 124 of
2 the Habitat Evaluation Report stated that a wide
3 range of water quality metrics were evaluated with
4 respect to fish data. I believe we discovered
5 earlier that the only water quality metrics we
6 actually looked at were dissolved oxygen and heat,
7 is that true?

8 A. Those were the primary water quality
9 parameters that we evaluated. We considered
10 several others that are described in Appendix C.
11 We subsequently -- I think I might have mentioned
12 this previously to you during the last hearings.

13 We've evaluated other water
14 quality parameters using the CART analysis that
15 was attached to my testimony. We've used that
16 same analysis to evaluate dissolved oxygen,
17 temperature, ammonia, chloride and turbidity as
18 well to evaluate whether any of those factors in
19 combination with others might be important.

20 Q. Is this discussion contained in the
21 analysis of the relationship between fish and
22 water quality?

23 A. Yes. Appendix C describes the
24 original analyses.

1 Q. Getting back to temperature. What
2 temperature factors did you look at?

3 A. I'll have to find the list. I think
4 we did, but I don't know where it is.

5 MR. ANDES: We can provide those.

6 BY THE WITNESS:

7 A. I just don't have the list in front
8 of me. I can recall some of them and I can name
9 them, but it wouldn't be a complete list from
10 memory.

11 BY MR. ETTINGER:

12 Q. Okay. You mentioned that the -- on
13 page, I think, 24 of this analysis the CDOM
14 temperature data from 2001 through 2007 were
15 evaluated to assess the rates -- what the rates of
16 compliance would have been had the proposed
17 standards been in place during the data period and
18 how that would relate to fish in the CAWS.

19 We're looking now at the
20 analysis of relationship between fish and water
21 quality. Does anybody know this is probably an
22 exhibit already?

23 A. That's Attachment A.

24 MR. ANDES: That's Attachment A

1 to -- Attachment C.

2 MS. WILLIAMS: None of it has been
3 entered as an exhibit.

4 MS. TIPSORD: It's all part of
5 Public Comment 284, correct?

6 MR. ANDES: Right.

7 MR. ETTINGER: This is all part of
8 Public Comment 284, I believe.

9 MR. ANDES: Yes. Attachment C, I
10 believe.

11 MR. ETTINGER: I'll just refer to it
12 as Attachment C of Public Comment 284.

13 MS. WILLIAMS: There's probably two
14 attachments because the Habitat Evaluation Report
15 and Habitat Improvement Report are both Public
16 Comment 284.

17 MS. TIPSORD: And, actually, the
18 analysis of the relationship between fish and
19 water quality is actually Appendix C, not
20 Attachment C.

21 MR. ETTINGER: Okay. Appendix C.

22 BY MR. ETTINGER:

23 Q. Looking to -- do you have that in
24 front of you or can you cause it to be made to be

1 put in front of you?

2 A. My copy doesn't have the appendixes
3 so I think we have it electronically.

4 MS. TIPSORD: I have a copy if you
5 need it.

6 BY THE WITNESS:

7 A. I have it.

8 BY MR. ETTINGER:

9 Q. We're on page 24 and I'm just trying
10 to understand what was analyzed in terms of this
11 heat versus fish in the CAWS that you looked at
12 there and maybe the best thing for me to do is let
13 you read this sentence under 3.1.2 proposed
14 temperature standards and maybe you could tell us
15 a little bit about what was done with regard to
16 that?

17 A. So you're asking me to read the
18 first sentence?

19 Q. Actually, the sentence that I just
20 read into the record, the CDOM temperature data
21 were evaluated to asses what rate the compliance
22 would have been had the proposed standards been in
23 place during the data period and how that would
24 relate to fish in the CAWS?

1 A. Okay.

2 Q. So what more can you tell us about
3 that?

4 A. So we used the 2001 to 2007
5 temperature data from the CDOM stations to
6 calculate the percent of time that the proposed
7 daily maximum temperature standard would have been
8 exceeded in the 12 months, the 12 months preceding
9 a fish sampling event in each year and compared
10 that percentage of time that the standard would be
11 exceeded statistically with fish metrics.

12 Q. Okay. So let's say we had a
13 particular site and it exceeded proposed
14 temperature standard 20 percent of the time. You
15 would have -- that would be one data point you'd
16 have and then another site that exceeded the
17 proposed heat standard no percent of the time or
18 always comply with the current standards and you
19 compared a -- for a fancy way of saying it
20 statistics that you compare basically those types
21 of situations?

22 A. That's correct, and we did that to
23 determine whether there was a correlation between
24 the fish metrics and that percent attainment or

1 percent exceedance which is what I think we used.

2 Q. Was there any effort made to look at
3 what the fish metrics were at the time the
4 exceedances were occurring?

5 A. No. What we were doing is we were
6 trying to determine whether there was an
7 indication the temperature should be brought along
8 with the analysis with dissolved oxygen.

9 Q. Okay. Fish like warmer temperatures
10 in the winter, don't they?

11 A. I suppose some fish do.

12 Q. Some fish do. So you'd expect on a
13 yearly basis that those fish would be more likely
14 to be in the warm spots than the cool spots,
15 wouldn't you?

16 A. Perhaps.

17 MS. WILLIAMS: Can I ask a follow
18 up, Albert?

19 MS. TIPSORD: Go ahead.

20 MS. WILLIAMS: Didn't you testify
21 last time that the temperature DO data was not
22 taken in the same location as the fish data, am I
23 correct?

24 THE WITNESS: That's correct. The

1 sampling stations are at different locations.

2 They're close, but they're not the same.

3 BY MR. ETTINGER:

4 Q. You're here for one purpose, but how
5 much do you know about temperature and fish? Is
6 that something you've studied?

7 A. I'm not an expert.

8 MR. ANDES: I'm sure we'll be
9 hearing more about temperature later.

10 BY MR. ETTINGER:

11 Q. Perhaps, but perhaps not from
12 Mr. Bell.

13 BY MR. ETTINGER:

14 Q. Let's talk about -- let's go down to
15 69. I think we touched on this in a few ways, but
16 just to ask more generally. Might areas outside
17 the CAWS to some degree provide off channel
18 habitat?

19 A. Yes, it's possible.

20 MS. TIPSORD: Mr. Harley has a
21 follow up.

22 MR. HARLEY: Before we move onto
23 Albert's questions regarding the Habitat
24 Improvement Report, I want to go back to question

1 62 which is would you expect to see similar levels
2 of fish variability in data taken from other
3 waterbodies? In answering that question, I was
4 wondering if you would clarify or elaborate on
5 something which is contained in your pre-filed
6 testimony.

7 There's a technical memo in your
8 pre-filed testimony January 14th, 2010, technical
9 memo and the conclusions to that memo on page
10 seven you state there is a dominant fish community
11 that occurs throughout the CAWS. This population
12 includes species representing multiple trophic
13 levels --

14 THE COURT REPORTER: I'm sorry.
15 Louder.

16 MR. HARLEY: -- and predator/prey
17 relationships commonly observed in natural
18 waterways within the region. Is that a response
19 to question 62 in terms of how CAWS compares to
20 other waterbodies that occur in the region?

21 THE WITNESS: Question 62 asked if
22 we would expect to see fish variability in other
23 waterbodies and the answer to that is you would
24 expect to see variability in most waterbodies, I

1 think, and what you're referring to is this
2 comparison of our observations of what makes up
3 the fish community in the CAWS and the fact that
4 we identified this dominant fish community that
5 has representation of different trophic levels.

6 So what we would expect to see
7 in other waterbodies is that there would likely be
8 a dominant group of fish that would be
9 representing various trophic levels, but probably
10 or -- let me say this. Not necessarily the same
11 group that we see in the CAWS. Does that answer
12 your question?

13 MR. HARLEY: In what sense is CAWS
14 similar to natural waterways within the region as
15 stated in this technical memo?

16 THE WITNESS: In the context of that
17 technical memo, the CAWS is similar to other
18 waterways because it contains a dominant fish
19 community that represents the major trophic levels
20 that you would expect to see.

21 MR. HARLEY: On page eight of the
22 same technical memo you talk about ubiquity of the
23 dominant communities suggests the CAWS is
24 supporting a viable, structurally complete and

1 regionally appropriate fish community under the
2 existing unmanaged conditions. Do you recall
3 that?

4 THE WITNESS: I'll take your word
5 for it. I don't have the memo in front of me, but
6 I assume it's correct.

7 MR. HARLEY: In what sense is the
8 CAWS similar to other regional waterbodies in
9 terms of the dominant community that exists within
10 the CAWS?

11 THE WITNESS: The sentence that
12 you're referring to, and I don't have the memo in
13 front of me, I apologize, but my recollection is
14 that the intent of that statement was the fish
15 that we observed in the dominant fish community
16 and actually the other clusters of fish that we
17 observed are different fish than we see anywhere
18 else. They're the same types of fish that occur
19 in other systems regionally not to say that the
20 dominant community is the same, but it appears
21 within the CAWS that that dominant community is
22 ubiquitous. I mean, at all system stations it is
23 the dominant fish group and it is apparently
24 stable because it represents a variety of trophic

1 levels.

2 MR. HARLEY: What is meant by the
3 specific phrase regionally appropriate?

4 THE WITNESS: I think that -- again,
5 going from recollection the phrase regionally
6 appropriate refers to the fact that within the
7 CAWS given the nature of the system in the context
8 of systems that are different elsewhere in the
9 region for that system that's probably an
10 appropriate fish community. It's apparently what
11 fish succeed there right now.

12 MR. HARLEY: Thank you.

13 MS. TIPSORD: Ms. Franzetti?

14 MS. FRANZETTI: Mr. Bell, do I
15 understand correctly then that when you in that
16 sentence refer to regionally, the region you're
17 referring to is the CAWS?

18 THE WITNESS: Again, I don't have it
19 in front of me. My recollection is that's the
20 case, though.

21 MS. FRANZETTI: Okay.

22 MS. TIPSORD: Mr. Ettinger, back to
23 you.

24

1 BY MR. ETTINGER:

2 Q. Okay. This has been very helpful as
3 they ask you questions. I was able to eliminate
4 more of my redundant questions. This is exciting.
5 Still, we go to page 138. We touched on this a
6 little, but I just want to be clear. This is page
7 138 of the Habitat Evaluation Report which has
8 Figure 7.2 results of CAWS habitat index score for
9 major CAWS reaches.

10 MS. FRANZETTI: Albert, I'm sorry to
11 interrupt, but for us trying to follow, is this a
12 pre-filed question or no?

13 MR. ETTINGER: I'm building up to a
14 pre-filed question. It's going to be pre-filed
15 question 68, but I wanted everybody to get to the
16 right place in their programs.

17 MR. ANDES: This is like a prequel.

18 MR. ETTINGER: I was trying to be
19 helpful and tell you where to start looking before
20 I read question 168 -- 68.

21 BY MR. ETTINGER:

22 Q. What is the significance of the CAWS
23 habitat index scores?

24 A. I'm referring to page 138. We see a

1 histogram of those scores. The significance is
2 that these scores give you a way to differentiate
3 overall habitat quality between major reaches in
4 the CAWS using the variables that we identified as
5 being the most important variables to fish in the
6 CAWS.

7 Q. Okay. Now, if I had a hundred,
8 nobody scores a hundred, but if I had a hundred,
9 would that mean I have all of the positive factors
10 found in the CAWS, right?

11 A. Yes.

12 Q. But there are positive habitat
13 factors that are not found in the CAWS, is that
14 correct?

15 A. Yes.

16 MR. ANDES: And there are also
17 negative habitat factors in the CAWS that are not
18 found elsewhere?

19 THE WITNESS: Yes.

20 MR. ETTINGER: I'll ask that
21 question again. I thought it was interesting what
22 you were getting at so do you want to go ahead?

23 MR. ANDES: There are negative
24 habitat aspects in the CAWS that are also not

1 addressed in the index, correct?

2 THE WITNESS: Yes.

3 BY MR. ETTINGER:

4 Q. Right. So -- and that hundred
5 actually reflects both the absence of negative as
6 well as the presence of positive?

7 A. Yes.

8 Q. So the Upper North Shore Channel
9 which is near where I live, so I'm happy to see
10 that it scores best, it is the best within the
11 CAWS and it has the most of the positive factors
12 and the least of the negative factors present in
13 the CAWS?

14 A. As reflected in the index.

15 Q. As reflected in the index. Okay.
16 Now, I, of course, was disturbed to hear the
17 potential for percentage increase was the lowest
18 in this segment, but isn't that almost a factor of
19 mathematics when you're at 70 it's a lot harder to
20 make a bigger percentage improvement than when
21 you're at two?

22 A. I thought that's what you might be
23 asking. Yes, I would agree. I think it's a
24 reflection of the fact the index measures

1 conditions within the CAWS, not within the
2 universe of possibilities.

3 Q. Right. Now, is there some reason
4 why we couldn't add something to the CAWS that
5 doesn't currently exist in the CAWS?

6 MR. ANDES: Something being a body
7 of water?

8 BY MR. ETTINGER:

9 Q. Something positive like, let's say,
10 hypothetically that the presence of a sunken
11 battleship is a positive factor. Analytically, is
12 there some reason why we couldn't put that
13 somewhere in the CAWS in our analysis?

14 A. I think you had me up until our
15 analysis. I don't know what that means.

16 Q. Well, here is what confused me. It
17 seems to me when we did our Habitat Improvement
18 Report we looked at the same factors as were
19 currently in the CAWS, right?

20 MR. ANDES: Let me stop you there.
21 I'm not sure what factors you mean. They did
22 discuss a variety of possible actions to improve
23 habitat in that report that were not addressed in
24 the other report.

1 BY MR. ETTINGER:

2 Q. Well, let's use a slightly less
3 ludicrous example. We decide one of the things
4 the CAWS doesn't have that might be is a good
5 habitat factor in other waters is riffle habitat.
6 Did you consider whether riffle habitat might be
7 created in the CAWS?

8 A. No.

9 Q. Why not?

10 A. I don't think -- well, first of all,
11 it's not something that can be created system-wide
12 and we try to -- most of our evaluation was
13 focusing system-wide. So the index is posed to be
14 a representation of system-wide conditions.

15 Now, you could add riffles -- I
16 don't know if you could add riffles, but we did
17 look at the possibility of adding channel
18 complexity which is usually what generates riffles
19 and pools in a natural system and the nature of --
20 most of the reaches of the CAWS are very straight
21 and don't lend themselves to sort of the riffle
22 pool sequencing that you'd normally see, but I'm
23 not really answering your question directly, but I
24 can't really recall why we didn't specifically

1 look at riffles, but it wouldn't be the first
2 thing I'd consider adding.

3 Q. I just used that as an example, but
4 there are, for example, critters that breed in
5 riffles and then spend the rest of their life in
6 another area or another type of body of water.

7 A. Right. And we did look at the
8 possibility of adding modifying substrates. So
9 adding large substrates. So adding gravel and
10 usually these riffles -- gravel is what you use
11 often when you're building rivers and stream
12 restoration. So we did look at the possibility of
13 adding substrate.

14 Q. Did you look at constructed
15 wetlands?

16 A. No.

17 Q. Why not?

18 A. Are you talking about constructive
19 wetlands within the channels of the CAWS?

20 Q. Anywhere in the system.

21 A. No, we didn't. We were looking at
22 improvements that could potentially be made within
23 the waterways themselves.

24 Q. You actually are -- reading your

1 resume, you're pretty knowledgeable on
2 constructive wetlands, aren't you? You've done it
3 in Columbus, Indiana, Alton, Illinois?

4 A. For different reasons other than
5 habitat.

6 Q. For different reasons other than
7 habitat. What reasons would those be?

8 A. In those cases, those were for water
9 quality improvement.

10 Q. What was the problem?

11 A. A variety. Storm water was one.
12 Another one was CSO treatment.

13 Q. You don't have anything like that in
14 the CAWS?

15 A. Again, treating quality water --
16 improving water quality, wasn't the focus of the
17 habitat improvement study.

18 MR. ANDES: So you -- am I correct
19 the constructive wetlands projects were routing
20 effluents through constructive wetlands?

21 THE WITNESS: That's correct.

22 MR. ANDES: Not routing entire
23 waterbodies through constructive wetlands?

24

1 BY MR. ETTINGER:

2 Q. Well, if you had a constructive
3 wetland that was connected to the waterbody, might
4 that not add some habitat to the system?

5 A. Yes.

6 MR. ANDES: Do you have any
7 particular place where we would add?

8 MR. ETTINGER: Yes, I have some
9 ideas. So do some other people.

10 MR. ANDES: You don't want to ask
11 Mr. Bell about them, though?

12 MR. ETTINGER: I'm going to get
13 there. It's one of my pre-filed questions when we
14 get down to our program. We've jumped off a
15 little bit.

16 BY MR. ETTINGER:

17 Q. Down to regarding the Habitat
18 Improvement Report. I've cut out one and two as
19 redundant and the first part of three has also
20 been covered, but the last sentence in three of
21 the questions regarding the Habitat Improvement
22 Report did you consider whether any changes in
23 operations by the commercial or navigational
24 operations using the manmade structures would

1 improve habitat?

2 A. I don't know what you necessarily
3 mean by -- could you clarify what you mean by
4 changes in operations?

5 Q. Yes. I didn't want to set too much
6 prologue. I was criticized for that. So now I'll
7 have to explain. I think we decided that the
8 manmade structures are effecting the fish
9 conditions, but we're not quite sure why, but --
10 correct me if I'm missummarizing any of your
11 testimony, but we think it has to do with the
12 operations that are using those manmade
13 structures, is that correct?

14 A. It's the possibility that that's the
15 case, yes.

16 Q. You wouldn't -- you were surprised
17 to find that manmade structures were as an
18 important a factor as they turned out to be in
19 your study?

20 A. I'm not sure I'd say surprised. At
21 the outset, it probably wouldn't have been at the
22 top of the list of things that we would have said
23 that's going to be an important thing later on.

24 Q. These manmade structures in

1 themselves might be good or bad? I mean, the
2 structure might be --

3 A. That's true.

4 Q. I don't have the text right in front
5 of me, but I think you suggested that it might be
6 the operations going on around those manmade
7 structures that were actually having those
8 effects. So up here might actually be -- not have
9 any effect, but the boat going to and from the
10 pier might have some effect?

11 A. That's correct.

12 Q. So my question, now properly
13 introduced, was did you consider whether any
14 changes in the operations using those manmade
15 structures might improve the habitat conditions?

16 MR. ANDES: Mean less frequent use?
17 Less frequent barge traffic, is that what you're
18 asking about?

19 MR. ETTINGER: That could be one
20 possibility. Different propellers, whistling
21 twice to give the fish a chance to get out of the
22 way.

23 BY MR. ETTINGER:

24 Q. Anything that -- did you consider

1 anything that would be different in the operation
2 of those manmade structures that might improve the
3 habitat?

4 A. No, I didn't.

5 Q. Question four, were you asked to
6 look at any steps that might be taken to address
7 the high turbidity which the Habitat Improvement
8 Report identifies as a problem at page ten?

9 A. We were not asked to do that.

10 Q. Did you do that?

11 A. No.

12 Q. When you built the constructed
13 wetlands for these various places, did they result
14 in reduced turbidity?

15 A. Turbidity was not a measure of water
16 quality parameter in any of those cases.

17 Q. What were you mainly aiming to get
18 at with those wetlands?

19 A. Nutrients and bacteria.

20 MR. GIRARD: Let me just clarify.
21 You were removing nutrients and removing bacteria?

22 THE WITNESS: That was the
23 intention, correct.

24 MR. GIRARD: Thank you.

1 MR. ETTINGER: Thank you.

2 BY MR. ETTINGER:

3 Q. You didn't look at any of the
4 tributaries as to whether there could be any
5 habitat improvements there that could lead to an
6 improved fish population within the CAWS?

7 A. No, we did not.

8 Q. Did you consider whether any changes
9 in the operation of the Corps of Engineers might
10 improve conditions for aquatic water life?

11 A. No, we did not.

12 Q. Might any changes in the operations
13 of Metropolitan Water Reclamation District benefit
14 aquatic life?

15 A. We didn't evaluate that.

16 Q. Okay. Now, I hope -- my numbers get
17 very funky on this list of questions here. You'll
18 have to take my word for it that I am aware that
19 three normally does not follow eight, but it does
20 on the sheet I'm reading here. So I'll just have
21 to read the question.

22 Are you aware of proposals that
23 were developed to establish periods of shallow
24 aquatic areas in Bubbly Creek, the Collateral

1 Channel and South Branch slips by the wetlands in
2 connection with development of mitigation sites
3 from the O'Hare airport expansion?

4 A. I am not aware of those proposals.

5 Q. Did the District tell you anything
6 about proposals it had or considered for habitat
7 improvements in the CAWS?

8 A. I don't remember any specifics it
9 may have been. I can't say there were no
10 conversations about proposed actions. We were
11 primarily interested in activities that had been
12 completed and preferably ones where the habitat
13 project had been completed and where there have
14 been some measures of the effect on fish.

15 Q. I guess I don't understand. I guess
16 the point of the Habitat Improvement Report would
17 be what could be done in the future that might
18 improve habitat?

19 A. That's right, and we wanted to base
20 that on data, a knowledge of what had been done
21 and perhaps actually had an effect.

22 MR. ANDES: Can you describe the
23 kind of projects that you did assess in the
24 Habitat Evaluation Report?

1 THE WITNESS: Well, just to be
2 clear. There were two different aspects of the
3 habitat improvement that we investigated. We
4 tried to find projects that had been completed
5 where people could say, yes, this had a real
6 involved beneficial effect on fish and then there
7 were hypothetical improvements that we evaluated
8 to determine what the quantitative benefit would
9 be in the context of applying the index scores.
10 So how could you improve that score. So those are
11 two different things.

12 MR. ANDES: Why don't you describe
13 the type of projects that were contemplated in
14 both of these analyses?

15 THE WITNESS: In the first case, we
16 had no preconceptions about what those projects
17 might look like. We tried to contact agencies,
18 the City of Chicago and Friends of the Chicago
19 River and various other entities and I think
20 they're identified in our report and ask the
21 question what have you built and have you got any
22 data that we can use to demonstrate this is a good
23 thing? And then in the second case we looked at
24 the habitat variables that were contained in the

1 index and said if those things are bad or not good
2 enough, what would you do to change those?

3 So we looked at, for example,
4 the possibility of modifying a vertical bank wall
5 to something other than that that might look
6 like -- more like a natural channel. So removing
7 the vertical structures and sloping the bank back
8 and adding vegetation and that sort of thing.

9 MR. ANDES: And adding channel
10 complexity was one of those?

11 THE WITNESS: No. Actually, we
12 classified potential actions as improvable or not
13 improvable and channel complexity was one of the
14 ones that we didn't think would be on a large
15 scale something that could be improved. You
16 couldn't add riffles in pools in most of the
17 systems. You couldn't remeander it. Just the use
18 of the system would preclude that. If you tried
19 to create riffles in pools in most of the system
20 or in the dredge portion of the system, the water
21 is too deep and someone might come along and
22 dredge it out anyway.

23 BY MR. ETTINGER:

24 Q. So make no small plans, but did you

1 make any large plans either? Did you consider
2 redirecting the North Shore Channel or reconnect
3 to Lake Michigan?

4 A. No.

5 Q. You didn't consider filling in much
6 of Bubbly Creek to make a constructed wetlands
7 that would address some of the CSO's?

8 A. No.

9 Q. Do you know what the Collateral
10 Channels are?

11 A. The Collateral Channels?

12 Q. Yes.

13 A. Yes.

14 Q. What are they?

15 A. Those are the channels that --
16 correct me if I'm wrong. I don't want to get the
17 definition wrong.

18 Q. Actually, let's drop that. Did you
19 look at any of the slips that are currently on the
20 South Branch of the Chicago River and consider
21 whether they could be filled in for 28 days or
22 wetlands?

23 A. No.

24 MR. ANDES: I would add as to the

1 specific projects asked about in question nine,
2 Ms. Wasik will be prepared to respond in more
3 detail.

4 MS. TIPSORD: Mr. Harley has a
5 follow up.

6 MR. HARLEY: I just want to ask
7 Albert's question about the Calumet River system.
8 Are you familiar with boat slips that exist in the
9 Lake Calumet River system?

10 THE WITNESS: Yes.

11 MR. HARLEY: Did you consider making
12 use of any of those boat slips, for example, to
13 create off channel bays or other habitat
14 improvements to that water system?

15 THE WITNESS: No.

16 MR. HARLEY: Why didn't you look at
17 those boat slips as a possibility?

18 THE WITNESS: We assumed that the
19 existing uses of the system would need to be
20 retained.

21 MR. HARLEY: And you're convinced
22 that all those boat slips are presently being used
23 for commercial purposes?

24 THE WITNESS: No, we didn't do a

1 thorough evaluation of all of the boat slips. So
2 I can't say how many are or are not currently in
3 use.

4 MR. HARLEY: Could a boat slip serve
5 as a basis for creating an off channel bay or
6 other habitat improvement?

7 THE WITNESS: It could if it's not
8 used as a boat slip, I think.

9 MR. HARLEY: Thank you.

10 BY MR. ETTINGER:

11 Q. Did -- I'm sorry. I had gone
12 through your resume. Have you personally worked
13 on habitat improvement projects?

14 A. I have worked on only a few.

15 Q. Have you worked on any that worked?

16 A. In what regard worked?

17 Q. They improved habitat and you had
18 data that showed the fish population in some way
19 was improved?

20 A. I have not worked on anywhere the
21 collection of post project data has been funded.
22 It's very uncommon to see that.

23 MR. ANDES: Are there challenges to
24 improve habitat that often lead to those projects

1 not being successful?

2 THE WITNESS: Yes.

3 MR. ANDES: What are some of those
4 challenges?

5 THE WITNESS: Well, the channels can
6 be very site specific. Among them can be
7 competing uses, lack of maintenance. I'd say
8 those are the two big ones. Over time, I mean,
9 when one tries to restore aquatic habitat, often
10 you're forced to work within a certain part of the
11 system and you can't change the whole system. So
12 it's necessary to protect the project in ways
13 against ongoing uses that might be damaging or go
14 back and perform maintenance to ensure the
15 conditions you tried to construct are having the
16 desired effect and that can be very expensive.

17 Q. Have you worked in the River Rouge
18 in Detroit?

19 A. Yes, I have, but not on habitat.

20 Q. What did you do on the River Rouge?

21 A. I suppose it was indirectly related.
22 We did a large study on the main one two branch of
23 the Rouge. It was a comprehensive investigation
24 of erosion and deposition sediment in the system.

1 going to ask questions or should I ask --

2 BY MR. ETTINGER:

3 Q. Getting back to the CAWS. Did you
4 study how fish move within the CAWS?

5 A. No, we did not.

6 Q. Do you have any idea of how far fish
7 move in the CAWS from one place to another?

8 A. No, I haven't studied that.

9 MR. ETTINGER: We don't have any
10 further questions.

11 MS. TIPSORD: Mr. Harley?

12 MR. HARLEY: This is one of Albert's
13 pre-filed questions I wanted to ask. Is it
14 correct to say -- this is question 13 regarding
15 the Habitat Improvement Report. Is it correct to
16 say that habitat could be most improved in the
17 Cal-Sag Channel?

18 THE WITNESS: I don't know what the
19 basis would be for saying it exactly that way, but
20 we found in our study that the South Branch of the
21 Chicago River had the highest potential based on
22 its index score potential.

23 MR. HARLEY: Then one other just
24 quick follow up. The decision to not evaluate for

1 habitat or water quality data on a reach by reach
2 basis, was that your decision or was that Water
3 Reclamation District's decision?

4 THE WITNESS: I don't recall the
5 specific thought process, but it would have been
6 as I said previously it was based on the lack of
7 sufficient data for the type of statistical
8 analysis we were doing. So it would have been our
9 recommendation when you work for someone and they
10 tell you to do it, if it can be done, you could do
11 it, but we would recommend that it wouldn't have
12 value because of the lack of sufficient data.

13 MR. HARLEY: Was that limitation in
14 the scope of the work agreements?

15 THE WITNESS: No.

16 MR. HARLEY: It was just something
17 that you discovered as you were undertaking the
18 analysis?

19 THE WITNESS: That's right.

20 MR. ANDES: Would it take a lot more
21 data to do this on a reach by reach basis?

22 THE WITNESS: Yes, it would.

23 MR. ANDES: Are there also benefits
24 to looking at a sort of the whole watershed in

1 terms of how habitat factors effect the fish?

2 THE WITNESS: I'm not sure I know
3 what you mean.

4 MR. ANDES: I'll drop the question.

5 MS. TIPSORD: Ms. Franzetti?

6 MS. FRANZETTI: Susan Franzetti,
7 counsel for Midwest Generation. Would you just
8 briefly explain why it would take a lot more data
9 to do this analysis on a segment by segment basis?

10 THE WITNESS: Yes. Our analysis has
11 been mentioned many times was a statistically
12 based analysis and for the statistical analysis to
13 bear fruit, to give you meaningful and reliable
14 results, you need a lot of data. On a segment by
15 segment basis on some cases we -- for example, in
16 Bubbly Creek, I think there was only one fish
17 sampling station and in many cases at stations
18 there were only two sampling events over the seven
19 year data we used.

20 So to sort of go reach by reach,
21 we might have ended up with maybe two or four or
22 even as few as seven fish samples and then to try
23 to do a statistical analysis of that with some
24 other factors such as water quality or habitat

1 wouldn't be sufficient quality to get reliable
2 results.

3 MS. FRANZETTI: Thank you.

4 MR. GIRARD: Mr. Bell, I have sort
5 of a general question here before we hopefully
6 wrap up for lunch. The question deals with the
7 area of channel substrate. In fact, I'm looking
8 at your pre-filed testimony on page six. In that
9 area, you were dealing with the concept of habitat
10 limitations in the channel substrate and sort of a
11 summary of all the data you were gathering and you
12 talked about how you sample the substrate at 28
13 stations in the CAWS and at 16 out of those 28
14 stations you characterize the substrate as
15 inorganic silt. At five of the stations, you
16 characterized it as bedrock and you considered
17 both of those categories as being undesirable from
18 a habitat prospective.

19 So for 21 out of the 28
20 stations, you said you had an undesirable channel
21 substrate type so, therefore, you concluded that
22 the channel substrates was poorer in composition
23 and texture than the CAWS.

24 Now, if you had gone, let's say,

1 to some place like Canada and you found a river
2 system which was relatively unimpacted by human
3 activity, so we'll call it natural, and you
4 established 28 channel substrate testing stations
5 and you found the same results, would you
6 characterize that channel substrate as being
7 poorer in compensation and texture?

8 THE WITNESS: Yes.

9 MR. GIRARD: So natural systems can
10 have substrates that you would characterize as
11 being poor?

12 MR. ANDES: Would -- if I can ask a
13 clarification? Would you be surprised to see
14 natural systems where the substrate was bedrock or
15 inorganic silt?

16 THE WITNESS: Yes, I would be
17 surprised in a natural system. I can't remember
18 the wording that you used, but I think you said
19 unimpacted by human activity or something along
20 those lines?

21 MR. GIRARD: Yes.

22 THE WITNESS: If I was up in Alaska?

23 MR. GIRARD: Wherever you want to
24 put it.

1 THE WITNESS: It would be surprising
2 to see those conditions in a system like that.
3 It's not to say they can't occur, but it would be
4 surprising, but if you did observe them I would
5 conclude the substrate conditions are relatively
6 poor there.

7 MR. GIRARD: When you use the term
8 surprised, in other words you're biased against
9 finding that kind of situation in nature?

10 THE WITNESS: I think I would be
11 based in the sense that my -- what I've observed
12 and what I read and what I've learned leads me to
13 expect a different condition when we look at
14 rivers and streams that are unimpacted by human
15 activity and that's what I mean by I say I'd be
16 surprised.

17 MR. ANDES: What in a natural
18 system -- why would you have, say, bedrock be the
19 substrate? Have you ever heard of --

20 THE WITNESS: The bedrock substrate
21 is perhaps less surprising because you could have
22 a channel that's eroded down to bedrock and ceases
23 to erode more. That's not surprising. But the
24 original question if I recall if I went to a

1 natural system and I measured 28 locations that I
2 believe were representative of the entire system
3 and I saw that the proportion was fine sediments
4 or silts and a smaller fraction were bedrock would
5 that be generally poor substrate and it would be
6 generally poor substrate for aquatic life and I
7 would be surprised to find that in a natural
8 stream at that proportion.

9 MR. ANDES: Because?

10 THE WITNESS: Because in cases where
11 you have a natural system unimpacted by human
12 activity, there is a better developed sediment
13 balance and you tend to see more sands and gravels
14 and rock, cobbles in the substrate. You don't
15 have this overwhelming loading of fine sediments
16 in a natural system. You can have fine sediments
17 certainly, but to see it so ubiquitous in a
18 natural system would be an unexpected outcome I
19 think because that's not what you typically see
20 in a watershed and in a waterbody that are
21 unaffected by human activity.

22 MR. GIRARD: Could you conceive of a
23 geological situation where flow rates, water table
24 down below -- I mean, any sort of conditions you

1 could think of where you could have a system that
2 is dominated by fine sediments?

3 THE WITNESS: I certainly can't rule
4 it out. You could -- there would be -- I mean,
5 you could have conditions that would create that.
6 I can't deny that.

7 MR. GIRARD: So if it was a natural
8 system, your use of the word poor might change?

9 MR. ANDES: But when you say poor,
10 are you talking about the extent to which it
11 supports a viable fish community?

12 THE WITNESS: When I say poor, yes,
13 to the extent it benefits the fish community, I
14 think it would still be less desirable than other
15 types of substrate.

16 MR. GIRARD: When you're talking
17 about desirable, you're talking about expecting to
18 see a specific species diversity or abundance of
19 certain individuals? If you had a natural system,
20 the species that are there are the natural
21 community?

22 THE WITNESS: You're right.

23 MR. ANDES: Just to be clear. You
24 could expect in that kind of a situation a less

1 diverse, less viable fish community in a number of
2 respects than, say, in a natural waterbody that
3 had cobble, coarse substrates, et cetera?

4 THE WITNESS: I don't know if I can
5 say it'd be less diverse or less viable, but it
6 would probably be different.

7 MS. WILIAMS: Mr. Bell, by
8 definition is it what is natural or what is
9 desirable?

10 MR. ANDES: I'm sorry?

11 THE WITNESS: I don't know if I can
12 answer that.

13 MR. ETTINGER: Seems like a
14 theological question to me.

15 THE WITNESS: That's almost too
16 general for me to answer. I think that floods are
17 natural and not everyone would agree.

18 MS. TIPSORD: Anything else? All
19 right. Let's go ahead and break for lunch. We'll
20 come back around 1:00 and start with Midwest
21 Generation.

22 (Whereupon, a break was taken
23 after which the following
24 proceedings were had.)

1 MS. TIPSORD: Ms. Franzetti, when
2 you're ready.

3 MS. FRANZETTI: Good afternoon,
4 Mr. Bell. My name is Susan Franzetti. I'm
5 counsel for Midwest Generation. I'm going to be
6 asking you some questions today. I did make an
7 attempt over the lunch hour to try and eliminate
8 questions if I thought they were duplicative of
9 Mr. Ettinger's questioning, but that may not have
10 been a fully complete effort.

11 So if I ask you a question and
12 you feel you've answered it before, please feel
13 free to tell me that you believe you've answered
14 the question in your prior testimony or perhaps a
15 portion of it and go on and answer the part that
16 has not been asked because my purpose is not to
17 have you repeat answers to questions. Okay?

18 A. Great.

19 Q. Let's begin with the first question
20 which relates to understanding what the
21 qualifications that you had on your curriculum
22 vitae attached to your pre-filed testimony.

23 What qualifications does one
24 need to have to become a, quote, board certified

1 environmental engineer by the American Academy of
2 Environmental Engineers, end quote, as you state
3 on page one of your pre-filed testimony?

4 A. As you said, the certification is
5 offered by the American Academy of Environmental
6 Engineers and the requirements that the Academy
7 has established are as follows; A, be a person of
8 good moral character and high ethical integrity
9 and professional standing as determined by the
10 Academy's Board of Trustees. B, possess a degree
11 in environmental engineering or any other
12 engineering field acceptable to the Academy's
13 Board of Trustees. C, hold a valid license or
14 certificate of registration to practice
15 professional engineering issued by the lawfully
16 constituted registration board of any state,
17 territory, possession or district of the United
18 States. D, be professionally engaged in
19 environmental engineering activities on a
20 full-time basis. E, have had at least eight years
21 progressively more responsible engineering
22 experience following receipt of a baccalaureate
23 degree and, finally, pass both written and oral
24 examinations administered by Academy

1 representatives.

2 Q. Moving onto question two. Please
3 explain the extent of effort involved in
4 conducting the Limnotech habitat study of the CAWS
5 in terms of the extent to which this study should
6 be viewed as extensive or rigorous evaluation of
7 the habitat conditions in the areas of the CAWS
8 you studied? I'm trying to get a sense of what
9 the magnitude was of this study or level of effort
10 as compared to studies generally.

11 A. Okay. Well, focusing on the words
12 extensive and rigorous. I think I used those
13 elsewhere. We believed this was an extensive and
14 rigorous evaluation of habit conditions in the
15 CAWS for several reasons.

16 First, we -- our field
17 scientists traversed the entire 78 mile length of
18 the study area by boat. We just didn't go out and
19 hit spots. We studied the entire system. We
20 collected information from the entire system
21 including digital video which allowed us to then
22 go back and quantify, for example, bank condition
23 over the entire length of the study area. Where
24 possible, we characterized these features, the

1 habitat features, over the entire length of the
2 system. Not just the sampling stations. Where
3 existing data weren't as sufficient as we'd like
4 or where we were limited by the visibility of the
5 water, we attempted new technologies to improve
6 our understanding of subsurface habitat such as
7 use of digital video or side scan sonar.

8 So we tried to push the envelope
9 a little bit on what had been collected
10 previously. The methods we used to analyze the
11 data were accepted methods supported by ample
12 references from available technical and scientific
13 literature and we were supported in our effort by
14 a number of outside scientists.

15 A couple of our collaborators on
16 the study and report were Dr. Kelly Wessell who
17 was one of the developers of the Michigan
18 Non-wadeable Habitat Index and Dr. Dave Wall who
19 holds due appointments with the University of
20 Illinois and the Illinois Natural History Survey.

21 We also collaborated with
22 scientists from the District who have probably
23 studied the system more than anyone else and were
24 able to provide a lot of insight into the data we

1 were collecting. And then upon completion of the
2 Habitat Evaluation Report or rather the draft
3 Habitat Evaluation Report, we had it independently
4 reviewed by three national experts to get their
5 input on what we might try to do differently.

6 Q. I'm going to skip three. I think
7 that's been adequately covered. Moving to four.
8 In the course of the CAWS Habitat Study Report
9 referring to the reports submitted January 6th,
10 2010 as part of Public Comment 284 in this
11 proceeding there is a review of the major large
12 river habitat assessment protocols CEG report of
13 pages 22 to 26.

14 It's noted that using a habitat
15 evaluation protocol that is developed and
16 validated for aquatic biota was considered
17 important because one of the habitat study
18 objectives was to determine what modifications to
19 physical habitat in the CAWS would be required to
20 improve aquatic habitat and that's when they
21 report Section 2.4.1 of page 25. This report goes
22 onto state that, quote, only the Ohio EPA
23 Qualitative Habitat Evaluation Index (Ranken 2004)
24 was found to be explicitly -- was found to

1 explicitly reference fish in its development
2 documentation citing Ranken 1989, end quote.
3 That's at pages 25 to 26. Would you please
4 explain the meaning of this statement with regard
5 to only the Ohio EPA Quantitative Habitat
6 Evaluation Index was found to explicitly reference
7 fish in its development documentation?

8 A. Yes. The habitat indices and
9 protocols are typically developed by comparing
10 habitat conditions to some other conditions such
11 as biota. Perhaps fish, perhaps
12 macroinvertebrates. The idea is that by comparing
13 these two sets of data you can determine a
14 descriptive relationship between habitat and the
15 biotic variable.

16 We were most interested in the
17 relationship between habitat and fish in our
18 study. So one of the things we would want to see
19 if we were to use an existing habitat protocol was
20 that it had been developed using fish data and
21 when we reviewed major habitat indices that were
22 used in the report the only one that we could
23 determine that had been used -- developed using
24 fish data was the QHEI.

1 Q. In this respect then, is your
2 index -- does your index share that same
3 characteristic as the Ohio index?

4 A. Yes.

5 Q. Moving to question five. Is it
6 correct that the CAWS habitat index was developed
7 because due to the manmade nature of the CAWS it
8 was determined that none of the existing habitat
9 indices adequately addressed these unusual
10 features of the CAWS?

11 A. Yes.

12 Q. Question six. In the CAWS Habitat
13 Study Report, page 106 Section 6.2.1, a
14 representation of fish data in the analysis of
15 habitat data at the end of the first paragraph it
16 states, quote, a fish index of biological
17 integrity (IBI) was not available, but
18 incorporated the selected metrics. Although the
19 process used to select the fish metrics was
20 exactly the same process used in many fish IBI
21 studies. Please explain the meaning of that
22 statement.

23 A. The process used to develop IBI's
24 elsewhere has been to assemble a group of fish

1 metrics and then sequentially reduce them into the
2 set of metrics that one wants to use in the index
3 and the process of reducing those potential
4 metrics to the final set is the same process that
5 we used in developing our combined fish metric.

6 So, in that regard, they share
7 many of the same developing characteristics and
8 some of those -- there are many commonly cited
9 papers for index development that I could provide
10 that to do that. They were also cited in our
11 report.

12 Q. So it is a common approach to
13 developing an index to first start with a larger
14 number of variables than you wind up using in the
15 final index itself?

16 A. Yes.

17 Q. So that's not something unique to
18 your index?

19 A. No, not at all.

20 Q. I'm going to skip to 6a. I think
21 that's been adequately addressed. Moving onto 7.
22 On page eight and in attachment three --

23 MR. ANDES: Can I follow up?

24 MS. FRANZETTI: Sure. Sorry.

1 MR. ANDES: I just want to make sure
2 we're clear on one issue. Mr. Bell, would you
3 explain how it is your index and IBI or is it
4 something different and if it is something
5 different, just explain how that is. What are the
6 ways in which it differs from an IBI?

7 THE WITNESS: The difference between
8 what we did and what you would do in developing a
9 full IBI is an IBI, an index of biotic integrity,
10 is at the end of its development able to give you
11 a measure of goodness of the biological community.
12 Ours wasn't designed to determine what was good
13 and what was poor. It was designed to create a
14 gradient, a way of measuring differences across
15 the system, but not to assign value to them.

16 MR. ANDES: So a grade of 75 isn't
17 like a B score in terms of relative to other
18 waterbodies that are out there?

19 THE WITNESS: That's right.

20 MR. ANDES: It's just relative to
21 other waterbodies within the CAWS?

22 THE WITNESS: Yes, that's right. It
23 just means in your example a grade of 75, which I
24 don't think we could get, but if we could would be

1 better than a grade of 50, but it doesn't tell you
2 whether the 75 is good or bad.

3 MS. FRANZETTI: Thank you. That is
4 helpful and I do think I understand it.

5 BY MS. FRANZETTI:

6 Q. So the scores that you generated in
7 your index, they can be used within the CAWS to
8 make some qualitative judgments in terms of which
9 areas of the CAWS are better than other areas,
10 correct?

11 A. I would say quantitatively it
12 describes which areas are better or -- which areas
13 have better fisheries than other areas.

14 Q. So, in that respect, I can look at
15 your values and interpret them based on a
16 numerical ranking from one to a hundred that if
17 you get a higher score you're better than the
18 areas that got the lower scores, can I say that
19 accurately?

20 A. Yes, except we didn't use a one
21 hundred scale, but the idea is the same.

22 Q. What was your scale?

23 A. I don't remember the exact range.

24 Q. Okay.

1 A. Usually, another difference is if
2 you were creating an actual index that someone was
3 going to use you could normalize it to a scale
4 that people are familiar with like zero to one
5 hundred which is really an arbitrary scale. So we
6 could have done that. It just wasn't necessary to
7 do that to complete our study.

8 MR. ANDES: So when you have waters
9 at the top of your scale, at 75, it doesn't mean
10 that that's a really good, clean water goal?

11 THE WITNESS: It's unrelated to
12 that.

13 MS. FRANZETTI: Okay.

14 BY MS. FRANZETTI:

15 Q. Mr. Bell, let me ask you. Read to
16 yourself question 7a. Do you think you've answer
17 that before?

18 A. All the parts?

19 Q. Just 7a.

20 A. Okay. Yes, I do believe I have.

21 Q. I thought so, too. Let's move onto
22 B, which I'm going to modify a little bit since
23 I'm not asking A. Let me read the intro to
24 question seven. On page eight and in attachment

1 three of your pre-filed testimony you discuss the
2 applicability of existing habitat indices to the
3 CAWS. In figure one of attachment three, you
4 compare QHEI scores with what is termed the CAWS
5 habitat index which includes a combined fish
6 metric consisting of 11 physical habitat
7 variables, is that correct?

8 A. Figure 1 of attachment three shows
9 comparison of QHEI scores for 20 fish sampling
10 stations in our study compared to the combined
11 fish metric for those stations. It does not
12 include any values of CAWS habitat status.

13 MS. FRANZETTI: Okay.

14 MR. ANDES: Just a clarification.
15 It's a comparison to QHEI's between combined fish
16 metrics?

17 THE WITNESS: It's a comparison of
18 fish to habitat as measured by the QHEI.

19 BY MS. FRANZETTI:

20 Q. And that combined fish metric is
21 what consists of the 11 physical habitat variables
22 or no?

23 A. No.

24 Q. That's where I have the disconnect.

1 The combined fish metric consists of what?

2 A. Just fish data.

3 Q. Just fish data. Good thing I asked
4 that question. Now, with respect to the six
5 variables that are mentioned in question seven,
6 I'm not going to read them all off, those do
7 explain 48 percent of the availability in the fish
8 data, correct?

9 A. Yes.

10 Q. So then proceeding on with question
11 B. If those six variables explain 48 percent of
12 the variability in the fish data, does the use of
13 the 11 variables (see CAWS habitat index) likely
14 explain more of the variability or am I comparing
15 apples and oranges?

16 A. Not there.

17 Q. Not there?

18 A. But --

19 Q. Help me.

20 A. I would say that -- no, you're not
21 because you're comparing habitat variables to fish
22 which is what we were getting at here, but I think
23 the question has to do with by adding the five
24 variables that are in the index that weren't --

1 adding those five to the original six does it
2 increase the explanatory power or the ability of
3 habitat variables to explain fish data and I would
4 say that under present day conditions system-wide
5 I'm not sure that it does because if those five
6 variables were able to explain a significant -- a
7 statistically significant additional amount of
8 fish data, they probably would have shown up in
9 the original analysis. So they're more
10 descriptive, but their statistical explanatory
11 power probably isn't that great under present
12 conditions.

13 Q. I'm going to skip 6. 7c, I think
14 you answered that. Moving onto D. You agree that
15 most IBI type indices produce only positive
16 values?

17 A. Yes, I do agree.

18 Q. So would you explain how or why does
19 the CAWS combined fish metric produce negative
20 values?

21 A. The metrics used to calculate the
22 combined fish metric some of those are negative so
23 there are --

24 Q. Can I stop you? I'm sorry. What

1 does it mean for it to be negative in this
2 context?

3 A. In this context, they're indicative
4 of a quality of fisheries that is poor. So, for
5 example, the presence of lesions and tumors, that
6 would be a thing that is a negative condition. So
7 a high score for that metric would be -- would
8 decrease the combined metric. So it would be a
9 subtracted value, if you will.

10 Q. Okay.

11 A. So we have ten metrics and, say,
12 three are negative, that would decrease your score
13 and seven are positive which would increase your
14 score. If you represent the three negatives as
15 negative decimals and you add all those things up
16 with your positives, sometimes you're going to get
17 negatives. If we were going as I said before to
18 create an index to make it more useable by people
19 down the road, you might then say let's just
20 transform that range of negative 20 to plus 20,
21 let's just transform that to a 100 point scale and
22 there's a couple mathematical things you can do
23 without changing the values or the differences
24 between the values, but you just shift them all

1 into the positive range of numbers.

2 We didn't bother to do that
3 because it wasn't necessary. We weren't trying to
4 represent anything with the numbers, per se,
5 except provide a description of fish that
6 represented the variation across the system and
7 that variation would have been the same if we
8 described it on a negative 20 to plus 20 scale or
9 a 40 to 80 scale or a 0 to 100 scale.

10 Q. So if I'm using a factor that is
11 deemed to be a positive factor, has a positive
12 effect, and I do my first positive one and my
13 score that I get with your index is ten, but then
14 I move onto the next factor and it's in the
15 negative factor category and my score on that
16 factor is 20, that 20 is going to get subtracted
17 from the 10?

18 A. Using the approach we used, yes.

19 Q. Using your approach, right. I
20 understand now. Did you ever actually try to
21 calculate what your maximum range of scores is for
22 your index?

23 A. I'm sure we did. I don't recall
24 what it was, though.

1 Q. Moving onto question 7f. One of the
2 CAWS fish metrics is the, quote, number of
3 Illinois native sunfish species, end quote. Does
4 this metric include all members of the sunfish
5 family?

6 A. The metric includes all Illinois
7 assigned native species belonging to the sunfish
8 family as defined in table two of the draft
9 Illinois IBI and I've got it cited as IDNR 2000.
10 I think it's got a date 2000 on it, but it's been
11 updated since then. It's a document that we got
12 from the state.

13 Q. Do you know or does your counsel
14 Mr. Andes know whether that is in the record
15 already?

16 MR. ANDES: I believe it is and we
17 can certainly provide.

18 BY MS. FRANZETTI:

19 Q. Moving onto D. With respect to the
20 counting of native sunfish or native minnows for
21 purposes of the CAWS fish index, are hybrid fish
22 included in these counts?

23 A. No.

24 Q. Moving onto question eight. On page

1 three of the attachment three to your pre-filed
2 testimony you state that, quote, linear regression
3 of these two sets of variables results in an R
4 squared value of 0.02. This indicates that the
5 QHEI explains about two percent of the variability
6 in fish data from the CAWS for this dataset, end
7 quote.

8 Given that the QHEI was
9 developed and calibrated against fish metrics
10 developed and calibrated in Ohio, would you agree
11 that it is not surprising that the QHEI explains
12 very little of the variation in the CAWS index
13 which has different metrics that were developed
14 for a system with a very limited fish community?

15 A. Yes, I would agree.

16 Q. Moving onto question nine. On page
17 three of attachment three to your pre-filed
18 testimony you state that, quote, it is also worth
19 noting that the QHEI results in a relatively
20 narrow range of scores (34 to 56) for the CAWS
21 stations indicating that the QHEI may be limited
22 in its ability to discern variability in physical
23 habitat within the CAWS, end quote.

24 Although you conclude that this

1 indicates a potential limitation of the QHEI to
2 discern physical habitat variability, is this
3 narrow range of QHEI scores from 34 to 56 also an
4 indication that habitat throughout the CAWS is
5 limiting and poor practically everywhere?

6 A. Yes, I would agree.

7 Q. Moving onto question ten. On page
8 11 of your pre-filed testimony, you indicate that
9 the R squared value of 0.48 for your CAWS habitat
10 index is very good compared to other habitat
11 indices, specifically with regard to the R squared
12 of 0.45 for the QHEI. Do you agree that the
13 developer of the QHEI, Mr. Ed Ranken, used data
14 only from reference sites as a means to minimize
15 the influence of factors other than habitat on the
16 biological scores generated by the QHEI?

17 A. To my knowledge, that's true.

18 Q. Subquestion A of ten. Because of
19 the highly disturbed nature of the CAWS, is it
20 true that such, quote, reference sites within the
21 CAWS do not exist and hence Limnotech could not
22 use them?

23 A. Yes, that's true.

24 Q. Question B. Do you think it is

1 likely that the approximately 50 percent of
2 variability not explained by the CAWS habitat
3 index is also explained by the existence of other
4 factors such as water quality, sediment
5 contamination, barge traffic, water level
6 fluctuations, urban runoff, et cetera, and not
7 solely the inherent variability of biological
8 data?

9 A. We found that of that half not
10 explained by physical habitat, most 70 percent of
11 that portion, or 35 percent overall, could be
12 explained by the natural variability, but I think
13 there are multiple factors that explain the fish
14 variability in the system that's not explained by
15 physical habitat and they might include the
16 factors you've noted in the question.

17 Q. So if I understand you correctly,
18 based on the results of your study you think those
19 other factors could explain about another 15
20 percent?

21 A. Potentially, yes.

22 MS. TIPSORD: Ms. Franzetti, before
23 you move on, I want to back up to your sub A and I
24 think it's partly because of the way you phrased

1 the question. I want to ask Mr. Bell. The
2 question talks about the highly disturbed nature
3 of the CAWS. Would you tell me what -- how you
4 interpret that phrase?

5 THE WITNESS: I interpret that to
6 mean the manmade aspect of it.

7 MS. TIPSORD: Thank you. I thought
8 that's what you were saying, but I wanted to make
9 sure we were all on the same page.

10 BY MS. FRANZETTI:

11 Q. Question 11. Actually, one more
12 follow up on your last answer to B, Ms. Tipsord's
13 question. How was it that you were able to
14 determine that about 50 percent of that -- excuse
15 me. Sorry. I'm saying it wrong. How were you
16 able to determine that about 70 percent of that 50
17 percent was attributable to natural variability?

18 A. First of all, it could be
19 attributable and the way we did that is we looked
20 at -- we did our regression with the habitat data
21 and the fish data and we got our -- the result
22 that showed about half of the variability could be
23 explained by habitat and then we looked at the
24 difference between what was predicted and what was

1 actually measured in fish. What was predicted by
2 the habitat and what was actually measured and
3 there's some variation there. There's a
4 difference, a delta between observed and measured
5 and that sort of reflects the other half of
6 what -- if it was a perfect description, if it was
7 a hundred percent, you'd get a dead on, straight
8 line match, but that's not what you get.

9 You get a little bit of
10 variation around that line. So if you take those
11 differences, those residuals, and calculate them
12 and compare that quantity to other things then you
13 can get some idea of what is causing that
14 variation that you're not accounting for with
15 habitat and one of the things we looked at was the
16 change in fish metrics over time at each station
17 and when we compared that we found there was a
18 relatively good correlation between those two, an
19 R squared of 0.7.

20 So that's what we mean when we
21 say that that's one factor that could explain as
22 much as 70 percent of that half that's not
23 explained by habitat.

24 Q. Moving onto question 11. In Table

1 4-1 of page 60 of the Habitat Evaluation Report,
2 Public Comment 284, it is stated that some of the
3 QHEI metrics are not useful for the CAWS because
4 these metrics when applied result in the same
5 score for most or all of the stations. Are the
6 QHEI scores you were referring to here accurately
7 described, though, as very low scores including
8 many zero scores?

9 A. Yes.

10 Q. So moving onto A. Given the
11 consistency of the very low or zero score results
12 for the CAWS, is this additional relevant evidence
13 that several habitat features that are important
14 to supporting a balanced fish community such as
15 riffle, bends in the river and shallow areas are
16 either absent from the CAWS or very close to being
17 absent?

18 A. I agree with the statement. I don't
19 know if I would say that they're evidence of the
20 absence of these things. I would say the absence
21 of those things necessarily results in very low
22 scores.

23 Q. Okay. Moving onto 12. On page 27
24 of the CAWS Habitat Study Report Table 2-4,

1 Limnotech characterizes the QHEI as not being a,
2 quote, quantitative, end quote, protocol. Is it
3 your opinion that the scoring system used in the
4 QHEI cannot be considered a quantitative protocol?

5 A. When we characterized the QHEI as
6 not quantitative, we meant it includes a number of
7 qualitative scoring variables. For example, when
8 evaluating substrate, the scores we estimate
9 percentages rather than make actual measurements.
10 There is also some qualitative judgment associated
11 with measuring or assessing imbedidness of
12 substrates or the presence of in stream cover.

13 So although numerical values are
14 assigned to a number of these things, they're not
15 actually measured. There's a greater allowable
16 degree of judgment on the part of the person
17 applying the score. So, in that sense, we
18 categorized it as a quantitative -- you may even
19 have said semiquantitative -- or semiqualitative,
20 but it is more qualitative than others in that
21 regard.

22 Other things such as morphology
23 metrics are judged using terms like high, moderate
24 low which are qualitative descriptors, not

1 quantitative, in the sense that they're not
2 measured in numerical quantities.

3 So -- and, lastly, I think those
4 are the reasons it's called the Qualitative
5 Habitat Evaluation Index because it's recognized
6 by the developers that it is a qualitative
7 assessment in this regard. Even though you come
8 up with a number score, a lot of things you do to
9 apply it are qualitative measures.

10 Q. Okay. Just to get a little more
11 comparison between your index and the QHEI. There
12 are, however, though, some of the metrics in the
13 QHEI which you would agree are quantitative?

14 A. Yes. Don't ask me to name them, but
15 I know they're not all quantitative.

16 Q. I won't ask you to name them. So
17 what you're saying is your index is more
18 quantitative than is the QHEI?

19 A. I would say that.

20 MR. ETTINGER: There are some --
21 when you looked at macrophyte cover, to your
22 knowledge, did someone go down and measure how
23 much the macrophyte cover was?

24 THE WITNESS: What we did was we

1 setup sample plots of a certain dimension and then
2 measured how much of the sample plots and there
3 were several within each region. I don't recall
4 the exact numbers or sizes, but those were
5 measured. So the judgment was applied in where to
6 select those sample sights because this and this
7 and this are most representative, but there was
8 measurements.

9 The difference I think is that
10 for the most part we tried to minimize -- because
11 we thought and believed and rightly believed this
12 would be subject to some scrutiny we wanted to try
13 to minimize subjective aspects of it.

14 MR. ETTINGER: Did you have a
15 measure of how crumbly the vertical wall was, for
16 example?

17 THE WITNESS: No, I don't think we
18 did.

19 MR. ETTINGER: And in terms of a
20 manmade structure, did you differentiate between
21 size of pier or measure?

22 THE WITNESS: No.

23 MR. ETTINGER: So it was either
24 present or not present?

1 THE WITNESS: We counted them. I
2 mean, it was -- yeah. It wasn't each individual
3 present or absent, but then they were counted.

4 MR. ETTINGER: Then they were
5 counted and a pure count of the same whether it
6 was crumbling down or whether it was standing
7 or --

8 THE WITNESS: Yes.

9 BY MS. FRANZETTI:

10 Q. I have another follow-up question.
11 If I want to -- I was going to ask this
12 hypothetically, but I'm not -- let me change it.
13 With respect to the CAWS, if I don't want to put
14 in the effort you put in to apply your index at
15 least at the first go around and instead I use the
16 QHEI, won't the QHEI give me a sense, for example,
17 all the scores in the CAWS segments stay within a
18 12.0 or so scale range and we already went over
19 the fact that they indicate poor habitat
20 conditions generally in the CAWS, correct?

21 A. Yes.

22 Q. So can't I use the QHEI as kind of a
23 screening tool even in the CAWS to just get a
24 sense of is it excellent, good or poor habitat?

1 A. I think so. It does a couple things
2 for you if you did that. First of all, you're
3 getting out and you're seeing the system and just
4 to get out and see it there's value. Secondly,
5 you're going to identify things that are present
6 or absent that you didn't know about before. So,
7 in this example, going out and trying to apply the
8 QHEI you'll note the absence of sinuosity and
9 absence of pools and riffles and that will start
10 you thinking along the lines of things you might
11 want to measure further or evaluate further.

12 Q. Then I can if I so choose and I have
13 the resources to come back and apply your index to
14 try to get some differentiation within the core
15 category of whether some of the areas aren't as
16 poor as others for purposes of potentially
17 creating two different use classifications instead
18 of just one that says the whole area is poor, is
19 that accurate?

20 A. Yes, you could do that.

21 Q. Let me still ask you 12a. Do you
22 agree that when the QHEI is applied and its
23 scoring conducted by adequately trained biologists
24 it's capable of yielding consistent scores among

1 such biologists?

2 A. I would agree. Well --

3 Q. Assuming it's appropriate -- the
4 area is appropriate for use of the QHEI?

5 A. Yes, that's what I was going to say.

6 Q. Moving onto B. Do you agree that
7 when the QHEI is applied by adequately trained
8 biologists, it's capable of yielding a reasonable
9 estimate of habitat quality?

10 A. Yes, I would agree as long as it's
11 applied to a system for which it's designed.

12 Q. Moving onto question 13. In the
13 CAWS Habitat Study Report, Limnotech discusses the
14 Illinois Index of Biological Integrity, also known
15 as IBI, for fish and notes it has certain
16 limitations namely that it was developed for
17 wadable systems. Please explain why the fact that
18 the Illinois IBI developed for wadable streams
19 makes it less suitable for use in the CAWS.

20 A. The natural structure and function
21 of large streams differs from small streams.
22 Large meaning deep, boatable streams compared to
23 small, wadable streams. So the methods that one
24 would use are different. There are different

1 things you'd look for and that's why different
2 protocols are developed and there are ample
3 references out there in the scientific literature
4 that will describe the need for non-wadable
5 assessment protocols.

6 Q. Moving onto A. Is it correct that
7 the Illinois IBI and the Ohio EPA boat IBI are
8 different IBI indices?

9 A. Yes.

10 Q. Do you agree that the Ohio boat IBI
11 is developed for rivers and not for wadable
12 streams?

13 A. Yes.

14 Q. Moving onto 14. Assuming that
15 sediment chemistry was not -- let me not assume.
16 Let me ask that as a separate question. Was
17 sediment chemistry included directly in the CAWS
18 habitat progression equation?

19 A. Yes. We included measuring and I
20 think I discussed this a little bit this morning.
21 So just in brief --

22 Q. Yes.

23 A. We did want to represent --
24 recognizing the contamination of sediments in the

1 system we wanted to represent that somehow in our
2 valuation of habitat factors. So we compared
3 sediment contamination to the macroinvertebrate
4 data to try to discern which containments seemed
5 to be most closely correlated with
6 macroinvertebrate condition assuming that would be
7 an indirect measure of how they effect fish as
8 well.

9 Q. Right. That's how you did it and I
10 think that was the point we were trying to
11 understand and I thought it did start to become
12 clearer this morning. You didn't use the metric
13 of sediment chemistry in your habitat regression
14 equation?

15 A. Yes, we did.

16 Q. You did?

17 A. Yes. There were three variables
18 reflecting sediment contaminant condition that
19 went into the mix of all possible habitat
20 variables. They ultimately weren't contained in
21 the final analysis, but when we did the final
22 regression they had been eliminated for various
23 reasons as described in the report, but we did put
24 them in along with all the other things we used as

1 possible habitat descriptors.

2 MR. ANDES: Do you want to explain
3 which ones those were and why they were
4 eliminated?

5 THE WITNESS: The three we selected
6 were total chromium, total PCB's --

7 MR. ANDES: Chromium?

8 THE WITNESS: Cadmium. Sorry.
9 Total cadmium, total PCB's and a variable called
10 simultaneously extracted metals, SEM's, which is a
11 measure of the bioavailable metals in sediments
12 and we selected those because those were the three
13 that were most strongly correlated with the
14 macroinvertebrate data and with the number of
15 different metrics of macroinvertebrates.

16 So they seem to be popping up a
17 lot and had strong correlations because -- I don't
18 know how many chemicals, but literally dozens,
19 possibly even hundreds, of chemicals that have
20 been measured and we simply -- we didn't think it
21 would be practical to put them all in the pot for
22 the analysis. So we wanted to discern the most
23 important ones.

24

1 BY MS. FRANZETTI:

2 Q. And the macroinvertebrates metric
3 was identified as a more important one than
4 sediment contamination, is that right, because it
5 gets carried through to the final analysis?

6 A. No.

7 Q. No?

8 A. Okay.

9 Q. You can tell I'm struggling with
10 this issue.

11 A. Yeah. The macroinvertebrate data
12 did not -- we only compared the macroinvertebrates
13 data to the sediment chemistry data to try to
14 determine which sediment chemicals were impacting
15 the food chain the most.

16 We didn't have macroinvertebrate
17 data compared to fish and we didn't have
18 macroinvertebrate data compared to habitat. We
19 wanted to get sediment contaminants as a habitat
20 variable into our analysis.

21 So the only thing we used
22 macroinvertebrate data for was to try to discern
23 which sediment containments we should put into the
24 mix as habitat variables to try to figure out if

1 they were effecting aquatic life the way other
2 habitat variables were.

3 MR. ANDES: Am I correct that the --
4 so the sediment counts you looked at were ones
5 that were well correlated with macroinvertebrate
6 conditions?

7 THE WITNESS: Yes.

8 MS. WILLIAMS: I think Mr. Andes
9 was going to ask you to explain when in the
10 process they were eliminated? Can we finish that
11 thought?

12 MR. ANDES: Sure. Go ahead.

13 THE WITNESS: That, I would have to
14 look up. Wait. It's right here. I happen to
15 have it right here. So total cadmium and total
16 PCB's were eliminated during the principal
17 components analysis.

18 MR. ANDES: Explain that, please.

19 THE WITNESS: The principal
20 components analysis was a method we used to
21 discern which variables, which habitat variables
22 exhibited the greatest degree of variation across
23 the system because ultimately we wanted to do this
24 multiple linear regression. We knew that for

1 us -- to be able to get statistically significant
2 results we needed what we called strong gradients.
3 We needed variables that were well differentiated
4 or as differentiated as possible across the
5 system.

6 If everything is the same, you
7 just can't get a good statistical analysis. So we
8 wanted to try to figure out what was a variable.
9 So while these things were variable and correlated
10 with macroinvertebrates, it turns out that across
11 the system compared to other things they just
12 weren't that varied. So that's the principal
13 components analysis.

14 And the simultaneously extracted
15 metals was eliminated because it was strongly
16 correlated with vertical wall banks and strongly
17 correlated variables wouldn't work in the multiple
18 linear regression either. It's very important to
19 get statistically significant results in the
20 regression analysis that the variables at least be
21 numerically independent.

22 So if you have two variables
23 that are really strongly correlated, then the
24 statistical confidence in the analysis drops. So

1 that -- and there were other variables that were
2 like that that were removed because of their
3 correlation to their other variables, but that's
4 why they were screened out.

5 MS. WILLIAMS: So all of them were
6 screened out before they were compared to combined
7 fish metrics, is that correct?

8 THE WITNESS: Yes.

9 MS. WILLIAMS: Then, can you explain
10 for us which macroinvertebrate it was that
11 correlated with the sediment contamination you
12 looked at? I'm just trying to trick you.

13 THE WITNESS: I can say it wasn't in
14 any one macroinvertebrate metric, but I think I
15 would have to look that up and provide that answer
16 because there were a lot of metrics and these
17 chemicals were correlated to several different
18 ones. So I'd have to go through the attachment in
19 Appendix B and kind of make the list.

20 MS. WILLIAMS: So would we be able
21 to make that list ourselves?

22 THE WITNESS: You should be able to
23 do that. There should be correlation tables. I'm
24 pretty sure. I'm going by memory now, but we

1 could provide that. It would be relatively
2 straight forward to do that.

3 MS. WILLIAMS: Thank you.

4 BY MS. FRANZETTI:

5 Q. I'm going to skip to question 16 and
6 I know this morning you gave testimony which
7 included examples of what types of structures were
8 included in the terms manmade structures. My
9 question 16 is a little narrower, but staying with
10 regard to manmade structures. I also have trouble
11 with that term. Let me just stick with manmade
12 structures. Can you give me some examples of the
13 types of manmade structures that were determined
14 to have a detrimental impact on aquatic life as
15 part of your habitat study?

16 A. We didn't evaluate the impacts of
17 specific structures on aquatic life. We just
18 grouped three types into a category and then
19 assessed that category against fish. So the three
20 types were bridge abutments, dolphins and piers.
21 So the presence of all of those or some of those
22 as a group was discussed.

23 Q. And I think you touched on A this
24 morning, but I'm going to err on the side of

1 inclusion in asking it. Does the CAWS habitat
2 index with respect to the manmade structures
3 factor attempt to quantify the various manmade
4 structures located within a given segment of the
5 CAWS to which the index was applied?

6 A. The variable we used for manmade
7 structures was a count of the number of manmade
8 structures in a sampling reach.

9 Q. So just how many existed within that
10 400 meter range?

11 A. Yes, and it had nothing to do with
12 size.

13 Q. So would it be correct -- and I'm
14 just paraphrasing a little, changing the remainder
15 of it. So you didn't consider differences in size
16 of the various manmade structures within a given
17 location just how many there were there?

18 A. That's right.

19 Q. Moving onto 17. At page 57 of the
20 CAWS Habitat Study Report, there's a finding that
21 fish metrics are positively correlated to
22 dissolved oxygen, but dissolved oxygen is a poorer
23 predictor of fish metrics. Please explain further
24 what this finding means including what the phrase

1 positively correlated means?

2 A. The phrase positively correlated
3 means that in many cases as the DO metric
4 increased, depending which one you were looking
5 at, as it increased, the quality of fish condition
6 also increased, but those relationships were found
7 to be relatively weak because the R squared values
8 were low and in many cases not even statistically
9 significant.

10 Q. So that DO has a positive -- you
11 found that DO has a positive effect on fish, but
12 not much of one in the CAWS?

13 A. Yes.

14 Q. All right. Moving onto 18. In
15 Appendix C of the Habitat Evaluation Report,
16 Public Comment 284, and on pages two to three of
17 your pre-filed testimony you consider the
18 relationships between fish and water quality,
19 particularly dissolved oxygen. Is it correct that
20 the Limnotech study determined that dissolved
21 oxygen was a much poorer predictor of the quality
22 of the fish community than was habitat?

23 A. Yes.

24 Q. Do you agree that in the CAWS

1 habitat is a much more important factor to the
2 quality of the fish community than is dissolved
3 oxygen?

4 A. Yes.

5 Q. I'm skipping 19 and going to 20. At
6 page 57 of the report in the third bullet, it
7 stated, quote, some fish metrics are positively
8 correlated to temperature, but more poorly than
9 with dissolved oxygen. Relatively few fish
10 metrics show statistically significant correlation
11 to observed temperature data, end quote. Would
12 you please explain in more detail the meaning of
13 this finding and the data on which it is based?

14 A. The finding is based on regression
15 analysis of fish data with temperature data from
16 the CAWS collected between 2001 and 2007. Those
17 were data from the District's CDOM stations and we
18 calculated metrics from those data including the
19 24 hour antecedent temperature, the 48 hour
20 antecedent average temperature, the percent of
21 time temperature exceeded the proposed standard,
22 the percent of time temperature exceeded the
23 proposed standard by more than two degrees. And,
24 for those metrics, we found in general the

1 regression to fish data were -- had very low R
2 squared values and based on that concluded that
3 temperature was a poor predictor of fish data.

4 Q. Let me just jump -- I'm going to
5 skip down to D. What is the significance of the
6 finding that relatively few fish metrics showed
7 statistically significant correlations to observe
8 temperature data?

9 A. Our conclusion was that very little
10 of the variability in the CAWS fish data is
11 explained by temperature variation.

12 MR. ETTINGER: Can I just inquire
13 where did you find the temperature violations in
14 the system?

15 MR. ANDES: The temperature
16 violations?

17 MR. ETTINGER: Which were the sites
18 in which there were temperature violations?

19 THE WITNESS: I don't recall the
20 specific sites.

21 MR. ETTINGER: So do you know of any
22 of them that would be anywhere other than -- that
23 would be any of them other than Midwest
24 Generation's plants?

1 MS. FRANZETTI: Objection to the
2 question. Inaccurate. Facts assumed.

3 MR. ETTINGER: Do you know of any of
4 them?

5 THE WITNESS: We can go back and
6 look at our data and I can tell you, but I can't
7 tell you from memory.

8 MR. ETTINGER: Do you know if there
9 are any heat sources other than the Midwest
10 Generation power plants?

11 THE WITNESS: Off the top of my
12 head, I couldn't tell you.

13 MR. ETTINGER: Thank you.

14 BY MS. FRANZETTI:

15 Q. Just for clarity of the record.
16 When we're talking about violations, are we
17 talking about of the proposed standards or the
18 existing standards?

19 MR. ETTINGER: The document says
20 proposed standards.

21 MS. FRANZETTI: That's how you were
22 using it. It just wasn't clear in the question.

23 BY MS. FRANZETTI:

24 Q. Moving onto 21. At page 57 of the

1 CAWS Habitat Evaluation Report, the third bullet
2 goes onto state, quote, applying the proposed
3 water quality standards for temperature for the
4 2001 to 2007 CDOM datasets does not suggest that
5 attainment of these proposed standards is a good
6 indicator of fish health. Please explain this
7 finding in more detail.

8 A. It just means when we compared the
9 fish metrics to the percent of time temperature
10 exceeded the proposed standard that none of those
11 fish metrics we looked at had a statistically
12 significant correlation with the percent of time
13 the proposed standards were exceeded.

14 Q. With regard to temperature, is it
15 correct that the Limnotech study found that
16 temperature in the CAWS rarely exceeded the
17 current secondary contact water quality standards?

18 A. Yes. In the data we evaluated, the
19 proposed temperature standard wasn't exceeded at
20 most stations.

21 MR. ETTINGER: Wait a minute. Your
22 question was to the current standard. So there
23 were violations of the current standard that you
24 found?

1 THE WITNESS: No. I apologize.

2 BY MS. FRANZETTI:

3 Q. For example, there is a --

4 A. I thought it was referring to the
5 proposed. I'm sorry. I apologize. I misread
6 your pre-filed question and I thought it was
7 referring to -- the line of questioning had been
8 dealing with proposed.

9 MS. FRANZETTI: Actually, I didn't
10 think you did because I thought I was rare.

11 THE WITNESS: I would have to go
12 back and look at the data to answer that. I can't
13 say right now. I misread it.

14 BY MS. FRANZETTI:

15 Q. That's okay.

16 A. I apologize. I misread it.

17 Q. It's okay, Mr. Bell. The data is in
18 the record. I was just trying to get a summary
19 statement of somebody who studied it all in that
20 2001 to 2007 time period.

21 MR. ETTINGER: Did we look at
22 anything different from what we talked about
23 earlier this morning is percentage of time that
24 the site is in violation versus fish metrics? We

1 didn't look what the fish metrics were at the time
2 it was in violation?

3 THE WITNESS: That's right. There's
4 nothing that can be said about the occurrence of
5 violation at the time. I can't say anything about
6 the occurrence of violation or the kinds of
7 samples were taken.

8 MR. ETTINGER: You don't know
9 whether there were good fish or bad fish at any
10 given site at the actual time of the violation?

11 THE WITNESS: No.

12 MR. ETTINGER: Thank you.

13 BY MS. FRANZETTI:

14 Q. Moving onto 22. Regarding the data
15 contained in Table 3-1 in Appendix C, I think you
16 did testify this morning that Limnotech compares
17 the 12 fish metrics with the percent of the time
18 the daily maximum temperature exceeded the maximum
19 proposed water quality standards -- temperature
20 standards in the 12 month period proceeding each
21 fish sampling event, correct?

22 A. Yes.

23 Q. Did it find that in none of the
24 cases was the correlation significant?

1 A. Yes.

2 Q. Is it also correct that Limnotech
3 found that there was not a significant
4 relationship between the combined fish metric and
5 testimony?

6 A. Yes.

7 Q. Moving onto 23. Regarding the data
8 contained in Table 3-2 in Appendix C, does this
9 information present Limnotech's comparison of the
10 fish metrics and the percent of time the daily
11 maximum temperature exceeded the maximum proposed
12 water quality temperature standard by greater than
13 two degrees Celsius within a regulatory period?

14 A. Yes.

15 Q. Did Limnotech's comparison of this
16 data also fail to find any statistically
17 significant relationships?

18 A. Yes.

19 Q. Question 24. Table's 3-3 and 3-4 of
20 Appendix C, do these two tables present
21 Limnotech's comparison of the 12 fish metrics and
22 the 24 hour and 48 hour average antecedent
23 temperature respectfully?

24 A. Yes.

1 Q. In these comparisons, is it correct
2 that you found statistically significant
3 relationships with three metrics and the combined
4 fish metric?

5 A. Yes.

6 Q. For the three metrics where a
7 statistically significant relationship was found,
8 is it correct, though, that the R squared values
9 were low ranging from 0.04 to 0.21?

10 A. Yes.

11 Q. Is it also correct that based on
12 these low R squared values Limnotech concluded
13 that, quote, low R squared values suggest
14 relatively weak relationships?

15 A. Yes.

16 Q. Is it true that the 24 hour and 48
17 hour average antecedent temperatures, at most,
18 explained only about 20 percent of the variability
19 in any of the fish metrics and usually much less
20 and that for most fish metrics these temperatures
21 did not even show a statistically significant
22 relationship?

23 A. Yes.

24 Q. Moving to 25. Based on the various

1 analyses that Limnotech conducted, and I'm going
2 to slightly modify this question based on your
3 testimony, do you agree that temperature was not a
4 strong indicator of fish health in the CAWS?

5 A. Yes.

6 MS. WILLIAMS: May I ask a follow
7 up?

8 THE WITNESS: Yes.

9 MS. WILLIAMS: Do you agree,
10 Mr. Bell, that in the areas with the best
11 temperature, the highest compliance, lowest
12 temperatures you had the highest quality fish,
13 highest fish metric values?

14 THE WITNESS: I can't answer that
15 off the top my head. I'd have to go back and look
16 at the fish data.

17 MS. WILLIAMS: I think we went over
18 this a little bit last time, but I was hoping
19 you'd remember. We could refer back to we talked
20 about Attachment C.

21 MS. TIPSORD: Appendix C to what,
22 Ms. Williams?

23 MR. ANDES: If we can borrow that
24 again, I'd appreciate it.

1 MS. WILLIAMS: Do you have it?

2 MS. TIPSORD: What page are you on,
3 Ms. Williams?

4 MS. WILLIAMS: C1.

5 THE WITNESS: Got it.

6 MS. WILLIAMS: I'm looking at -- why
7 don't we start with percent top carnivores by
8 weight versus percent time daily max exceeded.
9 That would be the right-hand column, the second
10 box down. Do you see that.

11 THE WITNESS: Yes.

12 MS. WILLIAMS: Do you agree that,
13 again, the best fish metric value occurred within
14 the best temperature data on the far left with --
15 the lowest temperature data had the highest fish
16 metric value?

17 THE WITNESS: Yes, the highest
18 metric in that chart occurs at zero percent.

19 BY MS. FRANZETTI:

20 Q. What is that metric measuring?

21 A. Percent top carnivores. It's the
22 percentage of fish in a particular sample that
23 would be classified as top carnivores.

24 Q. Let's try the one below. Illinois

1 ratio of non-tolerant coarse mineral substrate
2 spawners versus percent time daily max exceeded
3 previous 12 months. Would you agree that you had
4 the highest ratio of non-tolerant spawners in the
5 lowest temperatures?

6 THE WITNESS: Yes, at zero percent.

7 MS. WILLIAMS: Thank you.

8 BY MS. FRANZETTI:

9 Q. Do those answers in any way change
10 your testimony in response to my questions
11 regarding the significance of testimony?

12 A. No.

13 Q. Why not?

14 A. Because they're still -- there's
15 still no statistically significant relationship
16 between these data. The occurrence of higher
17 scoring fish metric at a place where a few
18 temperature metrics are low or lowest doesn't
19 necessarily mean that's a condition that can be
20 applied to the whole system.

21 I mean, the data are what the
22 data are, but I don't think it changes the fact
23 that there's not a statistically significant
24 relationship and I still would say that it's not a

1 limiting factor for fish based on the data we've
2 analyzed.

3 Q. Thank you. I think I'm on question
4 26. Based on the various regression analyses
5 performed by Limnotech, did you find that
6 attainment of the water quality standards proposed
7 in this UAA rulemaking is not a good indicator of
8 fish health?

9 A. Yes.

10 Q. It is your expert opinion that the
11 fish community in the CAWS will not improve
12 measurably if the proposed water quality standards
13 are adopted?

14 A. Yes, based on the data we've
15 analyzed.

16 Q. Question 27. At page 57 of the CAWS
17 Habitat Evaluation Report, Section 3.3.3,
18 concludes with the statement, quote, while no
19 definitive statement can be made about causation
20 from regression analysis, the weak correlation
21 between fish metrics and dissolved oxygen
22 indicates that incremental improvements in water
23 quality alone may have at best a small benefit to
24 fish if all other conditions effecting fish in the

1 system remain unchanged, end quote.

2 Does this statement mean that
3 because of the habitat conditions in the CAWS and
4 other stressors besides water quality, improving
5 just the water quality without addressing these
6 other stressors is not going to result in a
7 significant improvement in the aquatic activity?

8 A. Yes.

9 MR. ETTINGER: By water quality
10 here, you did not include the turbidity measure?

11 THE WITNESS: Actually -- and I
12 think I made reference this morning to this. We
13 did subsequent to our report do an additional
14 classification or regression tree or CART analysis
15 in which we used not just dissolved oxygen and
16 temperature, but we added turbidity, chloride and
17 ammonia and none of the analysis -- the analysis
18 didn't change.

19 BY MS. FRANZETTI:

20 Q. I'm just going to ask a piece of 28
21 that I think was not already answered. At pages
22 63 to -- hang on a second. I don't think I need
23 to read that intro. Let me just jump to C, 28C.
24 At page 64 of the report, it stated that, quote,

1 based on these correlation analyses, three
2 sediment chemical parameters were chosen for use
3 in the habitat evaluation. Cadmium concentration,
4 total PCB concentration and concentration of
5 simultaneously extracted metals, which is a
6 measure of the bioavailability of heavy metals in
7 sediments. The three factors actually you just
8 mentioned a few minutes ago. Why were those three
9 sediment parameters selected for use in the
10 habitat evaluation?

11 A. As I said previously, they were
12 selected because those were the three contaminant
13 measures that were most strongly and frequently
14 associated with macroinvertebrate data and that's
15 the list of correlations that we were going to
16 provide in answer to one of the State's questions.

17 Q. Okay. Moving onto -- I think 29 has
18 been covered. Thirty, at page 65 and in several
19 other sections of the report relating to habitat
20 conditions references are made to the, quote,
21 1999, end quote, article. Please provide a copy
22 of this article for introduction into the record
23 of this rulemaking. Is your counsel going to do
24 that?

1 A. Counsel is now fishing for that in
2 his box of records.

3 MS. FRANZETTI: Could counsel keep
4 fishing so he can cover the next question if he
5 has it?

6 MR. ANDES: Yes. The first document
7 Chapter 10 Stream Habitat Management, Ronald J.
8 Orth and Woody J. White in a book called Inland
9 Fisheries Management in North America, second
10 edition.

11 MS. TIPSORD: If there is no
12 objection, we will enter Inland Fisheries
13 Management in North America second edition edited
14 by Christopher C. Kohler Chapter 10 as Exhibit
15 455. Seeing none, it's Exhibit 455.

16 (Document marked as IEPA Exhibit
17 No. 455 for identification.)

18 MS. FRANZETTI: Thank you,
19 Mr. Andes.

20 BY MS. FRANZETTI:

21 Q. Moving onto question 31. At page 81
22 of the CAWS Habitat Evaluation Report in Table 4-7
23 entitled, quote, habitat limitations in the CAWS
24 related to hydrology (after Bunn and Arthington

1 2002), end quote. The Bunn and Arthington 2002
2 article is cited in support of several of the
3 statements in Table 4-7 regarding the habitat
4 limitations in the CAWS related to hydrology.
5 Please provide a copy of this article for
6 introduction into the record and please explain
7 the meaning of the parenthetical (after Bunn and
8 Arthington 2002)?

9 MR. ANDES: The name of the document
10 is Basic Principles and Ecological Consequences of
11 Altered Flow Regimes for Aquatic Biodiversity.

12 MS. TIPSORD: If there's no
13 objection, we will enter the Bunn and Arthington
14 article as Exhibit 456. Seeing none, it's Exhibit
15 456.

16 (Document marked as IEPA Exhibit
17 No. 456 for
18 identification.)

19 BY THE WITNESS:

20 A. You asked about the parenthetical
21 citation after Bunn and Arthington?

22 BY MS. FRANZETTI:

23 Q. It's the inclusion of the word
24 after. I'm sorry. I'm not familiar with that and

1 I'm not sure what that means.

2 A. What we meant was several of the
3 things that are in that table were paraphrased
4 from their findings. So we didn't directly quote
5 or copy the table, but the content of the table
6 was extracted. We wanted to credit them with
7 that.

8 Q. I see. Okay. Thank you. I didn't
9 know that's how that term is used.

10 A. That's how we used it.

11 Q. Moving to subpart A of 31. In Table
12 4-7 regarding the section on flow, it states that,
13 quote, Bunn and Arthington 2002 cite flow as the
14 major determinant of physical habitat and biotic
15 composition in river echo systems, end quote.

16 Can you explain further what the
17 Bunn and Arthington paper found with respect to
18 the influence of flow on physical habitat and
19 biotic composition?

20 A. Yes, I've got some quotes from that
21 article that I think reflect what was intended
22 here. I'd like to read those.

23 Q. Okay.

24 A. On page 493 is the statement, quote,

1 the shape and size of river channels, the
2 distribution of riffles in pool habitats, and the
3 stability of the substrate are all largely
4 determined by the interaction between the flow
5 regime and local geology and landform. Two, on
6 page 494, this complex interaction between flows
7 and physical habitat is a major determinant of the
8 distribution, abundance and diversity of stream
9 and river organisms.

10 On page 494, quote, the most
11 commonly cited abiotic determinants of aquatic
12 macrophyte assemblage structure are all flow
13 related structures. On page 495, quote, physical
14 disturbance from floods and droughts is thought to
15 be a major determinant of the spatial and temporal
16 dynamics of benthic communities and streams and on
17 page 495, quote, many fish species display a
18 preference for particular types of habitat such as
19 pools, riffles and backwater areas and the
20 intention here was to point out just the
21 importance of flow regime in natural systems.

22 Q. Okay. Moving onto B. Also in Table
23 4-7 regarding the section on flow regime, it
24 states that Bunn and Arthington 2002 states that

1 species whose life history strategies have evolved
2 with defined flow regimes may experience
3 recruitment failure in managed systems. These
4 altered systems promote the establishment, spread
5 and persistence of exotic and introduced species,
6 end quote. Please explain further the meaning and
7 basis of these conclusions.

8 A. There's a table two in that paper
9 that I think lists some of the life history
10 responses that are referenced by the quote. The
11 point is, again, that flow regime is an important
12 factor in establishing and determining biotic
13 community in natural systems and where the flow
14 regime is absent or highly disturbed or
15 manipulated by human activity that there's a
16 detrimental effect as concluded by these authors.

17 Q. That table two is at page 497 of the
18 paper, Mr. Bell, that you're referring to. Did
19 you keep a copy of it there?

20 A. We reproduced the copy of paper and
21 I have a copy of the paper.

22 Q. Check 497 just so I can --

23 A. That's right.

24 Q. And that table specifies what some

1 of the specific flow variables are that are the
2 basis of this statement?

3 A. That's right. And we don't mean to
4 imply that all these effects are present in the
5 CAWS, but simply that in natural systems the
6 observation has been by these researchers that the
7 altered flow regime can have a detrimental effect
8 in various ways on fish.

9 MR. ETTINGER: Are we doing anything
10 more than reading this report and putting it into
11 the record here? I'm just asking. Seriously, I'm
12 not trying to insult you. I'm just asking are we
13 reading the paper here and discussing that which
14 is fine?

15 MR. ANDES: It was cited in his
16 testimony.

17 MR. ETTINGER: And you are citing.
18 Do you have independent knowledge of those facts
19 or is this something you thought was something
20 good to cite?

21 THE WITNESS: I think that's the
22 case. It's a citation, a technical citation.

23 MR. ETTINGER: I guess I ask further
24 as to this report then before we leave the report

1 do you have independent knowledge of the influence
2 of modified temperature regimes on life history
3 patterns?

4 THE WITNESS: No. Independent
5 knowledge?

6 MR. ETTINGER: Yes.

7 THE WITNESS: Meaning have I
8 personally studied? No.

9 MR. ETTINGER: Then you wouldn't
10 disagree that modified thermal patterns and day
11 length cues have been shown not only to disrupt
12 insect emergent patterns, but also to reduce
13 population success?

14 THE WITNESS: In natural systems, I
15 wouldn't disagree with that.

16 BY MS. FRANZETTI:

17 Q. Question C. Do you agree that a
18 flow regime of a waterbody is important to the
19 health and quality of the fish community?

20 A. Yes, in natural systems.

21 Q. Why do you add natural systems
22 there?

23 A. Because we're talking about the CAWS
24 here today and I don't have any -- we were unable

1 to draw any strong conclusions about flow in the
2 system from the data we had. So I want to make
3 sure I am clear about what I'm saying.

4 MR. ANDES: Let me follow up. If
5 one were to assume for a moment that basically all
6 the system has the same flow regime which is
7 completely managed, the fact that it is a
8 completely managed artificially created system is
9 important to the nature of the fish community,
10 correct?

11 THE WITNESS: Yes, I would expect
12 that to be the case although we don't have data to
13 corroborate that, but yes.

14 MR. ANDES: Variability between
15 reaches in terms of flow regime did not come out
16 as a significant factor?

17 THE WITNESS: No, it did not.

18 BY MS. FRANZETTI:

19 Q. Is that really what you're saying
20 when you say you don't have adequate data? You
21 were trying to use flow or flow regimes to
22 determine does that make a difference within the
23 CAWS to why some segments may be a little better,
24 less poor than other segments, correct?

1 A. That's what we were trying to
2 determine. We were trying to determine whether
3 flow was an important habitat variable to fish in
4 the CAWS.

5 MR. ANDES: To explain differences
6 between reaches in the CAWS?

7 THE WITNESS: Correct.

8 MS. WILLIAMS: You used a model for
9 that, right?

10 THE WITNESS: That's right.

11 MS. WILLIAMS: Which model?

12 THE WITNESS: It was the DUFLOW
13 Model by Dr. Melching.

14 BY MS. FRANZETTI:

15 Q. Actually, I understand that you're
16 qualifying your opinion that the flow regime of a
17 waterbody, you know, is important to the health
18 and community of the fish community, health and
19 quality of the fish community to those in natural
20 systems, but, in fact, your study really didn't
21 study whether the flow regime here was the -- at
22 least one of the fundamental contributors to all
23 these segments not scoring very well objectively
24 in terms of quality of habitat?

1 A. We attempted to determine that, but
2 all we had to use were model data or model
3 results.

4 MR. ANDES: Let me clarify. You
5 weren't looking at it in terms of this waterbody
6 relative to other waterbodies outside the system?

7 THE WITNESS: No.

8 BY MS. FRANZETTI:

9 Q. That's what I'm getting at.

10 A. No, we weren't doing that.

11 Q. Now, I understand. Thank you. I
12 think D has been asked. I'm going to jump to E.
13 Is it correct then that flow or flow regime -- let
14 me change that based on your testimony. Is it
15 correct that flow or flow regime is potentially
16 another adverse condition that's present in
17 certain of the CAWS segments, but which your
18 scoring system doesn't account for?

19 A. Yes.

20 Q. Question 32. At page 119 of the
21 CAWS Habitat Evaluation Report immediately below
22 Figure 6.6 that's entitled Comparison of the CAWS
23 Habitat Regression Model With 2008 Fish Data, it
24 states, quote, as shown in Figure 6-6, the six

1 variable habitat regression model developed using
2 2001 to 2002 fish data shows a relatively good fit
3 with the 2008 fish data. Why is that important?

4 A. The 2008 fish data was used as a
5 validation dataset for us. The regression is a
6 type of environmental model and it's typical to
7 try to validate these models with independent
8 datasets and that's what we did here. That
9 dataset from 2008 only had 20 data pairs, which is
10 a very small number and we were still able to
11 demonstrate an R squared of 0.29, which for that
12 quality of data, I believe, is good.

13 Q. The same paragraph goes onto state
14 the R squared value of 0.29 (P equals 0.014)
15 indicates that there is good and statistically
16 significant correlation (98.6 percent confidence)
17 between the habitat regression model and the 2008
18 fish data. Why is that important?

19 A. Again, R squared of 0.29 per dataset
20 of only 20 pairs is quite a good result to get and
21 we felt that that was a validation that we were on
22 the right track.

23 Q. In the next paragraph the last
24 sentence it states, quote, the regression fits the

1 long term averages with an R squared of 0.51
2 indicating that the six habitat variables in the
3 regression equation explain more than 50 percent
4 of the variability in fish data over long periods,
5 end quote.

6 Are those the same six habitat
7 variables that you've been -- you've testified to
8 earlier?

9 A. Yes.

10 Q. Does this statement mean that these
11 six habitat variables are the ones that have the
12 greatest impact on the quality of the fish
13 community in the CAWS?

14 A. I'd say these are the six habitat
15 variables that explain most of the variability in
16 the fish data that we evaluated. So, in that
17 sense, the answer would be yes.

18 Q. Moving onto question 33. At page
19 120 of the CAWS Habitat Evaluation Report, Section
20 6.4 entitled Relative Importance of Physical
21 Habitat in the CAWS, it is stated, quote, as
22 previously discussed, the regression analysis
23 shows that physical habitat can explain 48 percent
24 of the fish data collected from 2001 to 2007, end

1 quote.

2 You state in your pre-filed
3 testimony at page two that, quote, multiple linear
4 regression shows that the dominant habitat
5 variables identified in the study had an R squared
6 of 0.48 with fish, indicating that these habitat
7 variables explained as much as 48 percent or about
8 half of the variability in the fish data, end
9 quote.

10 Please clarify what you mean by
11 these statements with regard to why they clearly
12 support your finding that physical habitat is more
13 important to fish than dissolved oxygen?

14 A. What we meant by that statement as
15 pointed out in the quote the R squared of the
16 regression between habitat and fish data was 0.48
17 and that's a significantly larger number than the
18 regression between the DO variables and fish that
19 we found which were two -- 0.02 to 0.27.

20 Q. I think I'm going to skip 34. Give
21 me just a moment. Skipping 34. I think I'm going
22 to ask 35. As you also discussed on page three of
23 your pre-filed testimony and at page 123 of the
24 CAWS Habitat Evaluation Report regarding Figure

1 6-9 comparison of regression residual with percent
2 of time dissolved oxygen less than five mg/L. It
3 is stated that, quote, DO alone can explain 27
4 percent of the variability in the same seven years
5 of fish data. This indicates that physical
6 habitat is relatively more important in
7 understanding fisheries in the CAWS than water
8 quality, end quote. Is this conclusion based on
9 the finding that, quote, physical habitat can
10 explain 48 percent of the fish data as compared
11 with dissolved oxygen explaining only 27 percent?

12 A. Yes.

13 Q. Can it be inferred from these
14 results that if one improves the dissolved oxygen
15 levels in these waters from what they are today,
16 there's not going to be a significant change in
17 the fish community because the physical habitat
18 remains unchanged?

19 A. I would say that based on our
20 analysis there is no reason to expect that
21 improving dissolved oxygen in the CAWS will result
22 in a higher fish community across the CAWS.

23 Q. Moving to B. You state on page
24 three of your pre-filed testimony that Limnotech

1 tested various measures of dissolved oxygen and
2 found that the strongest relationship between any
3 of them and the combined fish metric had an R
4 squared value of 0.27 with the other measures of
5 dissolved oxygen having R squared values ranging
6 from only 0.02 to 0.08. So does that mean that
7 the strongest correlation between DO and the fish
8 data was 27 percent and the other DO measures
9 tested were substantially less significant at two
10 to eight percent?

11 A. Yes.

12 Q. And which measure of dissolved
13 oxygen resulted in explaining 27 percent of the
14 variability in the seven years of fish data?

15 A. That would be the percent of time
16 between June and September that dissolved oxygen
17 was less than five mg/L, which had the R squared
18 of 0.27 with the combined fish metric.

19 MS. WILLIAMS: Isn't it correct,
20 Mr. Bell, that none of the habitat metrics alone
21 accounted for as much variability as that one DO
22 metric did alone?

23 THE WITNESS: That's correct.

24 MS. WILLIAMS: Thank you.

1 MR. ANDES: Would you explain
2 further?

3 THE WITNESS: As we discussed during
4 the last hearings, along the same lines of
5 questioning, that it's my opinion that
6 consideration of a single independent habitat
7 variable would be appropriate. So you can't draw
8 very much meaning from the regression of a single
9 habitat variable in fisheries because you have to
10 consider the interplay of those variables.

11 BY MS. FRANZETTI:

12 Q. Moving onto question 36. At page
13 124 of the CAWS Habitat Study Report, at the end
14 of Section 6.4.2, it is stated that, quote, this
15 result indicates that including DO with the
16 habitat variables improve the amount of fish data
17 variability explained by the regression by about
18 four percent over physical habitat alone. What is
19 the significance of this finding?

20 A. The finding illustrates that across
21 the CAWS as a whole habitat and dissolved oxygen
22 combined explain only a little more variability in
23 fish than habitat alone does.

24 Q. Does this also support the

1 conclusion that based on the findings of the
2 Limnotech Habitat Evaluation Study, physical
3 habitat has a far greater effect on the quality of
4 the fish community in the CAWS than does the
5 existing levels of dissolved oxygen in the CAWS?

6 A. Yes.

7 Q. Moving to 37. With regard to trying
8 to explain the causes of the fish data
9 variability, it appears from the content of
10 Appendix C to the report that temperature was
11 another metric that was studied to see to what
12 extent it explained the fish data variability in
13 the CAWS, correct?

14 A. Yes.

15 Q. Did you conclude that temperature
16 played even less of a role in explaining the
17 variability of the fish data than did dissolved
18 oxygen?

19 A. Yes.

20 Q. Moving to 38. In Section 8.1 on
21 page 141 of the CAWS Habitat Evaluation Report,
22 there is the finding that based on statistical
23 comparison of key physical habitat variables and
24 DO metrics habitat is much more important to fish

1 than dissolved oxygen. Based on the statistical
2 comparison of key physical habitat variables in
3 temperature, is it also correct that the results
4 show that habitat is much more important to fish
5 than temperature?

6 A. Yes.

7 Q. Is it correct that the statistical
8 comparison results would rank temperature in the
9 CAWS as relatively less important to the quality
10 of the fish community than either habitat or
11 dissolved oxygen?

12 A. Yes.

13 Q. Question 39. On page ten of your
14 pre-filed testimony, you state that, quote, two
15 habitat variables; maximum channel depth and
16 percent overhanging vegetation were the most
17 important factors in describing fish data from the
18 CAWS, end quote. Also in the CAWS Habitat Study
19 Report the first finding at the bottom of page 124
20 states, quote, the two most important physical
21 habitat variables in the CAWS that are positively
22 correlated with fish are the amount of macrophyte
23 cover and the quantity of areas that act as off
24 channel bays to provide refuge from the main

1 channel, end quote.

2 Do these statements mean that
3 these two habitat characteristics; maximum channel
4 depth and percent overhanging vegetation have the
5 greatest positive effect on the quality of the
6 fish community in the CAWS?

7 A. No.

8 Q. Would you clarify what I'm
9 misunderstanding there?

10 A. Yes. These two statements refer to
11 two different analyses we performed. The first
12 statement you quoted refers to the CART analysis
13 and the second refers to the multiple linear
14 regression analysis.

15 Q. So can I stop you for a second? On
16 page ten of your pre-filed testimony, that refers
17 to the two habitat variables; maximum channel
18 depth and percent overhanging vegetation. That's
19 referring to the CART analysis?

20 A. That's right.

21 Q. Which is different from what you
22 were referring to at the bottom of page 124 where
23 you cite to the other two physical habitat
24 variables, right?

1 A. That's right. That refers to the
2 multiple linear regression analysis.

3 Q. Keep going. I just want to make
4 sure we all understood.

5 A. Just to underscore the distinction.
6 The CART analysis which was the limiting factor
7 analysis, showed that the two most important
8 habitat variables for fish in the CAWS were
9 channel depth and overhanging vegetation. Channel
10 depth has a negative effect on the combined fish
11 metric in the CAWS. So as it increases, the
12 combined fish metric goes down. Percent
13 overhanging vegetation has the opposite effect.
14 As it increases, the fish metric gets better so
15 they have a different effect and the reference to
16 the multiple linear regression means that off
17 channel bays and macrophyte cover are the two
18 variables that were positively correlated with the
19 combined fish metric. So out of the six variables
20 in the regression model, those two have a positive
21 effect as they increase. The rest have a negative
22 effect as they increase.

23 Q. I'm going to skip over A and B. I
24 think you've covered that. On C, in question 39,

1 what is meant by the, quote, quantity of areas
2 that act as off channel bays? For example, does
3 this mean the aerial extent of the areas and/or
4 the number of the areas? So similar to how you
5 explained manmade structures that you were just
6 counting the number, not how big, not the extent
7 of them within a study location? Can you explain
8 how you dealt with off channel bays?

9 A. Yes, this refers to the number of
10 those areas that are larger than five square
11 meters. So it's a count, but it's a count of the
12 areas that are greater in aerial extent than five
13 square meters.

14 Q. If you know, why was five square
15 meters used as kind of the litmus test for whether
16 that got counted or not?

17 A. Just going back. My memory we
18 had to -- we wanted to pick a size that was large
19 enough to distinguish it from what we call bank
20 pocket areas, which were smaller indentations in
21 the shoreline, but not so large that they were
22 never present. So this seemed to be an
23 appropriate size. So there's nothing magical
24 about it. It's just based on the context we were

1 doing it in. It was large enough to be
2 substantially counted as present, but not so large
3 that we would never find it and not so small it
4 would get mixed up with other variables.

5 MS. BARKLEY: Mary Barkley with
6 Prairie Rivers Network. I wonder if less than
7 five square meters or greater than five square
8 meters of aquatic use were of biological
9 significance?

10 THE WITNESS: No.

11 BY MS. FRANZETTI:

12 Q. Question 40. The second finding at
13 125 of the CAWS Habitat Evaluation Report states,
14 quote, the four most important physical habitat
15 variables in the CAWS that are negatively
16 correlated with fish are the maximum depth of the
17 channel, the amount of vertical wall banks, the
18 amount of riprap banks and the number of manmade
19 structures.

20 You know what, I think you've
21 pretty much answered this, not related to these
22 variables, but I think we all understand how you
23 used the term negatively correlated versus
24 positively correlated.

1 So I'm moving onto 41. Is Table
2 7-7 on page 139 of the CAWS Habitat Evaluation
3 Report accurately described as a summary of the
4 CAWS habitat index scores for the major reaches in
5 the CAWS?

6 A. Yes.

7 Q. So does Table 7-7 provide a summary
8 view of the relative differences in physical
9 habitat in the CAWS and, again, summary views?

10 A. Yes.

11 Q. Is it correct to conclude that based
12 on the habitat index scores presented in Table
13 7-7, the Chicago Sanitary and Ship Canal and the
14 South Branch Chicago River have the lowest quality
15 of habitat for fish among the major reaches in the
16 CAWS?

17 A. Yes.

18 MS. TIPSORD: Before you start on
19 question 42, why don't we go ahead and take
20 another break. I was hoping to get through yours.

21 MS. FRANZETTI: I know. I was
22 thinking the same. I don't mind. I could use a
23 break.

24

1 (Whereupon, a break was taken
2 after which the following
3 proceedings were had.)

4 MS. TIPSORD: Are we ready to go
5 back on the record? Ms. Franzetti, whenever
6 you're ready.

7 MS. FRANZETTI: Thank you.

8 BY MS. FRANZETTI:

9 Q. I'm going to skip 42. Let's go to
10 43. Regarding page five of your pre-filed
11 testimony and your discussion of the
12 channelization of the CAWS, why is the creation of
13 shipping channels so detrimental to fish life?

14 A. The potential impacts of shipping on
15 aquatic life are discussed in Section 4.2.2 of the
16 Habitat Evaluation Report and include habitat loss
17 and denaturization of the flow regime through
18 things we've talked about in the CAWS such as
19 straightening and deepening and bank modification
20 and floodplain disconnection, substrate removal
21 through drudges and vegetation removing through
22 dredges.

23 There can be direct impacts on
24 fish although we did not measure these in the

1 CAWS. Things like propellor and vessel impacts
2 and physiological effects from wakes, sheer
3 stresses from the passing vessels and that sort of
4 thing and finally increase suspended sediment
5 likely as a detrimental effect.

6 Q. Question 44. On page six of your
7 pre-filed testimony, you stated, quote, in rivers
8 and streams, connection to the floodplain is not
9 only important for the system's hydrology, but is
10 important for aquatic biota. For fish,
11 floodplains can provide seasonal habitat diversity
12 as well as a source of organic and inorganic
13 material required by various organisms and various
14 life stages, end quote. What do you mean by
15 connection to the floodplain?

16 A. In this context, what I mean is a
17 hydrologic connection between the channel of a
18 river or stream and its floodplain. It can either
19 be a temporary or permanent connection which
20 allows the exchange of water and organisms and
21 nutrients.

22 Q. On pages six to seven of your
23 testimony, you state that, quote, floodplains
24 never existed. For the 75 percent of the CAWS

1 that were excavated where channels did not
2 previously exist such as the Cal-Sag Channel and
3 the Chicago Sanitary and Ship Canal, why didn't
4 floodplains exist?

5 A. For the portion of the CAWS that
6 were constructed from where channels didn't
7 previously exist, the floodplains didn't exist
8 because you can't have a floodplain without a
9 stream or a river.

10 Q. Okay. On page seven of your
11 testimony, of your pre-filed testimony, you state
12 that, quote, in the CAWS reaches that were once
13 natural waterways or partially so, channelization
14 has eliminated floodplain connectivity almost
15 entirely, end quote. Please explain how
16 channelization eliminates floodplain connectivity?

17 A. Channelization includes the
18 steepening of banks and the deepening of the
19 channels. Sometimes with the widening of the
20 channels with the specific intent of containing
21 the flows that occur. So preventing flows from
22 exceeding the banks. So once that happens, if
23 it's a successful, that connection to what may
24 previously have been a floodplain is cutoff.

1 Q. On page ten of your pre-filed
2 testimony, you state that, quote, the absence of
3 floodplain and floodplain connectivity in the CAWS
4 is for the most part an irrevocable condition.
5 Please explain why.

6 A. To restore floodplains or implement
7 new floodplains where they didn't exist
8 previously, it would require large areas of what
9 are today mostly developed land along the channels
10 to be cleared to allow the flooding to occur and
11 it would also require some of the removal of the
12 things in the channel that have been put in place
13 to facilitate their function for navigation and
14 flood conveyance and storm water conveyance. So
15 it seems to me impracticable to do that on any
16 large scale in an urban setting.

17 Q. Question 45. On page seven of your
18 pre-filed testimony, you state that, quote, the
19 CAWS habitat study found that channel depth -- you
20 know what, I'm going to change this because I
21 really was just trying to understand what strongly
22 negatively correlated with fish condition means.
23 So when you've talked about negative
24 correlation -- when you add this strongly negative

1 correlation, what is the difference?

2 A. Strong refers to higher R squared
3 value.

4 Q. Higher R squared value?

5 A. Yes.

6 Q. Showing a negative effect on some?

7 A. The higher R squared value would
8 show a stronger relationship. It could be a
9 positive or a negative.

10 Q. Right. I'm trying to say with
11 strongly negative?

12 A. Yes.

13 Q. But did you have any numerical kind
14 of cutoff for where you feel it's really strongly
15 correlated on R squared values?

16 A. Relative comparison for the most
17 part.

18 Q. Moving to 46. On page six of your
19 pre-filed testimony, you state the CAWS Habitat
20 Evaluation Report, quote, found that sediment
21 contamination was statistically correlated to poor
22 invertebrate condition, do you think you've
23 answered that question?

24 A. I think I have.

1 Q. I think you have, too. I'm going to
2 skip that. Forty-seven. On page seven of your
3 pre-filed testimony, you state that, quote, CAWS
4 reaches with high commercial navigations were
5 found to have a statistically significant poorer
6 fisheries condition than those reaches without
7 high commercial navigation. Is this Chicago
8 Sanitary and Ship Canal one of the reaches with
9 high commercial navigation?

10 A. Yes.

11 Q. And did you have a basis for
12 determining if commercial navigation usage was
13 high as you used that term?

14 A. The business for this was the use of
15 commodity tonnage data from the Corps of Engineers
16 which had been subsequently processed by the Great
17 Lakes Fishery Commission.

18 Q. So it was based on looking at the
19 Corps of Engineers data?

20 A. Yes.

21 Q. Page 48 -- question 48. On page
22 three of your pre-filed testimony, you discuss the
23 finding that there is a limited potential for
24 physical habitat improvement in the CAWS. You

1 discuss the effect that, quote, reach wide
2 improvement of the primary habitat impairment that
3 can be improved would result in habitat index
4 score increases between 0 and 13 points, end
5 quote.

6 What do you mean by, quote,
7 reach wide improvement of the primary habitat
8 impairments, end quote?

9 A. The phrase reach wide improvement of
10 the primary habitat impairments mean the habitat
11 attributes that were identified in the habitat
12 index over entire reaches of the CAWS such as the
13 entire Chicago Sanitary and Ship Canal.

14 Q. Moving to question 49. On page 13
15 of your pre-filed testimony regarding the habitat
16 improvement report, you discuss the fact that some
17 of the Limnotech assumptions regarding habitat
18 improvement potential may not be realistic and you
19 give the example of the estimates that proposed
20 improvements would increase the habitat index
21 score from 34 to 47, a 38 percent increase for the
22 South Branch Chicago River and that this is
23 largely predicated on the assumption that half of
24 the vertical side walls can be removed and

1 improved, which may not be feasible.

2 Please explain further what the
3 assumption is regarding removal and improvement of
4 the vertical side wall of the South Branch of the
5 Chicago River entailed and what is the improvement
6 you're contemplating there?

7 A. The improvement -- there's a
8 conceptual example of what that might look like
9 given in the Habitat Improvement Report, but it
10 includes the removal of the vertical structure at
11 the bank such as sheet piling and then excavating
12 the bank back from there to create a stable slope,
13 stabilization of that slope to prevent subsequent
14 erosion and then some type of vegetation addition.
15 So planting of the bank to create -- in an effort
16 to create something that resembles a more natural
17 bank condition.

18 Q. Are you aware of any similar
19 projects in scope and size being done?

20 A. Not on this scale, no. Not on this
21 scale.

22 Q. Move onto the next question, 50.
23 Referring to page 14 of your pre-filed testimony,
24 is it correct that the CAWS habitat index

1 Limnotech developed does not account for all of
2 the stressors for the fish community that exist in
3 the CAWS?

4 A. Yes.

5 Q. It is correct that the fish
6 community stressors that are not accounted for in
7 the CAWS habitat index include effects of
8 navigation, sediment contamination and flow
9 variability?

10 A. Yes.

11 Q. Do you agree that all three of these
12 exist in the South Branch of the Chicago River?

13 A. Yes.

14 Q. Do all of them exist in the Chicago
15 Sanitary and Ship Canal?

16 A. Yes.

17 Q. Moving onto 51. On Page 15 of your
18 pre-filed testimony, you state first a cluster
19 analysis of the fish data used in the study
20 (attachment four) indicates that a dominant fish
21 community occurs throughout the CAWS suggesting a
22 degree of stability in the fish community. In
23 light of this, it is unlikely that the small
24 increases in habitat scores discussed here would

1 likely result in significant change in fish
2 community (i.e., new species or significant change
3 in relative proportion of existing species), end
4 quote.

5 Please explain what you mean by
6 the phrases, quote, dominant fish community, end
7 quote, and, quote, stability in the fish
8 community?

9 A. The phrase dominant fish community
10 as we used it in this context refers to the most
11 commonly observed group of fish species in the
12 cluster analysis, which was observed at every
13 station in the CAWS and it includes large mouth
14 bass, common carp, and a number of minnow and
15 sunfish species. The phrase stability of the fish
16 community refers to the fact that all trophic
17 levels are represented in this dominant fish
18 community.

19 Q. So the fact that the fish species
20 cover three trophic levels indicates stability in
21 the fish community?

22 A. I don't know that the number is
23 three, but, yeah, the trophic levels that you
24 would typically expect to see.

1 Q. Okay. Question 52. Referring to
2 page five of attachment four to your pre-filed
3 testimony, it states, quote, one cluster comprised
4 the majority of the most abundant fish species
5 including large mouth bass, blue gill, common carp
6 and a number of minnow and sunfish species. This
7 group was observed at every station in the CAWS.
8 For this evaluation, that cluster will be referred
9 to as the, quote, dominant fish community. Is
10 this the description of the fish species that
11 makeup the, quote, dominant fish community in the
12 CAWS that you were referring to in your pre-filed
13 testimony?

14 A. Yes.

15 Q. Referring to page five of attachment
16 four to your pre-filed testimony, specifically
17 with respect to table one on that page, you state,
18 quote, an evaluation of the direction of the
19 trophic levels (food chain links) represented
20 within the clusters indicates that the dominant
21 community has the most complete representation
22 from all trophic levels while other clusters
23 primarily consist of fewer components of the food
24 web.

1 This suggests that the dominant
2 community represents a relatively complete fish
3 community in the sense that its members occupy
4 most trophic levels. The other clusters lack the
5 components such as prey bait to exist as
6 independent communities, end quote.

7 Please explain the significance
8 of the statement that, quote, this suggests that
9 the dominant community represents a relatively
10 complete fish community in the sense that its
11 members occupy most trophic levels. In other
12 words, why is it significant that the dominant
13 fish community members occupy most trophic levels?

14 A. It's significant because the
15 presence of the -- the fact that trophic levels
16 are all represented is an indicator that the
17 community is self-sustaining, if you will, where
18 as if some were absent it might indicate that an
19 unstable condition, a transient condition in the
20 fish community, that might not be there next year.

21 MR. ANDES: If I can follow up on
22 that. When you talk about a relatively complete
23 fish community is representing various trophic
24 levels, are you saying anything in terms of having

1 both tolerant and intolerant species? Does it
2 have to have tolerant and intolerant to be
3 complete or is that a different issue?

4 THE WITNESS: No. This just refers
5 to the trophic levels.

6 MR. ANDES: In terms of tolerance,
7 what do you generally see here in this particular
8 fish community?

9 THE WITNESS: These tend to be more
10 tolerant.

11 MR. ANDES: So they're generally
12 tolerant, but they're still a complete community
13 in terms of having several different trophic
14 levels, is that correct?

15 THE WITNESS: Yes.

16 MS. WILLIAMS: Can I ask a follow
17 up? Does the list of dominant species we're
18 discussing also include some intermediate species?

19 THE WITNESS: I don't know. I'd
20 have to look.

21 MS. WILLIAMS: Where would you look?
22 Explain where you would look to determine that.

23 THE WITNESS: I'd have to look at
24 the list, first of all, and I don't have the

1 complete list in front of me and then there's a
2 table that we use to classify species in terms of
3 tolerant, intolerant and intermediately tolerant
4 so I would cross reference.

5 MS. WILLIAMS: So you didn't look at
6 tolerant, intolerant and intermediately
7 intolerant?

8 THE WITNESS: Right. So we'd have
9 to cross reference the list in the dominant fish
10 community with that tolerance table and then you
11 could determine that. So I don't recall.

12 MS. WILLIAMS: Is it possible that
13 this dominant community is composed of tolerant
14 and intermediately tolerant species?

15 THE WITNESS: It's possible. I'd
16 have to check.

17 MS. WILLIAMS: Thank you.

18 BY MS. FRANZETTI:

19 Q. Question 54. I'm not going to read
20 the whole intro and just get to the question.
21 Does the data collected in your study support the
22 conclusion that the substrate plays an important
23 role in determining the nature of the fish
24 community that can be expected to be present in a

1 given waterbody?

2 A. I would say the results of CART
3 analysis support that, yes -- I'm sorry. The
4 cluster analysis.

5 Q. Can you elaborate just a little bit
6 further on why the results of the cluster analysis
7 support that?

8 A. There is -- again, I don't have the
9 memo in front of me, but there was a table in
10 there that related the observed fish clusters to
11 their substrate preferences and I think that's
12 what this quote refers to. Let me just read it to
13 myself.

14 Q. Sure.

15 A. So the quote that you didn't read
16 has to do with the fact that there was a cluster
17 of rock bass, small mouth bass that have a
18 preference for coarse substrate and they're less
19 frequent or hardly found at all actually in the
20 CAWS so when you look at the dominant clusters
21 that were identified in the CAWS they seem to be
22 clusters that are associated with substrate that
23 is found in the CAWS.

24 Q. Moving onto question 55. On page

1 six of attachment four to your pre-filed testimony
2 you state, quote, the distribution of pollution
3 tolerances among the clusters indicates that all,
4 but one of the clusters are dominated by tolerant
5 species, end quote.

6 For the clusters that were
7 dominated by tolerant species, what does this say
8 about the general quality of the fish community in
9 the areas of the CAWS where these clusters were
10 found?

11 A. It simply means that the observed
12 fish clusters were dominated by tolerant species.

13 Q. Would you say that's not a very good
14 quality of fish community?

15 A. I would say it's not surprising.

16 Q. I guess I'm just looking for on the
17 scheme of relative -- will --

18 MR. ANDES: When we say they're
19 tolerant, what are they tolerant of?

20 MS. FRANZETTI: Right.

21 THE WITNESS: The answer to that is
22 they're tolerant because they're classified as
23 tolerant.

24 MR. ANDES: What are they

1 tolerating?

2 THE WITNESS: Typically, poor water
3 quality.

4 MR. ANDES: Poor habitat quality?

5 MR. GIRARD: How do you know poor
6 water quality when you see it?

7 THE WITNESS: The assignment of
8 tolerance was made by using -- by referring to
9 other studies and those other studies classify the
10 tolerance of these species according to the
11 tolerance of their pollution. So that's all I'm
12 saying is that when we use their tolerance
13 assignments by implication, the tolerance is based
14 on that and all we're observing here is that most
15 of the fish community or fish clusters we observed
16 are dominated by these tolerant -- pollution
17 tolerant species.

18 MR. ETTINGER: Are rock bass
19 pollution tolerant?

20 THE WITNESS: I don't believe so.

21 MR. ANDES: Are they observed
22 frequently in this area?

23 THE WITNESS: No.

24

1 BY MS. FRANZETTI:

2 Q. Were the clusters found in the South
3 Branch of the Chicago River and in the Chicago
4 Sanitary and Ship Canal dominated by tolerant
5 species?

6 A. Yes.

7 MS. FRANZETTI: Give me just a
8 moment.

9 BY MS. FRANZETTI:

10 Q. There's a question I have for
11 Dr. Mackey that I think based on your testimony
12 may be more suitably directed at you.

13 A. Okay.

14 Q. Did you consider as part of your
15 work in developing this CAWS Specific Habitat
16 Index, did you consider the Ohio EPA use
17 classification system?

18 A. No.

19 Q. So you didn't do any work to look at
20 whether or not Ohio's use classification system
21 might contain appropriate use classifications for
22 the CAWS?

23 A. No.

24 Q. Okay. That wasn't a trick question.

1 I was curious as to whether or not that had been
2 looked at and, if rejected, why?

3 MS. FRANZETTI: Thank you, Mr. Bell.
4 I don't have any further questions.

5 MS. TIPSORD: Any other questions
6 for Mr. Bell at this time?

7 MS. BARKLEY: I would just like to
8 ask a few clarifying questions. I think,
9 Mr. Bell, you testified earlier that the 12 fish
10 metrics and fish sampling stations were not the
11 same places that dissolved oxygen and temperature
12 were taken, is that correct?

13 THE WITNESS: Yes.

14 MS. BARKLEY: So is it clear in the
15 record at which point fish sampling points were
16 done and at which point dissolved oxygen
17 temperature sampling was done? Is it clear? Is
18 it going to be clear in the record the distance
19 and other influences that might be -- might impact
20 those fish communities between the water quality
21 sampling station and the biological sampling
22 stations?

23 THE WITNESS: I think it's
24 Appendix C to the Habitat Evaluation Report

1 addresses that. There should be a table in there
2 that lists the fish sampling stations and
3 describes which CDOM stations we paired to those
4 fish sampling stations and I think there's also --
5 in fact, I'm fairly certain there's also a map in
6 there that shows all of the fish sampling stations
7 and all of the CDOM stations. So it should be
8 pretty easy to put them together so you can see
9 how close or how far they were.

10 MS. BARKLEY: Is there a reason that
11 dissolved oxygen and temperature profiles were not
12 taken at the time you collected fish?

13 THE WITNESS: First of all, we did
14 not collect all of the fish. The District
15 collected most of the fish samples in the area
16 between 2001 and 2007. I can't answer why they
17 didn't do profiles. When we did our 2008 sampling
18 to supplement the sampling for validation, we
19 didn't do profiling because it wouldn't match the
20 historical data. So we wanted to get a dataset
21 that was reflective historically. So we relied in
22 2008 on the CDOM data as well.

23 MR. ANDES: The 2001 to 2007 data
24 was that all collected before this rulemaking

1 started?

2 THE WITNESS: Yes.

3 MS. BARKLEY: Was any water quality
4 data collected at the fish sampling stations that
5 the District has established?

6 MS. TIPSORD: Ms. Barkley, you're
7 going to have to speak up.

8 MS. BARKLEY: Sorry. Was there any
9 water quality data collected at the time that the
10 fish samples -- fish sampling was done?

11 THE WITNESS: I would have to go
12 back and look at the record to see what was
13 collected at the same time as the fish sampling.
14 There are certain water quality measures that are
15 collected at the same locations as the fish
16 sampling stations, but off the top of my head I
17 don't recall what the District's practice is in
18 sampling water quality at the time of fish
19 sampling.

20 MS. BARKLEY: Thank you.

21 MS. TIPSORD: Anything else for,
22 Mr. Bell? Thank you very much, Mr. Bell. We
23 appreciate your testimony.

24 MS. BARKLEY: Thank you.

1 MS. TIPSORD: Let's move onto
2 Dr. Mackey. While we're switching around, I
3 understand that there's going to be -- IEPA is
4 going to defer so are we starting with Prairie
5 Rivers or where are we going? If none of the
6 participants have an objection, that's fine. We
7 can start with Citgo if that's okay with everyone.
8 Then, we'll start with Citgo.

9 (Whereupon, a break was taken
10 after which the following
11 proceedings were had.)

12 MS. TIPSORD: Are we ready? We'll
13 have Dr. Mackey sworn in.

14 WHEREUPON:

15 SCUDDER MACKEY
16 called as a witness herein, having been first duly
17 sworn, deposeth and saith as follows:

18 MS. TIPSORD: If we can have a copy
19 of his testimony. If there is no objection, we
20 will mark the pre-filed testimony. It was
21 actually filed February 2nd, 2001, and I want --
22 I'm going to be doing that with witnesses from the
23 District who have testified more than once so it's
24 clear with what we're talking about. If there's

1 no objection, we will enter
2 Dr. Mackey -- Scudder D. Mackey's testimony filed
3 February 2nd, 2001, as Exhibit 457.

4 MR. ANDES: 2011.

5 MS. TIPSORD: Yes. 2011. Thank
6 you.

7 MR. ANDES: We haven't been going
8 that long.

9 THE WITNESS: It feels like it.

10 MS. TIPSORD: It's Monday. Seeing
11 none, it's entered as Exhibit 457.

12 (Document marked as IEPA Exhibit
13 No. 457 for identification.)

14 MS. TIPSORD: Whenever you're ready.

15 E X A M I N A T I O N

16 BY MR. TESHER

17 Q. Good morning, Dr. Mackey. My name
18 is Ariel Tesher. I'm here on behalf of the Lemont
19 Refinery. I have a few questions that we
20 pre-filed for you. I don't think this will take
21 very long. We'll start with the first one. Based
22 on your education and training, do you support
23 discouraging or preventing evasive species from
24 entering Lake Michigan?

1 A. Yes, I support discouraging or
2 preventing evasive species from entering Lake
3 Michigan.

4 Q. Why is that?

5 A. They could do irreputable harm to
6 the Great Lakes Fishery and to the Great Lakes
7 ecosystem.

8 Q. To the best of your knowledge, does
9 the electric fish barrier prevent invasive species
10 from entering Lake Michigan?

11 A. I would say it's designed to do so,
12 but it may not be a hundred percent effective.
13 Let's hope that it is.

14 Q. It is partially effective?

15 A. It's hard to say. The effectiveness
16 evaluation is ongoing with the US Army Corps of
17 Engineers.

18 Q. Okay. Based on what you know, would
19 you favor maintaining the electric fish barrier?

20 A. Yes.

21 Q. Why is that?

22 A. Again, I think it's at least a short
23 term temporary way to prevent damage to the Upper
24 Great Lakes or to the Great Lakes Fishery and to

1 the Great Lakes ecosystem. I understand that
2 there are several ongoing efforts that are
3 exploring the feasibility of a hydrologic,
4 permanent separation of the two basins and the
5 electric field barrier provides us a bit of time
6 in order to get that analysis done and move
7 forward with whatever decisions are made.

8 Q. Would you consider the electric fish
9 barrier a physical habitat characteristic that is
10 also a limiting stressor on the Chicago Area
11 Waterways? I'm referring to page four of your
12 testimony where you talk about physical habitat
13 characteristics?

14 A. Yes. I believe I would consider it
15 a physical habitat characteristic. The caveat
16 that I have is as long as the barrier remains
17 operational. We are putting electric current in
18 the water. It is going to act in essence a
19 physical barrier to the migration of fish up or
20 down the CAWS.

21 Q. And, Dr. Mackey, do you know what is
22 the current plan for when the barrier is taken out
23 of operation? What is done in those periods of
24 time?

1 A. Could you -- taken out of operation
2 are you talking about maintenance?

3 Q. Yes.

4 A. It's been a while since I have had
5 an update on that, but I do understand that the
6 barriers do temporarily have to be maintained. I
7 believe barrier 2B is operational at this time and
8 barrier 2A I believe was down and it may still be
9 down for maintenance work, but I believe it's a
10 six to eight month schedule for maintenance.

11 Q. When all of them are taken down, do
12 you know how the Army Corps prevented fish from
13 coming past it?

14 A. It's my understanding that the
15 design of the system is as such that they will be
16 taking down one barrier while the other ones
17 remain operational. In other words, that's the
18 reason we have barrier 2A and 2B and then as a
19 backup we have the barrier one which is just a bit
20 upstream from 2A and 2B.

21 Q. Are you aware of the use of rotenone
22 when barrier pathogens have been taken out of
23 operation?

24 A. Yes.

1 Q. Why is rotenone used?

2 A. In that case, there was concern
3 about actual barrier 2A and 2B were not
4 operational and there was maintenance that had to
5 be done on barrier one and the Corps of Engineers
6 and the State of Illinois and other partners
7 decided to rotenone a 5.5 mile reach of the CAWS.
8 At that time, we did not believe that the leading
9 edge of Asian carp had reached that location and
10 this was a precautionary measure to basically if
11 there were any fish there to eliminate them or
12 move them downstream below the Lockport Lock and
13 Dam. That would give us a window of opportunity
14 to perform the maintenance work and then bring
15 barrier one back online.

16 Q. Back to the pre-filed questions
17 number five for those people keeping score. It is
18 your testimony on 11 in addition to the electric
19 barrier, the other physical characteristics in the
20 area of the electric barrier are unfavorable to
21 aquatic life or is it your testimony --

22 A. Yes, the physical characteristics in
23 the vicinity of the aquatic dispersal barrier are
24 very similar to other areas within the Chicago

1 Sanitary and Ship Canal and those characteristics
2 include vertical channel walls, composed of
3 limestone and bedrock, a rectangular channel
4 morphology. In other words, there's no shallow
5 littoral areas, relatively steep walls.

6 Relatively uniform deep water
7 across the channel. The flows are fairly moderate
8 except during major storm events and the flows are
9 in part regulated primarily bedrock and some
10 localized silt muck, mineral substrates. There's
11 an absence of coarse substrates in that area.
12 Limited bank edge and in stream habitat
13 structures. Virtually, no overhanging vegetation
14 or trees in that area. It's an area of fairly
15 intense navigation and there's no connection to a
16 floodplain. Virtually, no riparian.

17 Q. Thank you. In addition to those
18 physical aspects, does the existence of the
19 electric barrier make the stretch of the Ship
20 Canal even less hospitable to aquatic life?

21 A. I'd say certainly within the reach
22 that is directly effected by the electric field
23 that is produced by the dispersal barrier, I would
24 say yes. I don't think there's too many organisms

1 that would want to live in a pulsing, electric
2 field.

3 Q. Okay. That would be the RNA as
4 designated by the report?

5 A. Yes.

6 Q. Given the existence of an electric
7 fish barrier, do you recommend and support of
8 having a protected area around the barrier to
9 protect from the boating and others the might
10 drive in the Ship Canal?

11 MS. WILLIAMS: I object. Clearly
12 reactional use it has nothing on aquatic life so
13 it's not a fair question.

14 MS. TIPSORD: I lost the last bit,
15 Deb.

16 MS. WILLIAMS: I'm sorry. It's
17 purely a recreational use, not aquatic life use so
18 it's not appropriate for sub docket C.

19 MS. TIPSORD: Do you have a
20 response, Mr. Teshher?

21 MR. TESHER: Others who would
22 interact with the Ship Canal would include people
23 that would fish at the aquatic life.

24 MS. WILLIAMS: Again, fishing is a

1 recreational use activity not an aquatic life use.

2 MS. FRANZETTI: If the agency is
3 concerned about Dr. Mackey's response and the
4 Board finds it inappropriate, that's fine. We'll
5 deal with it.

6 MS. TIPSORD: I think it's
7 recreational use. I agree.

8 MS. FRANZETTI: All right.

9 BY MR. TESHER:

10 Q. I have some other questions that
11 probably get at the same area. Dr. Mackey, do you
12 think the Board should recognize the existence of
13 an electric fish barrier and discouragement of
14 species entering Lake Michigan as and the use of
15 the waters in which the electric barrier is
16 located?

17 A. Could you clarify the question by
18 what you mean by use of the waters?

19 Q. Sure. This rulemaking is concerned
20 with the use of the water. We have a reference to
21 the recreational uses, aquatic life uses. So my
22 question to you is given what we've talked about
23 with the protection from invasive species should
24 the application of invasive species as formed by

1 the electric fish barrier be recognized as a use
2 of the water? Is that one use of the water is
3 looked to in the area of the electric barrier?

4 A. I really haven't thought about it or
5 have an opinion on that. I think the electric
6 field barrier in itself is in place. It's
7 operational. Hopefully, it's a hundred percent
8 effective and until we come up with a more
9 permanent solution to the problem, I think the
10 electric field barrier is what we have. I don't
11 know if that requires a special designation in
12 terms of use.

13 Q. Would you say that's how the waters
14 are being used right now, one use of the water
15 right now?

16 A. Certainly, it's being used for
17 navigation purposes. I mean, we have commodities
18 and shipping moving up and down through that reach
19 of the waterway. Certainly, it's being used for
20 the conveyance of waste water and storm water
21 because the waters are moving through. So I still
22 say there are multiple functional uses of that
23 waterway.

24 Q. Absolutely. My only question is is

1 one of those uses to keep invasive species from
2 entering Lake Michigan and the Great Lakes?

3 A. In the location of the electric
4 field barrier, I would say yes.

5 Q. Would you believe -- this is perhaps
6 repetitive of the earlier question. Do you
7 believe the area of the electric fish barrier is
8 capable of supporting any significant, aquatic
9 life?

10 A. You're talking about significant
11 aquatic life. I suspect there may be some
12 macroinvertebrates that may be living in the soft
13 sediments.

14 Again, I'm not sure how happy
15 they would be subjected to a pulsing electric
16 field. I don't believe that fish are going to be
17 familiarly comfortable within the electric field
18 as designed to compel fish.

19 MR. TESHHER: That's all I have for
20 you, Dr. Mackey.

21 MS. TIPSORD: With that, we'll move
22 to Prairie Rivers. Albert?

23

24

1 EXAMINATION

2 BY MR. ETTINGER

3 Q. Did you work directly on the
4 Limnotech study?

5 A. No, I did not.

6 Q. Would it be accurate to say, though,
7 that a lot of your testimony is based on your
8 interpretation of the Limnotech studies?

9 A. No. Which testimony are you
10 speaking of?

11 Q. The testimony of Scudder D. Mackey
12 in support of the new aquatic life use
13 designation.

14 MR. ANDES: This testimony as
15 opposed to his earlier testimony in the matter or
16 both?

17 MR. ETTINGER: I think this is the
18 one that was filed in February. Yes, I'm just
19 talking about this one today. I can't go back
20 that far in the past. All I'm really trying to do
21 is cut us off of a lot of questions here today so
22 I don't go over the whole Limnotech study with
23 you.

24

1 BY MR. ETTINGER:

2 Q. So is it safe to say if we ask
3 Mr. Bell about the question of the Limnotech study
4 that you're unlikely to be able to add anything to
5 it that Mr. Bell didn't?

6 A. I would tend to agree with that.

7 Q. Thank you. You just knocked out a
8 lot here. So you did not work on the Limnotech
9 study, but I still have to ask question number
10 one. To your knowledge, has the type of study
11 done by Limnotech to assess habitat conditions in
12 the CAWS been done in any other waterbody?

13 A. I would say that there have been
14 numerous -- number one, there are a number of
15 different types of habitat assessment protocols
16 that have been developed by different states and
17 by different organizations primarily focused on
18 habitat assessment and certainly there are
19 numerous studies if you look at the literature and
20 reports from agencies and whatever.

21 So I would say from the habitat
22 component, yes. The habitat assessment is -- it's
23 a standard type of thing that's done these days in
24 terms of trying to assess the relative health of

1 rivers and streams. The problem is that with
2 respect to the CAWS is that most of these habitat
3 assessment protocols are based on natural systems
4 and we've already had this discussion I know
5 with --

6 Q. That's why I'm specifically not
7 trying to go over the same thing.

8 A. Right.

9 Q. You heard me ask the question of
10 Mr. Bell. Do you know of studies other than what
11 he has already discussed of this time?

12 A. Generally, they would be the same
13 types of things that Mr. Bell has testified.

14 Q. Do you know of any such report that
15 concluded that water quality was more important to
16 the waterbody study than habitat conditions?

17 A. I can't answer that question. In
18 other words, no, I don't know that.

19 MR. ANDES: Do you know of any that
20 concluded the opposite?

21 THE WITNESS: Not really, but,
22 again, the studies that we were talking about just
23 a few seconds ago in the first question, those
24 were primarily habitat assessments. They weren't

1 focused on water quality, per se. So those
2 comparisons weren't made, but this is certainly
3 the study we did, that Limnotech has done here of
4 the CAWS, is certainly an example of the city that
5 has shown that habitat is certainly limiting in
6 the system.

7 BY MR. ETTINGER:

8 Q. I understand, but we've gone over
9 that study. I'm just asking if there are other
10 studies that you know of that Mr. Bell hasn't
11 already brought to us and the answer to that
12 question is no?

13 A. That's correct.

14 Q. Because I think we've been over
15 question two and three with Mr. Bell quite
16 thoroughly. I'm going to skip that. Four, are
17 there forms of aquatic life that can be effected
18 by low dissolved oxygen levels other than fish?

19 A. Yes.

20 Q. What are those?

21 A. Certainly, benthic organisms and
22 macroinvertebrates. Those communities that live
23 in the sediments are on the bottom.

24 MS. TIPSORD: Dr. Mackey, I'm sorry.

1 When you're talking, we can't hear you over here.

2 MR. ETTINGER: He's important. I'm
3 just -- actually, he is the most important person.
4 Did you want him to repeat the question?

5 MS. TIPSORD: No. That's okay.
6 Just remember to keep your voice up.

7 THE WITNESS: Okay.

8 BY MR. ETTINGER:

9 Q. Then, number five. Are some species
10 of juvenile fish more sensitive to low dissolved
11 oxygen levels than adult fish of the species?

12 A. The answer to that is yes. But
13 we've been looking at the literature and there are
14 some studies that show juvenile -- some juvenile
15 fish have similar tolerance levels as to the
16 adults. So that's -- it's not -- it's a
17 generalization, but it may not be completely
18 correct.

19 Q. Reading my question six here and
20 it's not one of my better exhibits of the English
21 language so I'm going to try it anyway.

22 MR. ANDES: I'm not even going to go
23 there.

24

1 BY THE WITNESS:

2 A. I had difficulty in answering this
3 question.

4 BY MR. ETTINGER:

5 Q. Let me see if I can interpret this
6 from Cincinnati into English. I guess what I
7 meant to say here is from your knowledge of
8 Midwest fish species, what is missing here in
9 terms of waterbody? What would you -- what other
10 than intolerant or moderate -- are there any fish
11 that are missing other than ones that are
12 intolerant or moderately intolerant obligate
13 riffle dwellers --

14 MR. ANDES: Can I ask to clarify?
15 Do you have a list of the species of fish in the
16 Midwest that we're culling from?

17 MR. ETTINGER: We're culling from
18 his entire knowledge of the universe as it focuses
19 on the Midwest.

20 BY THE WITNESS:

21 A. Given that I'm a geologist primarily
22 by training and specialize in habitat work, the
23 answer to this is straight forward. I would defer
24 this question to Jennifer Wasik who may have a

1 better ability to answer this question.

2 MR. ETTINGER: Poor Jennifer is not
3 here to defend herself.

4 MR. ANDES: She is taking my place
5 down in Springfield.

6 MS. ETTINGER: Wow. She is lucky.

7 MR. ANDES: She'll be here tomorrow.

8 MR. ETTINGER: Right.

9 BY MR. ETTINGER:

10 Q. I'm going to read your sentence on
11 page four and then we'll just try to ask about
12 that. Leave off my incoherent sentence. So what
13 you wrote on page four of your pre-filed testimony
14 is even though the shoreline habitat improvements
15 recommended in the Habitat Improvement Report
16 would benefit many of the species already found in
17 the CAWS, it would not benefit populations of
18 intolerant or moderately intolerant obligate
19 riffle dwellers that require fast moving water and
20 coarse substrates commonly found in natural
21 channels and my question is, is there everything
22 in the CAWS now other than tolerant or moderately
23 intolerant riffle -- I'm sorry -- obligate riffle
24 dwellers?

1 A. As I stated before, I can't answer
2 that question because I don't know and, again, I
3 would defer to Jennifer Wasik.

4 Q. Okay.

5 MR. ANDES: Let me follow up a
6 little bit. If you can describe from a habitat
7 perspective what your judgment is as far as if
8 improvements were to be made in a habitat, which
9 species would be benefitted by that versus which
10 species would not be benefitted?

11 THE WITNESS: Of course, it would
12 depend on the types of habitat improvements that
13 you would make in the system. There was a
14 discussion with Mr. Bell earlier today talking
15 about the possibility of putting in riffle pool
16 sequences somewhere in the CAWS. Certainly, that
17 would conflict with the functional uses such as
18 navigation and with conveyance of waste water or
19 storm water, but if you could do that, it's
20 conceivable that you might be able to attract some
21 different fish that would use those types of
22 habitats and the other important thing to
23 remember, though, is that the riffle pool
24 sequences and this ties in with this article, the

1 Bunn and Arthington article, natural flow regimes,
2 when you do habitat restoration, if you want to do
3 sustainable habitat restoration, you need to make
4 sure that you design your restoration projects
5 with the appropriate flows in mind.

6 If you were to throw some gravel
7 in these areas to create pools and riffles and if
8 you don't have the appropriate flows to maintain
9 that type of habitat structure, you're going to
10 get a lot of silt and a lot of interstitial spaces
11 with silt in it.

12 So there has to be a lot more
13 modeling work or design work when you're actually
14 thinking about the types of habitat restoration
15 projects that you would want to do here.

16 MR. ANDES: So if you don't change
17 the fundamental aspects of the system in terms of
18 steep channel walls, the flow, et cetera, and you
19 try to do some things to modify habitat, are you
20 saying you're not going to get much in terms of
21 improvement of environment for the fish?

22 THE WITNESS: Yes, that's correct.
23 There's several different factors you're going to
24 have to consider. It's just not dumping gravel

1 into the river. You have to look at the flow
2 regime. You have to look at the pattern and
3 actually it's what we call the habitat diversity.
4 It's a pattern of connectivity between different
5 types of habitat that are really important when
6 you think about restoration because, for example,
7 just a pile of gravel sitting on the channel bed
8 that's all it is.

9 Fish come -- and if fish come
10 and they key in on that gravel and they spawn on
11 that gravel, but there's no adjacent nursery
12 habitat or no connection to the nursery habitat,
13 those eggs will not survive once they emerge from
14 the spawning beds because it's not connected to
15 other types of habitat structure that are
16 necessary for the organisms to basically grow
17 through the different life stages to become
18 adults. So it's just not about one type of
19 habitat. It's about a habitat pattern and
20 connectivity.

21 So I probably have gone a bit
22 around your question, but I would say if you could
23 put in the appropriate types of habitat structure
24 and pattern that you might have a chance to bring

1 in some different types of species.

2 Q. Okay. We don't want to make too
3 small of plans or too large of plans, but will
4 make our variety of possibility. All I want to
5 ask just to nail down these obligate riffle
6 dwellers question here, reading that sentence by
7 itself, it makes it seem like everything is
8 present in the CAWS that we could expect there
9 other than these obligate riffle dwellers, is that
10 what you meant to say or you're not sure?

11 A. I would say I'm not sure and that
12 was not the intent of this statement. The intent
13 of the statement was to say that there are some
14 fundamental habitat characteristics that are
15 necessary for certain species to, let's say,
16 reproduce and survive in the CAWS.

17 MR. ANDES: Does that mean if you
18 keep the basic functional characteristics in the
19 system you'll never get the tolerant species to
20 flourish here?

21 THE WITNESS: The chances are very
22 slim that that would occur here.

23 MR. ANDES: Thank you.

24

1 BY MR. ETTINGER:

2 Q. Good. We don't want to keep the
3 basic functions of this system necessarily.

4 MR. ANDES: You'll have to define
5 who we is.

6 MR. ETTINGER: Let's introduce a
7 exhibit and ask about the preliminary feasibility
8 of ecological separation of the Mississippi River
9 and Great Lakes to prevent the transfer of aquatic
10 species. I have two more copies of this that I
11 made at great expense.

12 MS. FRANZETTI: Albert, how long is
13 it?

14 MS. ETTINGER: It's about 104 pages.

15 MS. FRANZETTI: I would say I'll
16 make some copies in my office. I have questions.

17 MS. WILLIAMS: Albert, can you be
18 sure to put all the information in the record
19 about the title and the date and everything so we
20 can make sure we have it?

21 MR. ETTINGER: Along with the
22 calendar I gave you earlier, I'm going to give you
23 this.

24 MS. FRANZETTI: Albert, we're

1 hearing back here this is available
2 electronically?

3 MR. ETTINGER: I suspect it is.

4 MS. FRANZETTI: Albert, do you want
5 a copy back? I thought it was a more recent
6 report.

7 MS. TIPSORD: If there's no
8 objection, we will admit Great Lakes Fishery
9 Commission 2008 Project Completion Report
10 Preliminary Feasibility of Ecological Separation
11 of the Mississippi River and the Great Lakes To
12 Prevent The Transfer of Aquatic and Invasive
13 Species by Joel Brammeier, Irwin Polls and Scudder
14 Mackey, November 2008. We'll admit that as
15 Exhibit 258 if there's no objection. Seeing none,
16 it's Exhibit 458.

17 (Document marked as IEPA Exhibit
18 No. 458 for identification.)

19 BY MR. ETTINGER:

20 Q. Okay. Ms. Tipsord stole my thunder.
21 I was actually going to try to properly
22 authenticate something for once, but are you the
23 author of this report that was previously marked
24 as Exhibit No. 458?

1 A. I am one of the coauthors, yes.

2 MR. ANDES: Are there particular
3 sections of this report that you were responsible
4 for?

5 THE WITNESS: Yes, I was responsible
6 for the hydrology flow and navigation portions of
7 this report.

8 BY MR. ETTINGER:

9 Q. Specifically, let's get down here in
10 this -- are there any recommendations of this
11 report that you want to walk away from now?

12 A. No, I don't think so.

13 Q. You haven't woken up and read this?

14 A. This was written in 2008 and we're
15 both about the same age so we have issues.

16 Q. No. You must be much older than me.
17 I am only 39. Is there anything that you've now
18 looked over on this document and said, gee, Irwin
19 Polls wrote that, I can't stand by this anymore?

20 MR. ANDES: Are you going to ask him
21 to review -- he told you which parts he was
22 responsible for? Are you asking him to confirm he
23 has read every sentence in the report except
24 certain ones?

1 MR. ETTINGER: I'm not asking him if
2 he agrees with every sentence in the study. I'm
3 asking him whether based on his study and
4 preparation of your testimony today did you find
5 anything in this that you would like to say you
6 now decide you don't agree with?

7 BY THE WITNESS:

8 A. I would say that the one thing that
9 I would state differently would be what was in
10 your pre-filed question, which has to relate to
11 the periodic discharges from combined sewers
12 causing a decrease in the dissolved oxygen
13 concentration and its potential impact on the fish
14 community.

15 BY MR. ETTINGER:

16 Q. Did you author that?

17 A. No, I did not.

18 Q. Who did?

19 A. I believe that was Irwin Polls.

20 Q. In this report, you guys suggest the
21 possibility of some fairly major changes to the
22 system, is that correct?

23 A. That is correct.

24 Q. Such as shutting down the Chicago

1 Sanitary and Ship Canal is one of the things you
2 consider or breaking navigation, just below or in
3 the South Branch of the Chicago River. Is it
4 correct that you considered those possibilities?

5 A. I wouldn't use the term shutting
6 down the CAWS. The fundamental tenant of the
7 study was to explore possible options for some
8 sort of ecological separation of the Mississippi
9 Basin from the Great Lakes Basin, particularly
10 dealing with invasive species and one of the
11 things that came out of the study was that we
12 wanted to keep as much of the CAWS intact as
13 possible just because it's the most practical and
14 economically feasible thing to do.

15 We wanted to maintain as much
16 commodities and navigation functions as possible.
17 We want to maintain as much of the water
18 conveyance, storm water, waste water conveyance
19 functions as possible. So we look for options
20 that minimized impacts to that primary
21 functionality and yet still allow us to guarantee
22 a hundred percent ecological separation between
23 the two basins to prevent the transfer of invasive
24 species.

1 Q. Again, first of all, I don't think I
2 used the term shutdown the CAWS. I meant shutdown
3 the interconnection and I think the specific
4 things that you considered were things like
5 shutting down navigation traffic through the
6 Sanitary and Ship Canal or breaking the
7 hydrological connection either in the Chicago
8 River or in other locations, is that correct?

9 A. I don't believe we ever discussed or
10 at least seriously considered anything in the
11 sand -- Ship Canal, per se, because that is a
12 primary navigation route very heavily used by
13 barge traffic. A lot of commodities moving
14 through that portion of the system. In general,
15 most places where we were looking at possible if
16 you want to call it hydrologic separation is one
17 way you could do this. We're close to the lake as
18 possible. So it would minimize the impacts on the
19 internal components of the system.

20 Q. You did consider, though, bringing
21 the north side sewage treatment plant up to Great
22 Lakes standards for its discharge?

23 A. Yes, we had four or five different
24 scenarios. That was one scenario that was

1 considered.

2 Q. Did any of these big picture
3 plans -- were they considered in any way in your
4 habitat evaluation or in the Limnotech habitat
5 evaluation, to your knowledge?

6 A. Certainly, to my knowledge, in terms
7 of the Limnotech study, I was not part of that
8 study directly. So I don't know what they took
9 into account or didn't take into account in terms
10 of the feasibility of these types of changes to
11 the system.

12 In terms of the habitat
13 assessment work I did with the side scan sonar, it
14 wasn't even on my radar screen. I was focused
15 primarily on what was in the channels, what was in
16 the different waterway segments and I really
17 wasn't thinking so much about, well, where would
18 you put a structure or if flows were changed how
19 would this might impact that. It wasn't really
20 part of my -- what I was doing.

21 Q. So things were on your sonar?

22 MR. ANDES: I object to that
23 characterization.

24 BY MR. ETTINGER:

1 Q. You were at no time in your studies
2 asked to contemplate as part of your testimony
3 major changes to the system?

4 A. Not with respect to this feasibility
5 study in terms of the Asian carp and invasive
6 species.

7 Q. With respect to your testimony to
8 the Board today, were you asked to contemplate any
9 major feasibility? Just with regard to your
10 testimony, were you at any time asked to consider
11 any major changes to the system as an approach to
12 any of these issues?

13 A. No.

14 Q. I'm going to go to my pre-filed
15 testimony ten. On page ten of your testimony, you
16 state that electrofishing samples in a relatively
17 small volume of water estimated one to two million
18 cubic feet over a short period of time (hours).
19 What are the implications of this?

20 A. When I was speaking about the
21 electrofishing work in my pre-filed testimony,
22 that was with respect to comparing the volume of
23 water that was sampled using an electrofishing
24 technique versus the volume of water and the time

1 period that was actually sampled by the rotenone
2 event that occurred on the CAWS, the 5.5 miles of
3 the CAWS that was treated with rotenone to
4 basically kill all the fish within that reach.

5 So that comparison or actually
6 the point was is that you cannot compare the
7 results, the sampling results from those two
8 because they are sampling completely different
9 volumes of water over different periods of time
10 and the results are not directly comparable.

11 Q. How much do you know about
12 electrofishing?

13 A. I have used electrofishing
14 equipment, but I would not consider myself to be
15 an expert on electrofishing.

16 Q. I'm going to ask my questions and if
17 you feel like you don't know how to answer them I
18 don't know is also a good answer. Does
19 electrofishing uniformly catch all age classes of
20 fish?

21 A. If you're assuming that age classes
22 are related to size, the answer is no.

23 Q. How does electrofishing differ as to
24 size?

1 A. It has to do with the spacing
2 between the lines of force in the electric field.
3 So, generally, for electrofishing -- for
4 electrofishing larger fish are more, let's say,
5 deeply effected by the electro fields because you
6 have more lines of force crossing their body.
7 Small fish are not nearly as effectively brought
8 to the surface because there may be only one or
9 two lines of force or none depending on the
10 spacing of the electrodes and also the voltages
11 and pulsing.

12 Q. And does electrofishing catch fish
13 equally at various depth levels in the waterbody?

14 A. Not necessarily. Generally as you
15 increase your distance away from the anodes, the
16 electric current is attenuated and so it becomes
17 less effective. I believe Mr. Bell and I would
18 agree with his answer indicated that the depth --
19 effective depth for electrofishing is between
20 three to four meters or about twelve feet and
21 that's what we see in the literature.

22 Q. Does it differ -- is there a DC
23 versus AC electrofishing?

24 A. Yes, I understand that there is.

1 Q. Do you know what they did at the
2 Water Reclamation District?

3 A. I don't know. I would defer to
4 Jennifer Wasik. She is more familiar with the
5 electrofishing techniques at the District.

6 MR. ETTINGER: Poor Jennifer. You
7 better schedule an extra day.

8 BY MR. ETTINGER:

9 Q. Let's ask one more electrofishing
10 question. To your knowledge, is electrofishing
11 done during circumstances in which there are
12 effects from combined sewer overflows in the
13 system?

14 A. I don't know. Again, I would defer
15 to Jennifer Wasik.

16 Q. Okay. You mentioned on page 11 that
17 many of the catfish found in the Chicago Sanitary
18 and Ship Canal could have been from spawning in
19 the Lower Des Plaines River. Could catfish spawn
20 in other waters that are physically connected to
21 the portions of the CAWS?

22 A. It's certainly possible, but I don't
23 know.

24 Q. Do you think -- when you say the

1 Lower Des Plaines River, you're speaking of the
2 area below the Brandon Road Lock and Dam?

3 A. Yes.

4 Q. So you think that it's possible that
5 the catfish that were found in the Chicago
6 Sanitary and Ship Canal got past the dam?

7 A. It's possible or through the locks.

8 Q. And you think -- could they get past
9 the electric barrier?

10 A. No. It depends on the size of fish,
11 but I suspect that they cannot pass through the
12 electric field barrier.

13 Q. So if we find catfish above the
14 electric barrier, presumably they are from some
15 place within the system?

16 A. If you found them above the barrier,
17 yes. That's highly probable.

18 MR. ETTINGER: That's all the
19 questions I have.

20 MS. LIU: Mr. Ettinger, did you want
21 to ask Dr. Mackey your orange question?

22 MR. ETTINGER: We're all dying to
23 hear about the orange water. Thank you very much,
24 Alisa. That's very important. Why is that

1 picture orange is the Limnotech report?

2 THE WITNESS: For those of you who
3 weren't here this morning, there was an
4 interesting discussion with Mr. Bell.

5 MR. ETTINGER: It was fascinating.

6 THE WITNESS: In the -- first of
7 all, let's take a step back. I collected side
8 scan sonar data along several reaches of the CAWS
9 side scans and an acoustic tool that we use to map
10 the bottom of the channel. We can see features on
11 the bottom and also look at substrates and other
12 types of habitat structures and in the report
13 there is an image, an aerial photograph, where
14 it's actually a side scan mosaic. It's where the
15 side scan line has been geo referenced, put into
16 proper geographic space and it's actually been
17 laid right on top of the photograph.

18 So you can see what is on the
19 channel bed and then you can also see the
20 features, the adjacent features, the channel banks
21 and whatever other types of anthropogenic features
22 there are along the canal and the question was
23 Albert wasn't sure why it was sort of a bright
24 orangeish red color and I'm not sure it printed

1 out all that well, but the equipment I used is an
2 L3 Klein Sonar. It's a digital sonar.

3 And Klein -- the color there is
4 called Klein gold and there is a technical reason
5 for that color. There's almost an entire color
6 path and actually old side scan sonar used to be
7 black and white and used to be inverted because
8 that's the way it would be printed on the old, wet
9 paper charts, but the Klein gold color they did a
10 series of experiments and they found that the
11 human eye that that particular color and shading
12 actually accentuates the contrast and the detail
13 that you can see.

14 So that's the color I typically
15 use for most of my side scan work because it makes
16 it much more -- you can see the features much more
17 clearly and particularly if you're interpreting
18 the data and trying to build habitat polygons or
19 substrate polygons that color I find, at least for
20 my eyes, very, very useful.

21 The only caveat I would say is
22 that my wife has told me my color sense is
23 horrible, especially when it comes to decorating,
24 but I'm using the Klein color scheme.

1 MR. ETTINGER: If we have to,
2 Dr. Mackey, go do another report, we'll have the
3 Committee look at the different colors.

4 THE WITNESS: Yes.

5 MR. ETTINGER: I thank you very
6 much.

7 MS. TIPSORD: With that, let's
8 adjourn for the day and we'll start again in the
9 morning.

10

11

12

13

14

15

16

17

18

19

20

21

22

23


24

1 STATE OF ILLINOIS)
2) SS.
3 COUNTY OF COOK)
4

5 I, Steven Brickey, Certified Shorthand
6 Reporter, do hereby certify that I reported in
7 shorthand the proceedings had at the trial
8 aforesaid, and that the foregoing is a true,
9 complete and correct transcript of the proceedings
10 of said trial as appears from my stenographic
11 notes so taken and transcribed under my personal
12 direction.

13 Witness my official signature in and for
14 Cook County, Illinois, on this 26th day of
15 May, A.D., 2010.

16
17
18
19
20
21
22
23
24



STEVEN BRICKEY, CSR
8 West Monroe Street
Suite 2007
Chicago, Illinois 60603
Phone: (312) 419-9292
CSR No. 084-004675

| | | | | | |
|----------------------|---------------------|---------------------|------------------------|---------------------|----------------------|
| A | 137:2,14,16 | 139:16,17 | accurately | 42:5 49:5 | 64:16 |
| abatement | 137:22 | 143:3 144:6 | 126:19 | 51:7 54:8 | 200:14 |
| 57:1 | 144:6 | 174:14 | 139:6 192:3 | 58:12,20,24 | 219:18 |
| ability 29:12 | 158:16,17 | 204:18 | acknowledge | 60:18 77:6 | 220:17 |
| 64:8,13 | 160:22 | absolutely | 6:4 | 79:17,19 | additional |
| 130:2 | 161:4,5 | 25:13 | acknowledged... | 80:19 86:16 | 62:4 130:7 |
| 134:22 | 163:18 | 223:24 | 6:5 | 90:5 93:24 | 139:12 |
| 231:1 | 164:20 | abundance | acoustic | 97:7,8 | 168:13 |
| abiotic | 167:19 | 45:22 62:11 | 248:9 | 100:21 | address 98:6 |
| 173:11 | 171:20 | 115:18 | across 10:17 | 102:11 | 103:7 |
| able 6:9 | 176:23 | 173:8 | 20:7,14 | 103:18 | addressed |
| 25:20 27:19 | 177:1,3 | abundant | 21:3,6,7,12 | 132:20 | 34:20 90:1 |
| 68:18 72:18 | 182:7 | 203:4 | 74:9 125:14 | 137:11 | 91:23 123:9 |
| 77:1 88:3 | 185:17 | abutments | 132:6 | 138:1,2 | 124:21 |
| 120:24 | 190:24 | 28:22 | 150:22 | 140:15 | addresses |
| 125:10 | 193:18 | 153:20 | 151:4,10 | 160:9 | 212:1 |
| 130:6 | 196:23 | AC 245:23 | 183:22 | 168:11 | addressing |
| 137:13,16 | 204:22 | Academy | 185:20 | 169:7 | 168:5 |
| 151:1 | 208:8 | 118:1,5,6 | 220:7 | 178:15 | adequate |
| 152:20,22 | 214:24 | 118:24 | act 187:23 | 207:19 | 17:1 177:20 |
| 180:10 | 217:12 | Academy's | 190:2 | 214:21 | adequately |
| 226:4 | 218:2 219:3 | 118:10,12 | 217:18 | 229:3 | 121:7 123:9 |
| 232:20 | 222:3,22 | acceleration | acting 2:3 | 233:13 | 124:21 |
| about 6:16 | 223:4 | 53:3 | 4:11 | 234:3 | 144:23 |
| 10:4,8 19:5 | 224:10 | accentuates | actions 91:22 | 237:21 | 145:7 |
| 22:17 24:23 | 225:19 | 249:12 | 100:10 | 244:1,5 | adjacent |
| 28:4,6 29:3 | 226:3 | acceptable | 102:12 | 248:14,16 | 234:11 |
| 29:6 33:15 | 227:22 | 118:12 | 107:4,5 | 249:6,12 | 248:20 |
| 35:12,14,16 | 231:11 | accepted | active 64:21 | add 39:13 | adjourn |
| 39:12 40:13 | 232:15 | 120:11 | activities | 68:12 76:21 | 250:8 |
| 41:16 47:23 | 233:14 | according | 36:15 75:17 | 91:4 92:15 | Adm 1:5 |
| 49:17,18 | 234:6,18,19 | 209:10 | 100:11 | 92:16 95:4 | Admin 4:7 |
| 51:10 54:4 | 236:7,14,19 | account | 118:19 | 95:7 102:16 | administered |
| 55:14 60:20 | 238:15 | 23:15 | activity 64:22 | 103:24 | 118:24 |
| 61:7 65:18 | 242:17 | 179:18 | 112:3,19 | 131:15 | admit 9:1,15 |
| 74:23 75:21 | 243:20 | 201:1 242:9 | 113:15 | 176:21 | 237:8,14 |
| 76:10 80:15 | 244:11 | 242:9 | 114:12,21 | 196:24 | admitted 5:8 |
| 81:2 83:5,9 | 245:20 | accounted | 168:7 | 226:4 | 39:15 |
| 83:14 85:22 | 247:23 | 67:15 73:17 | 174:15 | added 23:2 | adopted |
| 93:18 95:11 | above 1:8 | 184:21 | 222:1 | 67:13 68:8 | 167:13 |
| 97:18 100:6 | 52:14 59:15 | 201:6 | actors 24:6 | 70:12,21 | adult 229:11 |
| 100:10 | 247:13,16 | accounting | actual 40:15 | 168:16 | adults 229:16 |
| 101:16 | abrupt 53:2 | 73:10 | 127:2 140:9 | adding 67:19 | 234:18 |
| 104:1,7 | absence 90:5 | 138:14 | 161:10 | 92:17 93:2 | adverse |
| 111:12 | 139:20,20 | accumulate | 219:3 | 93:8,9,9,13 | 179:16 |
| 115:10,17 | 144:8,9 | 46:3 | actually 8:9 | 102:8,9 | aerial 34:2 |
| 115:17 | 196:2 | accurate | 12:12,13 | 129:23 | 190:3,12 |
| 134:5 | 220:11 | 144:19 | 21:9 33:16 | 130:1 | 248:13 |
| 136:19 | absent | 225:6 | 33:20 39:9 | addition | aforesaid |

| | | | | | |
|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
| 251:8 | 134:10,15 | allowed | American | 183:20 | 127:8 |
| after 5:8,11 | 135:6,12 | 119:21 | 118:1,5 | 188:12,14 | 128:14 |
| 6:5 63:16 | 139:18 | allows | ammonia | 188:19 | 133:14,16 |
| 116:23 | 141:13 | 194:20 | 77:17 | 189:2,6,7 | 148:2,7 |
| 170:24 | 144:22 | almost 90:18 | 168:17 | 201:19 | 150:3,8,12 |
| 171:7,21,24 | 145:2,6,10 | 116:15 | among 47:17 | 202:12 | 150:18 |
| 193:2 | 146:10 | 195:14 | 47:20 54:14 | 207:3,4,6 | 157:15 |
| 214:10 | 155:24 | 249:5 | 73:10 106:6 | 217:6 | 164:23 |
| afternoon | 164:3,9 | alone 167:23 | 144:24 | Analytically | 170:6,19 |
| 117:3 | 165:12 | 183:3 | 192:15 | 91:11 | 171:9 |
| again 10:9 | 166:3 | 184:20,22 | 208:3 | analyze | 175:15 |
| 27:2 29:22 | 176:17 | 185:18,23 | amount 31:8 | 120:10 | 177:4,14 |
| 32:13 50:6 | 201:11 | along 10:11 | 31:14 130:7 | analyzed | 178:5 179:4 |
| 57:10 61:5 | 222:7 226:6 | 10:11 32:22 | 185:16 | 80:10 167:2 | 185:1 |
| 61:13 75:13 | 239:6 | 53:24 58:16 | 187:22 | 167:15 | 204:21 |
| 87:4,18 | 245:18 | 82:7 102:21 | 191:17,18 | Anand 2:3 | 205:6,11 |
| 89:21 94:15 | agreements | 112:19 | ample 120:11 | 4:16 | 208:18,24 |
| 164:24 | 109:14 | 144:10 | 146:2 | Andes 2:16 | 209:4,21 |
| 165:13 | agrees 239:2 | 147:24 | analyses 7:21 | 8:1,5,14 | 212:23 |
| 174:11 | ahead 9:15 | 185:4 196:9 | 77:24 | 12:20 34:22 | 215:4,7 |
| 180:19 | 82:19 89:22 | 236:21 | 101:14 | 35:11 37:24 | 225:14 |
| 192:9 207:8 | 116:19 | 248:8,22 | 164:1 167:4 | 38:2,10 | 227:19 |
| 216:22 | 150:12 | already 37:8 | 169:1 | 43:4 55:14 | 229:22 |
| 221:24 | 192:19 | 64:3 78:22 | 188:11 | 57:13 63:10 | 230:14 |
| 224:14 | aiming 98:17 | 133:15 | analysis 33:8 | 66:24 69:4 | 231:4,7 |
| 227:22 | airport 100:3 | 143:18 | 50:22 61:22 | 70:8,12,17 | 232:5 |
| 232:2 241:1 | Alaska | 168:21 | 67:3,5,8,12 | 74:21 76:8 | 233:16 |
| 246:14 | 112:22 | 227:4,11 | 70:9 71:5 | 78:5,24 | 235:17,23 |
| 250:8 | Albert 2:13 | 228:11 | 73:22 77:14 | 79:6,9 83:8 | 236:4 238:2 |
| against | 39:14 52:18 | 231:16 | 77:16,21 | 88:17 89:16 | 238:20 |
| 106:13 | 53:21 82:18 | Alsip 59:1 | 78:13,20 | 89:23 91:6 | 242:22 |
| 113:8 134:9 | 88:10 | altered | 79:18 82:8 | 91:20 94:18 | Andrea 4:12 |
| 153:19 | 224:22 | 171:11 | 91:13,15 | 94:22 95:6 | 5:22 |
| age 238:15 | 236:12,17 | 174:4 175:7 | 109:8,18 | 95:10 97:16 | and/or 190:3 |
| 244:19,21 | 236:24 | although | 110:9,10,12 | 100:22 | annual 37:20 |
| agencies | 237:4 | 31:12,22 | 110:12,23 | 101:12 | 58:15 |
| 101:17 | 248:23 | 34:3 35:5 | 123:14 | 102:9 | anodes |
| 226:20 | Albert's | 46:20 51:16 | 130:9 | 103:24 | 245:15 |
| agency 2:6 | 83:23 104:7 | 123:18 | 147:21 | 105:23 | anomaly 55:6 |
| 222:2 | 108:12 | 134:24 | 148:22 | 106:3 | another |
| ago 39:19 | Alewife 61:2 | 140:13 | 149:5,20 | 109:20,23 | 16:16 17:11 |
| 169:8 | alewives | 177:12 | 150:17,20 | 110:4 | 18:3 19:14 |
| 227:23 | 61:10 | 193:24 | 151:7,13,20 | 112:12 | 43:1 61:7 |
| agree 18:4 | Alisa 2:2 | Alton 94:3 | 151:24 | 113:17 | 69:15 81:16 |
| 25:12 26:15 | 4:17 247:24 | always 81:18 | 156:15 | 114:9 115:9 | 93:6,6 |
| 26:21,22 | allow 196:10 | amendments | 167:20 | 115:23 | 94:12 108:7 |
| 90:23 | 240:21 | 1:4 4:7 | 168:14,17 | 116:10 | 127:1 |
| 116:17 | allowable | America | 168:17 | 124:23 | 136:19 |
| 130:14,17 | 140:15 | 170:9,13 | 181:22 | 125:1,16,20 | 143:10 |

| | | | | | |
|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|
| 179:16 | anybody | Appendix | 18:19 86:1 | 212:15 | 233:1 |
| 186:11 | 8:23 78:21 | 61:24 77:10 | 87:3,6,10 | 217:10 | article |
| 192:20 | anymore | 77:23 79:19 | 145:3,4 | 219:20 | 169:21,22 |
| 250:2 | 238:19 | 79:21 | 185:7 | 220:11,14 | 171:2,5,14 |
| answer 14:11 | anyone 6:1 | 152:19 | 190:23 | 220:14 | 172:21 |
| 34:8 48:12 | 120:23 | 155:15 | 210:21 | 221:8 | 232:24 |
| 48:17,18,21 | anything | 161:15 | 221:18 | 222:11 | 233:1 |
| 60:12 74:22 | 21:10,24 | 162:8,20 | 233:5,8 | 223:3 224:7 | artificially |
| 76:9 84:23 | 24:13 32:14 | 164:21 | 234:23 | 247:2 | 177:8 |
| 85:11 | 35:12,13,15 | 186:10 | approxima... | areas 13:12 | Asian 219:9 |
| 116:12,16 | 41:16 51:8 | 211:24 | 136:1 | 13:23 14:19 | 243:5 |
| 117:15 | 94:13 97:24 | appendixes | aquatic 14:1 | 21:20 33:12 | asked 6:10 |
| 127:16 | 98:1 100:5 | 80:2 | 15:3 49:9 | 46:19 52:8 | 7:5 50:13 |
| 137:12 | 116:18 | apples | 49:20 99:10 | 52:15 56:6 | 60:19 61:7 |
| 152:15 | 132:4 | 129:15 | 99:14,24 | 57:5,12,14 | 84:21 98:5 |
| 160:12 | 160:22 | applicability | 106:9 114:6 | 57:16,23 | 98:9 104:1 |
| 164:14 | 161:5 175:9 | 128:2 | 121:16,20 | 58:19 71:6 | 117:16 |
| 169:16 | 204:24 | application | 150:1 | 83:16 99:24 | 129:3 |
| 181:17 | 213:21 | 222:24 | 153:14,17 | 119:7 126:9 | 171:20 |
| 208:21 | 226:4 | applied | 168:7 | 126:9,12,12 | 179:12 |
| 212:16 | 238:17 | 56:15 139:4 | 171:11 | 126:13,18 | 243:2,8,10 |
| 227:17 | 239:5 | 142:5 | 173:11 | 139:15 | asking 24:19 |
| 228:11 | 241:10 | 144:22 | 191:8 | 144:15 | 75:1 80:17 |
| 229:12 | anyway | 145:7,11 | 193:15 | 164:10 | 90:23 97:18 |
| 230:23 | 51:24 | 154:5 | 194:10 | 173:19 | 117:6 |
| 231:1 232:1 | 102:22 | 166:20 | 219:21,23 | 187:23 | 127:23 |
| 244:17,18 | 229:21 | apply 18:22 | 220:20 | 190:1,3,4 | 154:1 |
| 244:22 | anywhere | 141:9 | 221:12,17 | 190:10,12 | 175:11,12 |
| 245:18 | 86:17 93:20 | 143:14 | 221:23 | 190:20 | 228:9 |
| answered | 105:20 | 144:7,13 | 222:1,21 | 196:8 208:9 | 238:22 |
| 29:10 37:8 | 157:22 | applying | 224:8,11 | 219:24 | 239:1,3 |
| 117:12,13 | apologize | 19:6 101:9 | 225:12 | 220:5 233:7 | aspect 137:6 |
| 130:14 | 12:3 24:21 | 140:17 | 228:17 | Ariel 2:10 | aspects 89:24 |
| 168:21 | 86:13 160:1 | 159:2 | 236:9 | 215:18 | 101:2 |
| 191:21 | 160:5,16 | appointed | 237:12 | Army 216:16 | 142:13 |
| 197:23 | apparent | 4:3 | arbitrary | 218:12 | 220:18 |
| answering | 69:8 | appointme... | 34:10 127:5 | around 36:16 | 233:17 |
| 84:3 92:23 | apparently | 120:19 | area 1:3 4:6 | 59:3 97:6 | assemblage |
| 230:2 | 86:23 87:10 | appreciate | 11:17 13:8 | 116:20 | 173:12 |
| answers | appear 45:18 | 164:24 | 13:11 26:5 | 138:10 | assemble |
| 117:17 | appeared | 213:23 | 26:23 36:11 | 143:15 | 123:24 |
| 166:9 | 8:16 31:22 | approach | 41:22 56:9 | 214:2 221:8 | asses 80:21 |
| antecedent | 32:4 54:24 | 53:23 | 56:11,20 | 234:22 | assess 36:23 |
| 156:19,20 | 55:2 65:14 | 124:12 | 57:3 93:6 | Arthington | 78:15 |
| 162:22 | 65:24 66:1 | 132:18,19 | 111:7,9 | 170:24 | 100:23 |
| 163:17 | 69:20,21 | 243:11 | 119:18,23 | 171:1,8,13 | 226:11,24 |
| anthropog... | appears | approaches | 144:18 | 171:21 | assessed |
| 45:12,16 | 86:20 186:9 | 20:3 | 145:4 | 172:13,17 | 153:19 |
| 248:21 | 251:10 | appropriate | 209:22 | 173:24 | assessing |

| | | | | | |
|----------------------|---------------------|----------------------|--------------------|----------------------|-----------------------|
| 140:11 | 124:22 | available | 56:4 57:12 | 119:22 | 110:12 |
| assessment | 127:24 | 16:21 21:4 | 60:13 63:19 | 190:19 | 113:11 |
| 121:12 | 128:3,8 | 31:10,16 | 68:12 73:23 | 193:19 | 126:15 |
| 141:7 146:5 | 134:1,17 | 38:3,22 | 78:1 83:24 | 200:11,12 | 136:18 |
| 226:15,18 | 152:18 | 53:20 | 87:22 102:7 | 200:15,17 | 156:13,14 |
| 226:22 | 164:20 | 120:12 | 106:14 | 220:12 | 157:2 |
| 227:3 | 201:20 | 123:17 | 108:3 | banks 30:7 | 163:11,24 |
| 242:13 | 203:2,15 | 237:1 | 116:20 | 151:16 | 164:2 167:1 |
| assessments | 208:1 | Avenue 2:6 | 119:22 | 191:17,18 | 167:4,14 |
| 227:24 | attachments | 49:16 55:23 | 136:23 | 195:18,22 | 169:1 |
| assign 7:6 | 8:17 79:14 | average 58:3 | 144:13 | 248:20 | 179:14 |
| 42:16 | attainment | 156:20 | 158:5 | bar 50:2 | 183:8,19 |
| 125:15 | 81:24 159:5 | 162:22 | 160:12 | barge 28:24 | 186:1,22 |
| assigned 7:18 | 167:6 | 163:17 | 164:15,19 | 97:17 136:5 | 187:1 |
| 10:18 11:21 | attempt 30:3 | averages | 190:17 | 241:13 | 190:24 |
| 133:7 | 30:7 31:19 | 181:1 | 193:5 | Barkley | 192:11 |
| 140:14 | 47:19 117:7 | aware 99:18 | 200:12 | 191:5,5 | 198:18 |
| assignment | 154:3 | 99:22 100:4 | 213:12 | 211:7,14 | 209:13 |
| 10:20 12:2 | attempted | 200:18 | 219:15,16 | 212:10 | 210:11 |
| 34:10 209:7 | 30:9 38:7 | 218:21 | 225:19 | 213:3,6,8 | 215:21 |
| assignments | 51:19 52:22 | away 8:24 | 237:1,5 | 213:20,24 | 216:18 |
| 209:13 | 67:8 120:5 | 57:8 238:11 | 248:7 | BARNES | 225:7 227:3 |
| associated | 179:1 | 245:15 | background | 2:16 | 239:3 |
| 140:10 | attention | axis 41:10,12 | 50:23 51:12 | barrier 216:9 | bases 16:22 |
| 169:14 | 71:14 | 42:15 43:14 | 51:14,15 | 216:19 | 217:4 |
| 207:22 | attenuated | 49:5,9 50:7 | backup | 217:5,9,16 | basic 171:10 |
| assume 19:19 | 245:16 | 57:11,11,19 | 218:19 | 217:19,22 | 235:18 |
| 86:6 146:15 | attorney | 59:6 | backwater | 218:7,8,16 | 236:3 |
| 177:5 | 47:11 | A.D 251:15 | 173:19 | 218:18,19 | basically |
| assumed 73:3 | attract | a.m 1:13 | bacteria | 218:22 | 14:11 32:12 |
| 104:18 | 232:20 | <hr/> | 98:19,21 | 219:3,5,15 | 52:3 59:13 |
| 158:2 | attributable | B | bad 24:6 | 219:19,20 | 81:20 107:1 |
| assuming | 137:17,19 | B 3:10 | 35:12,14,15 | 219:23 | 177:5 |
| 145:3 | attributed | 118:10 | 42:4 54:22 | 220:19,23 | 219:10 |
| 146:14 | 55:6 | 125:17 | 64:24 97:1 | 221:7,8 | 234:16 |
| 147:6 | attributes | 127:22 | 102:1 126:2 | 222:13,15 | 244:4 |
| 244:21 | 62:24 63:2 | 129:11 | 161:9 | 223:1,3,6 | Basin 240:9,9 |
| assumption | 199:11 | 135:24 | bait 204:5 | 223:10 | basins |
| 199:23 | AUDIENCE | 137:12 | balance | 224:4,7 | 240:23 |
| 200:3 | 35:15 | 145:6 | 114:13 | 247:9,12,14 | basis 7:8 16:1 |
| assumptions | authenticate | 152:19 | balanced | 247:16 | 72:10 82:13 |
| 199:17 | 237:22 | 173:22 | 139:14 | barriers | 105:5 |
| attached | author | 183:23 | ban 34:3 | 218:6 | 108:19 |
| 77:15 | 237:23 | 189:23 | bank 30:4,4 | base 100:19 | 109:2,21 |
| 117:22 | 239:16 | baccalaure... | 45:1 56:5,9 | based 27:4 | 110:9,15 |
| attachment | authors 38:4 | 118:22 | 56:11,12,20 | 34:16 42:16 | 118:20 |
| 78:23,24 | 174:16 | back 22:16 | 57:14,15,23 | 48:13 67:22 | 174:7 175:2 |
| 79:1,9,12 | availability | 25:16 26:16 | 71:6 102:4 | 108:21 | 198:11 |
| 79:20 | 129:7 | 41:4 42:14 | 102:7 | 109:6 | bass 202:14 |
| | | 49:8 52:13 | | | |

| | | | | | |
|---------------------|----------------------|----------------------|----------------------|-----------------------|---------------------|
| 207:17,17 | 232:1 | 117:4 125:2 | 167:23 | big 56:21 | 12:6 34:4 |
| 209:18 | began 5:4 | 127:15 | 216:8 | 106:8 190:6 | 249:7 |
| bathymetric | begin 5:3,9 | 137:1 | better 42:6,9 | 242:2 | Blankenship |
| 32:18 | 5:18 6:6,17 | 160:17 | 42:13 43:5 | bigger 58:4 | 2:4 4:13 |
| bathymetry | 9:23 117:19 | 164:10 | 47:1,4 55:2 | 90:20 | blanket |
| 32:17 | behalf 5:4,13 | 174:18 | 64:5 70:1 | bioavailabi... | 13:16 |
| battleship | 215:18 | 184:20 | 114:12 | 169:6 | blue 203:5 |
| 91:11 | being 19:21 | 211:3,6,9 | 126:1,9,12 | bioavailable | board 1:1,10 |
| bay 56:10,21 | 67:9 89:5 | 213:22,22 | 126:13,17 | 148:11 | 4:3,12,13 |
| 56:23,24 | 91:6 104:22 | 226:3,5 | 177:23 | Biodiversity | 4:13,15 |
| 105:5 | 106:1 | 227:10,13 | 189:14 | 171:11 | 6:11,19 |
| bays 56:7 | 111:17 | 228:10,15 | 229:20 | bioenginee... | 117:24 |
| 104:13 | 112:6,11 | 232:14 | 231:1 246:7 | 107:22 | 118:10,13 |
| 187:24 | 139:16 | 245:17 | between | biological | 118:16 |
| 189:17 | 140:1 | 248:4 | 13:15 25:3 | 11:1 15:15 | 222:4,12 |
| 190:2,8 | 200:19 | Bell's 5:7 | 44:14 52:4 | 123:16 | 243:8 |
| bear 110:13 | 223:14,16 | belonging | 54:12 56:9 | 125:11 | Board's 6:12 |
| became | 223:19 | 133:7 | 66:17 70:3 | 135:16 | boat 97:9 |
| 56:21 | believe 5:5 | below 33:16 | 73:8 77:21 | 136:7 | 104:8,12,17 |
| become 48:3 | 20:10 28:8 | 114:24 | 78:20 79:18 | 145:14 | 104:22 |
| 117:24 | 37:20 38:2 | 165:24 | 81:23 89:3 | 191:8 | 105:1,4,8 |
| 147:11 | 39:8 42:5 | 179:21 | 122:14,17 | 211:21 | 119:18 |
| 234:17 | 67:23 74:14 | 219:12 | 125:7 | biologists | 146:7,10 |
| becomes | 75:4 77:4 | 240:2 247:2 | 128:15 | 144:23 | boatable |
| 245:16 | 79:8,10 | bends 139:15 | 131:24 | 145:1,8 | 145:22 |
| bed 31:13 | 114:2 | beneath | 137:24 | biology 26:18 | boating |
| 234:7 | 117:13 | 41:14 | 138:4,18 | biota 13:17 | 221:9 |
| 248:19 | 127:20 | beneficial | 141:11 | 121:16 | boats 57:9 |
| bedrock | 133:16 | 15:2 101:6 | 142:20 | 122:11 | body 57:2 |
| 111:16 | 180:12 | benefit 13:17 | 155:18 | 194:10 | 91:6 93:6 |
| 112:14 | 209:20 | 99:13 101:8 | 156:16 | biotic 122:15 | 245:6 |
| 113:18,20 | 217:14 | 167:23 | 162:4 | 125:9 | book 170:8 |
| 113:22 | 218:7,8,9 | 231:16,17 | 166:16 | 172:14,19 | borrow |
| 114:4 220:3 | 219:8 224:5 | benefits | 167:21 | 174:12 | 164:23 |
| 220:9 | 224:7,16 | 109:23 | 173:4,6 | bit 10:4 29:7 | both 11:5 |
| beds 234:14 | 239:19 | 115:13 | 177:14 | 53:12 67:1 | 31:4 35:8 |
| before 1:8 | 241:9 | benefitted | 178:6 | 80:15 95:15 | 39:20 57:18 |
| 6:6,16 | 245:17 | 232:9,10 | 180:17 | 120:9 | 65:14 67:10 |
| 45:20 50:13 | believed | benthic | 182:16,18 | 127:22 | 68:17,19 |
| 83:22 88:19 | 65:10 67:12 | 22:11 | 184:2,7,16 | 138:9 | 69:2 75:17 |
| 111:5 | 67:16 | 173:16 | 194:17 | 146:20 | 76:8 79:15 |
| 117:12 | 119:13 | 228:21 | 199:4 | 164:18 | 90:5 101:14 |
| 127:17 | 142:11,11 | besides 31:11 | 211:20 | 207:5 217:5 | 111:17 |
| 131:17 | Bell 2:19 3:2 | 168:4 | 212:16 | 218:19 | 118:23 |
| 136:22 | 5:4,8,11 | best 10:23 | 234:4 | 221:14 | 205:1 |
| 144:6 152:6 | 6:23 8:7 | 80:12 90:10 | 240:22 | 232:6 | 225:16 |
| 175:24 | 75:1 83:12 | 90:10 | 245:2,19 | 234:21 | 238:15 |
| 192:18 | 87:14 95:11 | 164:10 | bias 6:13 | black 11:16 | bother 132:2 |
| 212:24 | 111:4 116:7 | 165:13,14 | biased 113:8 | 11:20,23,24 | bottom 33:23 |

| | | | | | |
|----------------------|----------------------|-----------------------|----------------------|---------------------|-------------|
| 48:8 58:17 | 2:21 251:5 | 170:14 | camera 30:23 | 219:2 | 26:4,21 |
| 187:19 | 251:20 | 176:17 | Canada | cases 33:5 | 31:16 33:18 |
| 188:22 | bridge 28:21 | 186:10 | 112:1 | 46:1,3 | 37:6 45:12 |
| 228:23 | 153:20 | 189:24 | canal 44:14 | 64:19 66:19 | 50:12,15 |
| 248:10,11 | brief 146:21 | 211:24 | 192:13 | 94:8 98:16 | 51:10 52:2 |
| boulders | briefly 10:6 | 221:18 | 195:3 198:8 | 110:15,17 | 56:6 57:4,6 |
| 32:6 65:7,7 | 110:8 | cadmium | 199:13 | 114:10 | 60:7 72:5,9 |
| 66:9 | bright 49:14 | 148:8,9 | 201:15 | 155:3,8 | 72:13 78:18 |
| Boulevard | 248:23 | 150:15 | 210:4 220:1 | 161:24 | 80:11,24 |
| 2:14 | bring 219:14 | 169:3 | 220:20 | catch 244:19 | 83:17 84:11 |
| boundaries | 234:24 | calculate | 221:10,22 | 245:12 | 84:19 85:3 |
| 16:4 | bringing | 51:19 53:17 | 240:1 241:6 | categories | 85:11,13,17 |
| boundary | 241:20 | 81:6 130:21 | 241:11 | 47:13 62:7 | 85:23 86:8 |
| 16:9 | broken 74:1 | 132:21 | 246:18 | 62:9,18,22 | 86:10,21 |
| box 2:7 10:21 | brought 82:7 | 138:11 | 247:6 | 111:17 | 87:7,17 |
| 10:22 | 228:11 | calculated | 248:22 | categorize | 88:8,9,22 |
| 165:10 | 245:7 | 11:24 53:15 | capable | 31:19 | 89:4,6,10 |
| 170:2 | Bubbly 99:24 | 156:18 | 144:24 | categorized | 89:13,17,24 |
| boxes 58:11 | 103:6 | calculating | 145:8 224:8 | 140:18 | 90:11,13 |
| BPJ 10:23 | 110:16 | 7:9 | capsule | category | 91:1,4,5,13 |
| Brammeier | budget 32:9 | calculation | 45:10 | 62:17 | 91:19 92:4 |
| 237:13 | build 6:11 | 53:16 | caption | 132:15 | 92:7,20 |
| branch 17:17 | 249:18 | calculations | 33:21 | 144:15 | 93:19 94:14 |
| 17:20 26:1 | building | 60:11 71:19 | car 29:1 32:5 | 153:18,19 | 99:6 100:7 |
| 34:1,6 44:9 | 88:13 93:11 | calendar | care 27:1 | catfish | 108:3,4,7 |
| 59:15 100:1 | built 67:21 | 236:22 | carnivore | 246:17,19 | 111:13,23 |
| 103:20 | 98:12 | calibrated | 11:7 | 247:5,13 | 119:4,7,15 |
| 106:22 | 101:21 | 134:9,10 | carnivores | caught 61:18 | 121:8,19 |
| 108:20 | bullet 156:6 | call 44:22 | 165:7,21,23 | causation | 123:6,7,10 |
| 192:14 | 159:1 | 66:6,7 | carp 202:14 | 167:19 | 123:12 |
| 199:22 | Bunn 170:24 | 71:14 112:3 | 203:5 219:9 | cause 1:8 | 125:21 |
| 200:4 | 171:1,7,13 | 190:19 | 243:5 | 14:18 68:19 | 126:7,9 |
| 201:12 | 171:21 | 234:3 | Carrie 2:5 | 79:24 | 128:3,4,12 |
| 210:3 240:3 | 172:13,17 | 241:16 | 4:14 | caused 20:12 | 129:13 |
| Brandon | 173:24 | called 1:9 7:9 | carried 149:5 | causes 186:8 | 130:19 |
| 247:2 | 233:1 | 52:24 141:4 | cars 31:23 | causing 69:8 | 133:2,21 |
| bread 26:20 | business | 148:9 151:2 | CART 77:14 | 138:13 | 134:6,12,20 |
| break 63:11 | 198:14 | 170:8 | 168:14 | 239:12 | 134:23 |
| 63:15 72:3 | | 214:16 | 188:12,19 | caveat | 135:4,9,19 |
| 72:4,18 | C | 249:4 | 189:6 207:2 | 217:15 | 135:21 |
| 116:19,22 | C 2:1 4:10,21 | Calumet | case 10:23 | 249:21 | 136:2 137:3 |
| 192:20,23 | 77:10,23 | 17:18 104:7 | 16:20 18:12 | CAWS 14:23 | 139:3,12,16 |
| 193:1 214:9 | 79:1,9,12 | 104:9 | 18:12 22:9 | 15:4,6,7,9 | 139:24 |
| breaking | 79:19,20,21 | Cal-Sag | 48:22 55:5 | 16:21,24 | 143:13,17 |
| 240:2 241:6 | 118:13 | 58:24 | 64:6 75:6 | 17:2,3,6 | 143:20,23 |
| breakout | 155:15 | 108:17 | 87:20 96:15 | 18:10,10,14 | 145:13,19 |
| 72:7 | 161:15 | 195:2 | 101:15,23 | 19:4,7,10 | 146:17 |
| breed 93:4 | 162:8,20 | came 25:24 | 175:22 | 19:12 22:12 | 154:1,5,20 |
| Brickey 1:10 | 164:20,21 | 26:4 240:11 | 177:12 | 25:24 26:1 | 155:12,24 |
| | 168:23 | | | | |

| | | | | | |
|-------------|----------------------|----------------------|----------------------|-----------------------|----------------------|
| 156:16 | 240:6,12 | certification | channel | 242:15 | 147:13 |
| 157:10 | 241:2 244:2 | 118:4 | 32:19,21 | Chapter | 149:13 |
| 159:1,16 | 244:3 | certified | 33:4,4,5 | 170:7,14 | Chicago 1:3 |
| 164:4 | 246:21 | 117:24 | 44:24 48:8 | character | 1:11 2:11 |
| 167:11,16 | 248:8 | 251:5 | 49:15,22 | 118:8 | 2:14,18 4:5 |
| 168:3 | CD 39:15,20 | certify 251:6 | 52:14 56:7 | characteris... | 17:18,21 |
| 170:22,23 | CDOM 38:21 | cetera 116:3 | 56:10,21,23 | 42:20 44:7 | 29:24 30:1 |
| 171:4 175:5 | 39:4 74:11 | 136:6 | 56:24 57:2 | 44:12 123:3 | 34:1 44:4 |
| 176:23 | 74:12 78:13 | 233:18 | 57:8 59:1 | 217:9,15 | 47:4,6 |
| 177:23 | 80:20 81:5 | chain 149:15 | 59:14 71:7 | characteris... | 101:18,18 |
| 178:4,6 | 156:17 | 203:19 | 71:8 83:17 | 124:7 188:3 | 103:20 |
| 179:17,21 | 159:4 212:3 | Chairman | 90:8 92:17 | 217:13 | 108:21 |
| 179:22 | 212:7,22 | 2:3 4:11 | 100:1 102:6 | 219:19,22 | 192:13,14 |
| 181:13,19 | ceases 113:22 | challenges | 102:9,13 | 220:1 | 195:3 198:7 |
| 181:21 | CEG 121:12 | 105:23 | 103:2 | 235:14,18 | 199:13,22 |
| 182:24 | Celsius | 106:4 | 104:13 | characteriz... | 200:5 |
| 183:7,21,22 | 162:13 | chance 97:21 | 105:5 | 242:23 | 201:12,14 |
| 185:13,21 | CENTER | 234:24 | 108:17 | characterize | 210:3,3 |
| 186:4,5,13 | 2:13 | chances | 111:7,10,20 | 27:20 51:21 | 217:10 |
| 186:21 | central 28:15 | 235:21 | 111:22 | 111:14 | 219:24 |
| 187:9,18,18 | certain 7:7,7 | change 7:24 | 112:4,6 | 112:6,10 | 239:24 |
| 187:21 | 39:21 45:9 | 53:2 66:9 | 113:22 | characteriz... | 240:3 241:7 |
| 188:6 189:8 | 45:17 56:15 | 102:2 | 187:15,24 | 29:17,18 | 246:17 |
| 189:11 | 56:16 | 106:11 | 188:1,3,17 | 111:16 | 247:5 |
| 191:13,15 | 106:10 | 115:8 | 189:9,9,17 | 119:24 | 251:22 |
| 192:2,4,5,9 | 115:19 | 138:16 | 190:2,8 | 140:5 | chief 18:20 |
| 192:16 | 142:1 | 143:12 | 191:17 | characteriz... | chinook |
| 193:12,18 | 145:15 | 166:9 | 194:17 | 140:1 | 26:19,24 |
| 194:1,24 | 179:17 | 168:18 | 195:2 | chart 61:10 | 61:2 |
| 195:5,12 | 212:5 | 179:14 | 196:12,19 | 165:18 | chloride |
| 196:3,19 | 213:14 | 183:16 | 220:2,3,7 | charts 56:5 | 77:17 |
| 197:19 | 235:15 | 196:20 | 233:18 | 249:9 | 168:16 |
| 198:3,24 | 238:24 | 202:1,2 | 234:7 | check 12:20 | choose |
| 199:12 | certainly | 233:16 | 248:10,19 | 174:22 | 144:12 |
| 200:24 | 9:24 26:18 | changed 7:21 | 248:20 | 206:16 | chosen 169:2 |
| 201:3,7,21 | 38:4 74:21 | 7:23 59:22 | channeliza... | checked 31:6 | Christopher |
| 202:13 | 114:17 | 242:18 | 193:12 | 60:20 61:5 | 170:14 |
| 203:7,12 | 115:3 | changes | 195:13,16 | chemical | chromium |
| 207:20,21 | 133:17 | 52:20 95:22 | 195:17 | 24:7 169:2 | 148:6,7 |
| 207:23 | 220:21 | 96:4 97:14 | channels | chemicals | Cincinnati |
| 208:9 | 223:16,19 | 99:8,12 | 93:19 | 13:24 24:1 | 230:6 |
| 210:15,22 | 226:18 | 166:22 | 103:10,11 | 24:6 45:5 | circumstan... |
| 217:20 | 228:2,4,5 | 239:21 | 103:15 | 45:12,16,17 | 246:11 |
| 219:7 | 228:21 | 242:10 | 106:5 173:1 | 45:22,24 | citation |
| 226:12 | 232:16 | 243:3,11 | 193:13 | 148:18,19 | 171:21 |
| 227:2 228:4 | 242:6 | changing | 195:1,6,19 | 149:14 | 175:22,22 |
| 231:17,22 | 246:22 | 72:15 | 195:20 | 152:17 | citations |
| 232:16 | certificate | 131:23 | 196:9 | chemistry | 15:19 |
| 235:8,16 | 118:14 | 154:14 | 231:21 | 146:15,17 | cite 172:13 |

| | | | | | |
|------------------------|----------------------|-----------------------|----------------------|--------------------|-------------------|
| 175:20 | 115:23 | 238:1 | colors 250:3 | 155:16 | 155:22 |
| 188:23 | 125:2 | cobble 42:6,9 | Columbus | commercial | 156:2 |
| cited 124:8 | 158:22 | 43:3 116:3 | 94:3 | 59:8,8,13 | 167:11 |
| 124:10 | 177:3 | cobbles 65:6 | column 11:7 | 95:23 | 174:13 |
| 133:9 171:2 | 211:14,17 | 65:8 114:14 | 11:7,13 | 104:23 | 176:19 |
| 173:11 | 211:18 | Code 1:5 4:7 | 13:21 29:12 | 198:4,7,9 | 177:9 |
| 175:15 | 214:24 | coho 60:20 | 62:21 64:9 | 198:12 | 178:18,18 |
| Citgo 5:16 | cleared | 61:6 63:8 | 165:9 | Commission | 178:19 |
| 214:7,8 | 196:10 | collaborated | columns 11:6 | 198:17 | 181:13 |
| citing 122:2 | clearer | 120:21 | combination | 237:9 | 183:17,22 |
| 175:17 | 147:12 | collaborato... | 46:12 77:19 | Committee | 186:4 |
| city 101:18 | clearing | 120:15 | combinatio... | 250:3 | 187:10 |
| 228:4 | 64:21 | Collateral | 69:16 | commodities | 188:6 201:2 |
| clarification | clearly | 99:24 103:9 | combined 7:9 | 223:17 | 201:6,21,22 |
| 7:2 12:11 | 182:11 | 103:11 | 10:14 124:5 | 240:16 | 202:2,6,8,9 |
| 112:13 | 221:11 | collect 42:18 | 128:5,10,15 | 241:13 | 202:16,18 |
| 128:14 | 249:17 | 212:14 | 128:20 | commodity | 202:21 |
| clarify 14:16 | close 30:22 | collected | 129:1 | 198:15 | 203:9,11,21 |
| 30:2 43:4 | 83:2 139:16 | 28:13 33:24 | 130:19,22 | common | 204:2,3,9 |
| 44:21 50:17 | 212:9 | 34:11 36:24 | 131:8 152:6 | 15:15,23,24 | 204:10,13 |
| 84:4 96:3 | 241:17 | 60:2,5 | 162:4 163:3 | 124:12 | 204:17,20 |
| 98:20 179:4 | closely 147:5 | 75:16 | 184:3,18 | 202:14 | 204:23 |
| 182:10 | closest 29:21 | 119:20 | 185:22 | 203:5 | 205:8,12 |
| 188:8 | 47:7 | 120:9 | 189:10,12 | commonly | 206:10,13 |
| 222:17 | Club 5:9,15 | 156:16 | 189:19 | 84:17 124:8 | 206:24 |
| 230:14 | 5:20 | 181:24 | 239:11 | 173:11 | 208:8,14 |
| clarifying | cluster | 206:21 | 246:12 | 202:11 | 209:15 |
| 211:8 | 201:18 | 212:12,15 | come 12:14 | 231:20 | 239:14 |
| clarity | 202:12 | 212:24 | 24:2 25:10 | communities | comparable |
| 158:15 | 203:3,8 | 213:4,9,13 | 36:14 54:15 | 23:11 85:23 | 244:10 |
| classes | 207:4,6,16 | 213:15 | 71:4 102:21 | 107:5 | compare |
| 244:19,21 | clusters | 248:7 | 116:20 | 173:16 | 7:11 16:12 |
| classification | 86:16 | collecting | 141:7 | 204:6 | 16:15 17:18 |
| 168:14 | 203:20,22 | 121:1 | 144:13 | 211:20 | 17:21 18:9 |
| 210:17,20 | 204:4 | collection | 177:15 | 228:22 | 19:3,7,12 |
| classificati... | 207:10,20 | 28:16 | 223:8 234:9 | community | 43:19 81:20 |
| 42:1 144:17 | 207:22 | 105:21 | 234:9 | 7:10 10:13 | 128:4 |
| 210:21 | 208:3,4,6,9 | collections | comes 249:23 | 23:12 54:13 | 138:12 |
| classified | 208:12 | 60:1 | comfortable | 84:10 85:3 | 244:6 |
| 102:12 | 209:15 | collects 36:18 | 224:17 | 85:4,19 | compared |
| 165:23 | 210:2 | color 34:9 | coming 53:23 | 86:1,9,15 | 21:4 22:22 |
| 208:22 | coal 33:16 | 248:24 | 218:13 | 86:20,21 | 30:17 43:21 |
| classify 206:2 | coarse 13:13 | 249:3,5,5,9 | commencing | 87:10 | 54:23 65:20 |
| 209:9 | 13:13 116:3 | 249:11,14 | 1:12 | 115:11,13 | 81:9,19 |
| clay 41:20 | 166:1 | 249:19,22 | comment | 115:21 | 119:10 |
| clean 127:10 | 207:18 | 249:24 | 14:5,7 79:5 | 116:1 | 128:10 |
| clear 8:23 | 220:11 | coloration | 79:8,12,16 | 125:11 | 135:10 |
| 9:14 88:6 | 231:20 | 34:13 | 121:10 | 134:14 | 138:17 |
| 101:2 | coauthors | colored 34:3 | 139:2 | 139:14 | 145:22 |

| | | | | | |
|----------------------|-----------------------|--------------------|---------------------|-----------------------|---------------------|
| 147:2 | 177:7,8 | 222:3,19 | 18:15 22:10 | connected | considering |
| 149:12,17 | 229:17 | conclude | 22:11,11 | 15:6 95:3 | 18:16 |
| 149:18 | 244:8 | 113:5 | 30:4,5 | 234:14 | consist |
| 151:11 | completion | 134:24 | 31:13 32:22 | 246:20 | 203:23 |
| 152:6 159:8 | 121:1 237:9 | 186:15 | 48:15 51:21 | connection | consistency |
| 183:10 | complex | 192:11 | 65:10 86:2 | 100:2 194:8 | 36:22 |
| compares | 173:6 | concluded | 91:1 92:14 | 194:15,17 | 139:11 |
| 84:19 | complexity | 111:21 | 96:9 97:15 | 194:19 | consistent |
| 161:16 | 92:18 | 157:2 | 99:10 | 195:23 | 69:18 |
| comparing | 102:10,13 | 163:12 | 106:15 | 220:15 | 144:24 |
| 24:4 38:19 | compliance | 174:16 | 107:6 113:2 | 234:12 | consisting |
| 68:5 122:9 | 78:16 80:21 | 227:15,20 | 113:5 | 241:7 | 128:6 |
| 122:12 | 164:11 | concludes | 114:24 | connectivity | consists |
| 129:14,21 | comply 81:18 | 167:18 | 115:5 119:7 | 195:14,16 | 128:21 |
| 243:22 | component | concluding | 119:14 | 196:3 234:4 | 129:1 |
| comparison | 226:22 | 5:21 | 122:10,10 | 234:20 | constituent |
| 28:13 30:11 | components | conclusion | 130:4,12 | Consequen... | 107:4 |
| 71:17 85:2 | 150:17,20 | 33:10 157:9 | 143:20 | 171:10 | constituted |
| 128:9,15,17 | 151:13 | 183:8 186:1 | 150:6 | consider | 118:16 |
| 141:11 | 203:23 | 206:22 | 167:24 | 23:21 35:19 | construct |
| 162:9,15,21 | 204:5 | conclusions | 168:3 | 52:19 92:6 | 106:15 |
| 179:22 | 241:19 | 7:22 22:20 | 169:20 | 93:2 95:22 | constructed |
| 183:1 | composed | 32:24 37:3 | 226:11 | 97:13,24 | 93:14 98:12 |
| 186:23 | 206:13 | 37:7 38:19 | 227:16 | 99:8 103:1 | 103:6 195:6 |
| 187:2,8 | 220:2 | 51:13,17 | conducted | 103:5,20 | constructive |
| 197:16 | composition | 55:9 60:16 | 69:11 | 104:11 | 93:18 94:2 |
| 244:5 | 62:13 | 84:9 174:7 | 144:23 | 154:15 | 94:19,20,23 |
| comparisons | 111:22 | 177:1 | 164:1 | 155:17 | 95:2 |
| 163:1 228:2 | 172:15,19 | condition | conducting | 185:10 | contact |
| compel | comprehen... | 13:22 14:17 | 119:4 | 210:14,16 | 101:17 |
| 224:18 | 106:23 | 23:1,10,20 | conference | 217:8,14 | 159:17 |
| compensati... | comprised | 30:16 62:11 | 4:23 | 233:24 | contain |
| 112:7 | 203:3 | 66:1,2,20 | confidence | 240:2 | 13:24 |
| competing | computer | 67:24 | 151:24 | 241:20 | 210:21 |
| 106:7 | 51:18 | 113:13 | 180:16 | 243:10 | contained |
| complete | conceivable | 119:22 | confirm 32:5 | 244:14 | 11:23 77:20 |
| 6:12 78:9 | 232:20 | 131:6 147:6 | 33:11 47:21 | considerati... | 84:5 101:24 |
| 85:24 | conceive | 147:18 | 59:5 238:22 | 27:10 185:6 | 147:20 |
| 117:10 | 114:22 | 155:5 | conflict | considered | 161:15 |
| 127:7 | concentrati... | 166:19 | 232:17 | 27:7,9,21 | 162:8 |
| 203:21 | 169:3,4,4 | 179:16 | confused | 28:21 43:22 | containing |
| 204:2,10,22 | 239:13 | 196:4,22 | 28:6 41:18 | 54:22 63:3 | 195:20 |
| 205:3,12 | concept | 197:22 | 65:12 91:16 | 63:7 77:9 | containme... |
| 206:1 251:9 | 111:9 | 198:6 | confusing | 100:6 | 23:23 24:3 |
| completed | conceptual | 200:17 | 69:7 | 111:16 | 147:4 |
| 5:5 100:12 | 200:8 | 204:19,19 | confusion | 121:16 | 149:23 |
| 100:13 | concern | conditions | 12:22 | 140:4 240:4 | contains |
| 101:4 | 219:2 | 15:4 16:8 | conjunction | 241:4,10 | 14:14 85:18 |
| completely | concerned | 16:19 17:23 | 75:16 | 242:1,3 | contaminant |

| | | | | | |
|-----------------------|----------------------|-------------------|----------------------|---------------------|-----------------------|
| 22:23 | 100:10 | 143:20 | 191:16,23 | counting | 62:4 92:7 |
| 147:18 | conveyance | 146:6 150:3 | 191:24 | 26:10 | 92:11 177:8 |
| 169:12 | 196:14,14 | 152:7 | 196:22 | 133:20 | creates 14:12 |
| contamina... | 223:20 | 154:13 | 197:15,21 | 190:6 | creating |
| 22:24 23:2 | 232:18 | 155:19 | correlation | counts 26:7 | 105:5 127:2 |
| 149:19 | 240:18,18 | 159:15 | 54:12 69:10 | 28:17 | 144:17 |
| contaminat... | convinced | 161:21 | 81:23 | 133:22 | creation |
| 23:18,19 | 104:21 | 162:2 163:1 | 138:18 | 150:4 | 193:12 |
| 25:7 136:5 | Cook 251:3 | 163:8,11 | 152:3,23 | County | credit 172:6 |
| 146:24 | 251:14 | 177:10,24 | 156:10 | 107:9 251:3 | Creek 99:24 |
| 147:3 149:4 | cool 82:14 | 178:7 | 159:12 | 251:14 | 103:6 |
| 152:11 | copies 236:10 | 179:13,15 | 161:24 | couple | 110:16 |
| 197:21 | 236:16 | 184:19,23 | 167:20 | 120:15 | crew 58:10 |
| 201:8 | copy 34:3 | 186:13 | 169:1 | 131:22 | criticized |
| contemplate | 80:2,4 | 187:3,7 | 180:16 | 144:1 | 96:6 |
| 243:2,8 | 169:21 | 192:11 | 184:7 | course 13:18 | critters 21:14 |
| contemplat... | 171:5 172:5 | 200:24 | 196:24 | 90:16 121:8 | 93:4 |
| 101:13 | 174:19,20 | 201:5 | 197:1 | 232:11 | cross 32:19 |
| contemplat... | 174:21 | 205:14 | correlations | court 1:24 | 206:4,9 |
| 200:6 | 214:18 | 211:12 | 68:18,20 | 2:24 3:24 | crossing |
| content 172:5 | 237:5 | 228:13 | 69:3 148:17 | 6:8 84:14 | 245:6 |
| 186:9 | core 144:14 | 229:18 | 157:7 | cover 49:10 | crumbling |
| context 85:16 | Corps 59:9 | 233:22 | 169:15 | 49:11,13,20 | 143:6 |
| 87:7 101:9 | 59:11,16 | 239:22,23 | correspond | 50:3,6 | crumbly |
| 131:2,3 | 99:9 198:15 | 240:4 241:8 | 58:14,18 | 140:12 | 142:15 |
| 190:24 | 198:19 | 251:9 | correspond... | 141:21,23 | crummy 31:4 |
| 194:16 | 216:16 | corrected | 62:18 | 170:4 | CSO 48:14 |
| 202:10 | 218:12 | 7:20 11:11 | corroborate | 187:23 | 94:12 |
| continue | 219:5 | correcting | 177:13 | 189:17 | CSO's 46:13 |
| 55:11 | correct 7:4 | 8:8 | counsel 40:5 | 202:20 | 47:14 103:7 |
| continuous | 9:17 11:14 | correctly | 110:7 117:5 | coverage | CSR 1:10 |
| 39:5,22 | 21:21 35:9 | 20:9 74:12 | 133:13 | 27:22,22 | 2:21,22 |
| 40:23 | 39:11 49:17 | 87:15 | 169:23 | 50:8 | 251:20,23 |
| contrast | 51:8 54:1,9 | 136:17 | 170:1,3 | covered | cubic 243:18 |
| 249:12 | 54:16 58:14 | correlate | count 11:4 | 95:20 121:7 | cues 176:11 |
| contribute | 59:7,12 | 25:6 | 28:24 56:16 | 169:18 | culling 54:6 |
| 48:7 76:22 | 67:6 71:21 | correlated | 61:3 143:5 | 189:24 | 230:16,17 |
| contributed | 71:22 79:5 | 22:24 65:15 | 154:7 | co-depend... | curious |
| 36:11 | 81:22 82:23 | 65:16 147:5 | 190:11,11 | 73:19 | 211:1 |
| contributing | 82:24 86:6 | 148:13 | counted 11:8 | create 61:21 | current |
| 47:22,23 | 89:14 90:1 | 150:5 151:9 | 12:6 27:7 | 102:19 | 81:18 |
| contribution | 94:18,21 | 151:16,17 | 37:9 56:17 | 104:13 | 159:17,22 |
| 47:20 | 96:10,13 | 151:23 | 57:19 58:10 | 115:5 | 159:23 |
| contributio... | 97:11 98:23 | 152:11,17 | 61:11 143:1 | 125:13 | 217:17,22 |
| 47:17 | 103:16 | 154:21 | 143:3,5 | 131:18 | 245:16 |
| contributors | 108:14,15 | 155:1,2 | 190:16 | 200:12,15 | currently |
| 178:22 | 123:6 | 156:8 | 191:2 | 200:16 | 91:5,19 |
| Control 1:1,9 | 126:10 | 187:22 | counter 52:8 | 233:7 | 103:19 |
| conversati... | 128:7 129:8 | 189:18 | 55:3 | created 57:5 | 105:2 |

| | | | | | |
|----------------------|-------------|----------------------|----------------------|----------------------|---------------------|
| 117:21 | 55:22 60:2 | 165:14,15 | deals 111:6 | 246:14 | 30:6,8 |
| cut 54:14 | 60:4,13 | 166:16,21 | dealt 190:8 | define 236:4 | 32:20 33:3 |
| 95:18 | 61:19 65:21 | 166:22 | Deb 221:15 | defined 55:8 | 33:5 64:1 |
| 225:21 | 66:5,5 | 167:1,14 | Deborah 2:8 | 133:8 174:2 | 74:15,19,20 |
| cutoff 195:24 | 71:17 72:4 | 169:14 | 71:1 | definition | 187:15 |
| 197:14 | 72:7,11,11 | 177:2,12,20 | debris 34:15 | 103:17 | 188:4,18 |
| Cuyahoga | 74:4,5,10 | 179:2,23 | 34:18 35:24 | 116:8 | 189:9,10 |
| 17:19,22,24 | 74:12,17,23 | 180:2,3,4,9 | 36:2 41:19 | definitive | 191:16 |
| 18:2,23 | 75:8,15 | 180:12,18 | deceleration | 32:1 167:19 | 196:19 |
| C1 165:4 | 76:10,18 | 181:4,16,24 | 53:3 | deformities | 245:13,18 |
| | 77:4 78:14 | 182:8,16 | decide 92:3 | 45:10 | 245:19 |
| | 78:17 80:20 | 183:5,10 | 239:6 | degree 25:6 | depths 30:13 |
| D | 80:23 81:5 | 184:8,14 | decided 4:24 | 83:17 | 30:14 74:8 |
| D 3:1 118:18 | 81:15 82:21 | 185:16 | 16:22 24:9 | 118:10,23 | 74:13 75:4 |
| 130:14 | 82:22 84:2 | 186:8,12,17 | 32:8 67:11 | 140:16 | 75:24 76:3 |
| 133:19 | 100:20 | 187:17 | 70:5 96:7 | 150:22 | 76:6 |
| 157:5 | 101:22 | 198:15,19 | 219:7 | 201:22 | Des 1:4 4:6 |
| 179:12 | 105:18,21 | 201:19 | decimals | degrees | 246:19 |
| 215:2 | 109:1,7,12 | 206:21 | 131:15 | 156:23 | 247:1 |
| 225:11 | 109:21 | 212:20,22 | decision 6:12 | 162:13 | describe |
| daily 40:10 | 110:8,14,19 | 212:23 | 15:11 | delta 138:4 | 50:18 |
| 81:7 161:18 | 111:11 | 213:4,9 | 108:24 | demonstrate | 100:22 |
| 162:10 | 120:3,11,24 | 248:8 | 109:2,3 | 101:22 | 101:12 |
| 165:8 166:2 | 122:13,20 | 249:18 | decisions | 180:11 | 146:4 232:6 |
| dam 219:13 | 122:24 | dataset 134:6 | 27:13 217:7 | denaturiza... | described |
| 247:2,6 | 123:14,15 | 180:5,9,19 | decorating | 193:17 | 10:6 48:4 |
| damage | 129:2,3,8 | 212:20 | 249:23 | denotation | 62:9 77:10 |
| 23:14 | 129:12 | datasets | decrease | 43:11 | 132:8 139:7 |
| 216:23 | 130:3,8 | 159:4 180:8 | 131:8,12 | DENTON | 147:23 |
| damaging | 134:6 | date 40:16 | 239:12 | 2:9 | 192:3 |
| 106:13 | 135:13 | 133:10 | deemed | deny 115:6 | describes |
| darkened | 136:8 | 236:19 | 132:11 | depend | 77:23 |
| 10:21 11:17 | 137:20,21 | Dave 120:18 | deep 44:22 | 232:12 | 126:12 |
| data 21:4 | 147:4 | David 5:22 | 65:23 71:8 | depending | 212:3 |
| 22:23,23 | 148:14 | day 1:12 4:20 | 102:21 | 65:16 66:2 | describing |
| 24:4 25:17 | 149:11,13 | 4:21 6:19 | 145:22 | 70:4 155:4 | 10:13 |
| 26:17 27:13 | 149:13,17 | 130:4 | 220:6 | 245:9 | 187:17 |
| 27:15,17,19 | 149:18,22 | 176:10 | deepening | depends | description |
| 27:23 28:12 | 156:11,13 | 246:7 250:8 | 193:19 | 16:19 | 53:13 132:5 |
| 28:13 31:8 | 156:15,15 | 251:14 | 195:18 | 247:10 | 138:6 |
| 31:14 32:16 | 156:17,18 | days 103:21 | deepest 44:23 | deposeth | 203:10 |
| 34:19 38:16 | 157:1,3,8 | 226:23 | deeply 245:5 | 214:17 | descriptive |
| 38:21,24,24 | 157:10 | DC 245:22 | deepwater | deposition | 122:14 |
| 39:1,2,4,8 | 158:6 | dead 138:7 | 65:14 | 106:24 | 130:10 |
| 39:10,15,21 | 159:18 | deal 25:20 | defend 231:3 | 107:3 | descriptors |
| 39:23 40:7 | 160:12,17 | 60:15 222:5 | defer 20:15 | deposits 13:7 | 140:24 |
| 40:15,23 | 161:14 | dealing 16:20 | 34:12 214:4 | depression | 148:1 |
| 43:21 47:3 | 162:7,16 | 111:9 160:8 | 230:23 | 56:12 | design |
| 47:3 50:11 | 164:16 | 240:10 | 232:3 246:3 | depth 29:14 | 218:15 |
| 50:19 51:8 | | | | | |
| 51:9 54:24 | | | | | |

| | | | | | |
|----------------------|--------------------|---------------------|------------------------|-----------------------|----------------------|
| designated | 12:2 19:22 | 19:20 20:3 | 233:23 | disagree | 55:12 64:1 |
| 221:4 | 31:14 54:11 | 100:2 122:1 | 234:4,17 | 176:10,15 | 67:4 77:20 |
| designation | 118:9 123:8 | 122:7 124:9 | 235:1 | discern 31:23 | 193:11 |
| 58:17 | 153:13 | 125:10 | 241:23 | 134:22 | 227:4 |
| 223:11 | 155:20 | differ 76:22 | 242:16 | 135:2 147:4 | 232:14 |
| 225:13 | 173:4 | 244:23 | 244:8,9 | 148:22 | 248:4 |
| designed | determining | 245:22 | 250:3 | 149:22 | diseased 63:4 |
| 125:12,13 | 61:19 | difference | differentiate | 150:21 | dispersal |
| 145:11 | 174:12 | 25:10 52:4 | 17:1 43:24 | discharge | 219:23 |
| 216:11 | 198:12 | 56:9 73:7 | 89:2 142:20 | 37:10 | 220:23 |
| 224:18 | 206:23 | 125:7 127:1 | differentiat... | 241:22 | display |
| desirable | detrimental | 137:24 | 66:6 151:3 | discharges | 173:17 |
| 13:22 36:1 | 13:12,24 | 138:4 142:9 | 151:4 | 46:13,14 | disrupt |
| 36:3 67:13 | 153:14 | 177:22 | differentiat... | 47:15 | 176:11 |
| 115:14,17 | 174:16 | 197:1 | 144:14 | 239:11 | disrupting |
| 116:9 | 175:7 | differences | differently | disconnect | 45:4 |
| desired | 193:13 | 125:14 | 61:15 121:5 | 128:24 | dissimilar |
| 106:16 | 194:5 | 131:23 | 239:9 | disconnecti... | 22:1 |
| detail 104:3 | Detroit | 138:11 | differs 125:6 | 193:20 | dissolved |
| 156:12 | 106:18 | 154:15 | 145:21 | discourage... | 38:17,19 |
| 159:7 | develop | 178:5 192:8 | difficulty | 222:13 | 39:5,14,21 |
| 249:12 | 10:14 15:11 | different | 32:10 34:18 | discouraging | 72:22 73:24 |
| detailed | 16:6 123:23 | 10:13 16:24 | 66:18 230:2 | 215:23 | 74:3 75:8 |
| 20:17 | developed | 22:1 30:15 | digital 30:3 | 216:1 | 76:5 77:6 |
| determinant | 15:13,16 | 35:23 42:11 | 30:20 | discovered | 77:16 82:8 |
| 172:14 | 16:4,23 | 43:1 45:2 | 119:21 | 77:4 109:17 | 154:22,22 |
| 173:7,15 | 17:21 19:13 | 49:4 56:24 | 120:7 249:2 | discuss 15:19 | 155:19,20 |
| determina... | 51:19 99:23 | 69:16 74:8 | dimension | 55:19 76:15 | 156:2,9 |
| 173:11 | 114:12 | 83:1 85:5 | 142:1 | 91:22 128:1 | 167:21 |
| determinat... | 121:15 | 86:17 87:8 | dimensions | 198:22 | 168:15 |
| 18:12,17 | 122:9,20,23 | 94:4,6 | 56:14,15 | 199:1,16 | 182:13 |
| determine | 123:6 134:9 | 97:20 98:1 | diminish | discussed | 183:2,11,14 |
| 22:23 23:23 | 134:10,13 | 101:2,11 | 45:22,23 | 15:10 35:23 | 183:21 |
| 26:3 36:22 | 145:16,18 | 113:13 | direct 23:17 | 60:1 146:20 | 184:1,5,12 |
| 38:17 44:18 | 146:2,11 | 116:6 125:4 | 193:23 | 153:22 | 184:16 |
| 73:6,9 | 180:1 196:9 | 125:5 | directed | 181:22 | 185:21 |
| 81:23 82:6 | 201:1 | 134:13 | 210:12 | 182:22 | 186:5,17 |
| 101:8 107:2 | 226:16 | 144:17 | direction | 185:3 | 187:1,11 |
| 121:18 | developer | 145:24,24 | 203:18 | 193:15 | 211:11,16 |
| 122:13,23 | 135:13 | 146:1,8 | 251:12 | 201:24 | 212:11 |
| 125:12 | developers | 148:15 | directly 23:7 | 227:11 | 228:18 |
| 137:14,16 | 120:17 | 152:17 | 30:18 45:13 | 241:9 | 229:10 |
| 149:14 | 141:6 | 160:22 | 45:18 64:12 | discusses | 239:12 |
| 177:22 | developing | 188:11,21 | 92:23 | 145:13 | distance |
| 178:2,2 | 16:18 124:5 | 189:15 | 146:17 | discussing | 30:21 |
| 179:1 | 124:7,13 | 205:3,13 | 172:4 | 66:8 175:13 | 211:18 |
| 205:22 | 125:8 | 226:15,16 | 220:22 | 205:18 | 245:15 |
| 206:11 | 210:15 | 226:17 | 225:3 242:8 | discussion | distinction |
| determined | development | 232:21 | 244:10 | 37:1 41:2 | 56:22 189:5 |

| | | | | | |
|----------------------|---------------------|---------------------|----------------------|----------------------|-----------------------|
| distinguish | 215:12 | 226:11,12 | 250:2 | E 2:1,1 3:1 | effect 13:8 |
| 190:19 | 237:17 | 226:23 | draft 121:2 | 3:10 10:1 | 23:5 45:14 |
| distribution | 238:18 | 228:3 | 133:8 | 118:20 | 45:15,19 |
| 173:2,8 | documenta... | 246:11 | drainage | 179:12 | 46:5,6 48:5 |
| 208:2 | 122:2,7 | double 11:8 | 13:8 | 215:15 | 55:1 56:2 |
| district 5:4 | documents | down 11:15 | draw 55:9 | 225:1 | 60:24 69:24 |
| 5:13 27:18 | 38:16 | 28:10 30:17 | 177:1 185:7 | each 6:8 | 72:22,22 |
| 36:18 37:21 | doing 69:21 | 31:5 32:8 | dredge | 36:16,19 | 73:24 97:9 |
| 38:3,7,23 | 82:5 109:8 | 32:14 43:13 | 102:20,22 | 40:16 42:1 | 97:10 |
| 39:7,19 | 175:9 | 54:6 62:23 | dredges | 44:19 47:21 | 100:14,21 |
| 46:21 75:12 | 179:10 | 63:22,23 | 193:22 | 53:18 56:18 | 101:6 |
| 75:14 99:13 | 191:1 | 64:23 69:22 | drill 69:22 | 57:20 58:11 | 106:16 |
| 100:5 | 214:22 | 71:13 72:4 | drive 2:10,17 | 72:6,13 | 110:1 |
| 118:17 | 242:20 | 72:4,18 | 221:10 | 74:6 81:9 | 132:12 |
| 120:22 | dolphins | 74:1 83:14 | drop 52:17 | 107:10 | 147:7 |
| 212:14 | 28:22 | 95:14,17 | 103:18 | 138:16 | 155:11 |
| 213:5 | 153:20 | 113:22 | 110:4 | 142:3 143:2 | 174:16 |
| 214:23 | dominant | 114:24 | dropping | 161:20 | 175:7 186:3 |
| 246:2,5 | 42:20 44:6 | 131:19 | 54:5 | earlier 12:16 | 188:5 |
| District's | 44:11,22,24 | 141:22 | drops 151:24 | 12:17 22:17 | 189:10,13 |
| 58:15 74:11 | 84:10 85:4 | 143:6 157:5 | droughts | 24:9 36:9 | 189:15,21 |
| 74:23 76:10 | 85:8,18,23 | 165:10 | 173:14 | 48:4 77:5 | 189:22 |
| 109:3 | 86:9,15,20 | 189:12 | drudges | 160:23 | 194:5 197:6 |
| 156:17 | 86:21,23 | 217:20 | 193:21 | 181:8 211:9 | 199:1 |
| 213:17 | 182:4 | 218:8,9,11 | due 54:8 | 224:6 | effected 16:7 |
| disturbance | 201:20 | 218:16 | 120:19 | 225:15 | 21:15 |
| 173:14 | 202:6,9,17 | 223:18 | 123:7 | 232:14 | 220:22 |
| disturbed | 203:9,11,20 | 231:5 235:5 | DUFLOW | 236:22 | 228:17 |
| 90:16 | 204:1,9,12 | 238:9 | 178:12 | East 2:6 | 245:5 |
| 135:19 | 205:17 | 239:24 | dull 55:12 | easy 212:8 | effecting |
| 137:2 | 206:9,13 | 240:6 241:5 | duly 214:16 | echo 172:15 | 23:12 45:13 |
| 174:14 | 207:20 | downstream | dumping | ecological | 45:18 52:21 |
| divers 32:8 | dominated | 28:15 | 233:24 | 62:6,8,8,21 | 96:8 150:1 |
| diverse 116:1 | 115:2 208:4 | 219:12 | duplicative | 171:10 | 167:24 |
| 116:5 | 208:7,12 | dozens 69:16 | 117:8 | 236:8 | effective 76:1 |
| diversity | 209:16 | 148:18 | during 8:11 | 237:10 | 76:2,6 |
| 60:17 61:4 | 210:4 | Dr 6:17 | 77:12 78:17 | 240:8,22 | 216:12,14 |
| 115:18 | done 5:11 | 34:12,23 | 80:23 | economically | 223:8 |
| 173:8 | 18:4 19:2 | 76:8 120:16 | 150:16 | 240:14 | 245:17,19 |
| 194:11 | 46:9 63:8 | 120:18 | 185:3 220:8 | ecosystem | effectively |
| 234:3 | 80:15 94:2 | 178:13 | 246:11 | 216:7 217:1 | 13:15 57:6 |
| docket 4:9 | 100:17,20 | 210:11 | dwellers | Ed 135:13 | 245:7 |
| 221:18 | 109:10 | 214:2,13 | 230:13 | edge 219:9 | effectiveness |
| document | 127:6 | 215:2,17 | 231:19,24 | 220:12 | 75:9 216:15 |
| 9:20 38:5 | 200:19 | 217:21 | 235:6,9 | edited 170:13 | effects 23:21 |
| 133:11 | 211:16,17 | 222:3,11 | dying 247:22 | edition | 45:4 46:4,6 |
| 158:19 | 213:10 | 224:20 | dynamics | 170:10,13 | 97:8 175:4 |
| 170:6,16 | 217:6,23 | 228:24 | 173:16 | education | 194:2 201:7 |
| 171:9,16 | 219:5 | 247:21 | | 215:22 | 246:12 |
| | | | E | | |

| | | | | | |
|---|---|---|--|--|---|
| Effluent 1:3 4:5 | electrofished 75:17 | 123:15 125:10 | 190:19 191:1 | 72:12 245:13 | Ettinger 2:13 3:4,9 8:20 |
| effluents 94:20 | electrofishi... 60:3,5 75:9 | 133:3 134:6 134:23 | ensure 106:14 | equals 180:14 | 10:2 12:15 12:23 14:6 |
| effort 6:20 72:3 82:2 117:10 119:3,9 120:13 143:14 200:15 | 75:12,13,14 75:18,22,23 76:6,10 243:16,21 243:23 244:12,13 244:15,19 244:23 | 140:2 156:11 168:1 169:21 171:1 172:15 174:6 181:5 181:24 | entailed 200:5 enter 170:12 171:13 215:1 entered 6:1 79:3 215:11 | equation 146:18 147:14 181:3 equipment 30:20 244:14 249:1 | 14:9,10 34:24 35:9 35:13,17,21 37:24 38:6 38:12,15 39:17 40:6 40:18,22 41:7 43:8 |
| efforts 217:2 | 245:3,4,12 | 182:8 183:8 | entering 215:24 216:2,10 222:14 224:2 | erode 113:23 eroded 63:4 113:22 | 48:24 49:1 53:6,10 55:10,16,18 57:15,22 |
| eggs 234:13 | 245:19,23 | 185:13 | entire 44:5 94:22 107:2 114:2 119:17,19 119:20,23 120:1 199:12,13 230:18 249:5 | erosion 106:24 107:3,15,21 107:23 200:14 | 57:15,22 63:12,20,21 67:18 71:11 71:12 74:24 75:2 76:11 76:12 78:11 79:7,11,21 79:22 80:8 83:3,10,13 87:22 88:1 |
| eight 11:16 22:19 33:10 85:21 99:19 118:20 124:22 127:24 133:24 184:10 218:10 | 246:5,9,10 electronica... 39:1 80:3 237:2 | 187:18 188:1 194:14 195:15 199:4,8 202:3,6 204:6 208:5 | ended 51:24 110:21 endocrine 45:4 engaged 118:18 engineer 118:1 engineering 118:11,12 118:15,19 118:21 | err 153:24 error 7:16 11:10 especially 249:23 essence 217:18 essentially 71:22 73:13 establish 99:23 established 61:23 62:3 112:4 118:7 213:5 establishing 174:12 establishm... 174:4 | 83:3,10,13 87:22 88:1 88:13,18,21 89:20 90:3 91:8 92:1 95:1,8,12 95:16 97:19 97:23 99:1 99:2 102:23 105:10 107:24 108:2,9 116:13 141:20 142:14,19 142:23 143:4 157:12,17 157:21 158:3,8,13 158:19 159:21 160:21 161:8,12 168:9 175:9 175:17,23 |
| either 17:4,6 38:12 40:16 103:1 139:16 142:23 151:18 187:10 194:18 241:7 | 117:7 219:11 eliminated 26:11 27:10 61:16 147:22 148:4 150:10,16 151:15 195:14 | ended 51:24 110:21 endocrine 45:4 engaged 118:18 engineer 118:1 engineering 118:11,12 118:15,19 118:21 | entirely 44:9 195:15 entities 101:19 entitled 1:8 4:4 170:23 179:22 181:20 envelope 120:8 environment 233:21 environme... 2:2,3,6,13 47:12 118:1 118:2,5,11 118:19 180:6 EPA 41:6 71:2 121:22 122:5 146:7 210:16 EPA's 8:19 equally 72:6 | err 153:24 error 7:16 11:10 especially 249:23 essence 217:18 essentially 71:22 73:13 establish 99:23 established 61:23 62:3 112:4 118:7 213:5 establishing 174:12 establishm... 174:4 estimate 140:8 145:9 estimated 243:17 estimates 199:19 et 116:3 136:6 233:18 ethical 118:8 | 79:7,11,21 79:22 80:8 83:3,10,13 87:22 88:1 88:13,18,21 89:20 90:3 91:8 92:1 95:1,8,12 95:16 97:19 97:23 99:1 99:2 102:23 105:10 107:24 108:2,9 116:13 141:20 142:14,19 142:23 143:4 157:12,17 157:21 158:3,8,13 158:19 159:21 160:21 161:8,12 168:9 175:9 175:17,23 |
| elaborate 84:4 207:5 | eliminates 195:16 | Engineers 59:9,16 99:9 118:2 118:6 198:15,19 216:17 219:5 | English 229:20 230:6 enough 18:18 27:23 28:2 28:3 55:8 63:9 66:6 72:7,10,11 102:2 | essence 217:18 essentially 71:22 73:13 establish 99:23 established 61:23 62:3 112:4 118:7 213:5 establishing 174:12 establishm... 174:4 estimate 140:8 145:9 estimated 243:17 estimates 199:19 et 116:3 136:6 233:18 ethical 118:8 | 83:3,10,13 87:22 88:1 88:13,18,21 89:20 90:3 91:8 92:1 95:1,8,12 95:16 97:19 97:23 99:1 99:2 102:23 105:10 107:24 108:2,9 116:13 141:20 142:14,19 142:23 143:4 157:12,17 157:21 158:3,8,13 158:19 159:21 160:21 161:8,12 168:9 175:9 175:17,23 |
| electric 216:9 216:19 217:5,8,17 219:18,20 220:19,22 221:1,6 222:13,15 223:1,3,5 223:10 224:3,7,15 224:17 245:2,16 247:9,12,14 | eliminating 26:7 elsewhere 27:5 87:8 89:18 119:13 123:24 emerge 234:13 emergent 176:12 encountered 54:21 end 37:6 118:2 122:2 | ended 51:24 110:21 endocrine 45:4 engaged 118:18 engineer 118:1 engineering 118:11,12 118:15,19 118:21 Engineers 59:9,16 99:9 118:2 118:6 198:15,19 216:17 219:5 English 229:20 230:6 enough 18:18 27:23 28:2 28:3 55:8 63:9 66:6 72:7,10,11 102:2 | entirely 44:9 195:15 entities 101:19 entitled 1:8 4:4 170:23 179:22 181:20 envelope 120:8 environment 233:21 environme... 2:2,3,6,13 47:12 118:1 118:2,5,11 118:19 180:6 EPA 41:6 71:2 121:22 122:5 146:7 210:16 EPA's 8:19 equally 72:6 | err 153:24 error 7:16 11:10 especially 249:23 essence 217:18 essentially 71:22 73:13 establish 99:23 established 61:23 62:3 112:4 118:7 213:5 establishing 174:12 establishm... 174:4 estimate 140:8 145:9 estimated 243:17 estimates 199:19 et 116:3 136:6 233:18 ethical 118:8 | 83:3,10,13 87:22 88:1 88:13,18,21 89:20 90:3 91:8 92:1 95:1,8,12 95:16 97:19 97:23 99:1 99:2 102:23 105:10 107:24 108:2,9 116:13 141:20 142:14,19 142:23 143:4 157:12,17 157:21 158:3,8,13 158:19 159:21 160:21 161:8,12 168:9 175:9 175:17,23 |
| electro 245:5 electrodes 245:10 | end 37:6 118:2 122:2 | ended 51:24 110:21 endocrine 45:4 engaged 118:18 engineer 118:1 engineering 118:11,12 118:15,19 118:21 Engineers 59:9,16 99:9 118:2 118:6 198:15,19 216:17 219:5 English 229:20 230:6 enough 18:18 27:23 28:2 28:3 55:8 63:9 66:6 72:7,10,11 102:2 | entirely 44:9 195:15 entities 101:19 entitled 1:8 4:4 170:23 179:22 181:20 envelope 120:8 environment 233:21 environme... 2:2,3,6,13 47:12 118:1 118:2,5,11 118:19 180:6 EPA 41:6 71:2 121:22 122:5 146:7 210:16 EPA's 8:19 equally 72:6 | err 153:24 error 7:16 11:10 especially 249:23 essence 217:18 essentially 71:22 73:13 establish 99:23 established 61:23 62:3 112:4 118:7 213:5 establishing 174:12 establishm... 174:4 estimate 140:8 145:9 estimated 243:17 estimates 199:19 et 116:3 136:6 233:18 ethical 118:8 | 83:3,10,13 87:22 88:1 88:13,18,21 89:20 90:3 91:8 92:1 95:1,8,12 95:16 97:19 97:23 99:1 99:2 102:23 105:10 107:24 108:2,9 116:13 141:20 142:14,19 142:23 143:4 157:12,17 157:21 158:3,8,13 158:19 159:21 160:21 161:8,12 168:9 175:9 175:17,23 |

| | | | | | |
|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| 176:6,9 | 105:1 119:6 | 241:9 | 110:15 | 3:14,15,16 | 86:9 |
| 209:18 | 119:14 | every 202:12 | 119:22 | 3:17 5:8 6:1 | exotic 174:5 |
| 225:2,17 | 121:2,3,15 | 203:7 | 125:23 | 8:20,22 9:2 | expand 66:24 |
| 226:1 228:7 | 121:23 | 238:23 | 131:5 140:7 | 9:10,14,16 | expansion |
| 229:2,8 | 122:6 139:1 | 239:2 | 142:16 | 9:19,20 | 100:3 |
| 230:4,17 | 141:5 | everybody | 143:16 | 10:8 12:12 | expect 21:23 |
| 231:2,6,8,9 | 155:15 | 88:15 | 144:7 160:3 | 12:13,17,17 | 22:5 65:1 |
| 236:1,6,14 | 159:1 | everyone 4:2 | 190:2 | 39:15,17,24 | 66:14,20 |
| 236:21 | 167:17 | 116:17 | 199:19 | 40:13 78:22 | 76:17 82:12 |
| 237:3,19 | 169:3,10 | 214:7 | 200:8 228:4 | 79:3 170:14 | 84:1,22,24 |
| 238:8 239:1 | 170:22 | everything | 234:6 | 170:15,16 | 85:6,20 |
| 239:15 | 179:21 | 10:7 61:11 | examples | 171:14,14 | 113:13 |
| 242:24 | 181:19 | 151:6 | 15:18 55:4 | 171:16 | 115:24 |
| 246:6,8 | 182:24 | 231:21 | 153:7,12 | 215:3,11,12 | 177:11 |
| 247:18,20 | 186:2,21 | 235:7 | excavated | 236:7 | 183:20 |
| 247:22 | 191:13 | 236:19 | 195:1 | 237:15,16 | 202:24 |
| 248:5 250:1 | 192:2 | everywhere | excavating | 237:17,24 | 235:8 |
| 250:5 | 193:16 | 25:14 30:10 | 200:11 | exhibited | expectation |
| Ettinger's | 197:20 | 135:5 | exceedance | 150:22 | 67:15 |
| 9:23 117:9 | 203:8,18 | evidence | 82:1 | exhibits 8:24 | expected |
| evaluate 23:7 | 211:24 | 139:12,19 | exceedances | 229:20 | 206:24 |
| 47:16 72:9 | 216:16 | evident 73:13 | 82:4 | exist 17:4,6 | expecting |
| 77:16,18 | 242:4,5 | evolved | exceeded | 18:15 57:4 | 115:17 |
| 99:15 | evasive | 174:1 | 81:8,11,13 | 91:5 104:8 | expense |
| 108:24 | 215:23 | exact 11:4 | 81:16 | 135:21 | 236:11 |
| 144:11 | 216:2 | 37:21 53:16 | 156:21,22 | 195:2,4,7,7 | expensive |
| 153:16 | even 13:16 | 126:23 | 159:10,13 | 196:7 201:2 | 106:16 |
| evaluated | 33:5 110:22 | 142:4 | 159:16,19 | 201:12,14 | experience |
| 18:13 27:15 | 140:18 | exactly 29:10 | 161:18 | 204:5 | 118:22 |
| 36:17 77:3 | 141:7 | 48:12 | 162:11 | existed 27:17 | 174:2 |
| 77:9,13 | 143:23 | 108:19 | 165:8 166:2 | 154:9 | experiments |
| 78:15 80:21 | 148:19 | 123:20 | exceeding | 194:24 | 249:10 |
| 101:7 | 155:8 | Examination | 195:22 | existence | expert 75:23 |
| 159:18 | 163:21 | 3:4,8,9 | Excel 40:14 | 136:3 | 83:7 167:10 |
| 181:16 | 186:16 | examinatio... | excellent | 220:18 | 244:15 |
| evaluating | 220:20 | 118:24 | 43:23 | 221:6 | experts 121:4 |
| 61:16 140:8 | 229:22 | examine 30:4 | 143:24 | 222:12 | explain 34:13 |
| evaluation | 231:14 | 30:6 | except 25:12 | existing 11:5 | 41:9 64:4 |
| 13:6 14:4 | 242:14 | examining | 126:20 | 16:22 17:5 | 67:2 69:4 |
| 14:21 20:5 | event 81:9 | 27:16 | 132:5 220:8 | 17:7 19:3 | 96:7 110:8 |
| 23:3 26:2 | 161:21 | example | 238:23 | 27:15,19 | 119:3 122:4 |
| 29:8 33:2 | 244:2 | 17:10 26:20 | exchange | 86:2 104:19 | 123:21 |
| 37:16 46:10 | events 110:18 | 28:7 33:4 | 194:20 | 107:21 | 125:3,5 |
| 50:20 54:20 | 220:8 | 33:20,21 | exciting | 120:3 | 129:7,11,14 |
| 56:17 59:24 | eventually | 64:22 65:11 | 40:19,21,23 | 122:19 | 130:3,6,18 |
| 62:1 71:15 | 48:11 | 68:2 92:3 | 88:4 | 123:8 128:2 | 136:13,19 |
| 77:2 79:14 | ever 39:9 | 93:3,4 | excuse 35:3 | 158:18 | 138:21 |
| 88:7 92:12 | 113:19 | 102:3 | 137:14 | 186:5 202:3 | 145:17 |
| 100:24 | 132:20 | 104:12 | exhibit 3:13 | exists 13:13 | 148:2 150:9 |

| | | | | | |
|----------------------|---------------------|----------------------|-----------------------|-----------------------|----------------------|
| 150:18 | 119:3,5 | 27:17 28:7 | favorable | 217:5 | 55:20 78:3 |
| 152:9 | 186:12 | 32:9 52:8 | 65:11 | 220:22 | 96:17 101:4 |
| 154:23 | 190:3,6,12 | 71:20 72:5 | feasibility | 221:2 223:6 | 114:7 |
| 156:12 | extra 246:7 | 72:12,19 | 217:3 236:7 | 223:10 | 157:13 |
| 159:6 171:6 | extracted | 76:21 77:18 | 237:10 | 224:4,16,17 | 161:23 |
| 172:16 | 148:10 | 78:2 89:9 | 242:10 | 245:2 | 162:16 |
| 174:6 178:5 | 151:14 | 89:13,17 | 243:4,9 | 247:12 | 167:5 191:3 |
| 181:3,15,23 | 169:5 172:6 | 90:11,12 | feasible | fields 245:5 | 239:4 |
| 183:3,10 | eye 30:22 | 91:18,21 | 200:1 | fifth 4:20 | 247:13 |
| 185:1,22 | 249:11 | 110:1,24 | 240:14 | figure 8:21 | 249:19 |
| 186:8 190:7 | eyes 249:20 | 135:15 | features | 12:8 19:8 | finding 32:10 |
| 195:15 | | 136:4,13,16 | 119:24 | 22:20 26:2 | 113:9 |
| 196:5 200:2 | F | 136:19 | 120:1 | 32:23 33:24 | 154:20,24 |
| 202:5 204:7 | facilitate | 147:2 169:7 | 123:10 | 37:3 41:9 | 156:13,14 |
| 205:22 | 196:13 | 187:17 | 139:13 | 41:12,15 | 157:6 159:7 |
| explainable | fact 12:5 | 233:23 | 248:10,20 | 50:7 51:11 | 182:12 |
| 55:5 | 25:23 45:17 | facts 158:2 | 248:20,21 | 51:11,13,16 | 183:9 |
| explained 7:6 | 66:22 85:3 | 175:18 | 249:16 | 57:12,18 | 185:19,20 |
| 37:9 136:2 | 87:6 90:24 | faded 48:3 | February | 59:6 60:6 | 186:22 |
| 136:3,10,12 | 111:7 | fail 162:16 | 214:21 | 69:22 73:11 | 187:19 |
| 136:14 | 143:19 | failed 30:8 | 215:3 | 88:8 128:3 | 191:12 |
| 137:23 | 145:17 | failure 174:3 | 225:18 | 128:8 | 198:23 |
| 138:23 | 166:22 | fair 221:13 | feed 23:13 | 149:24 | findings |
| 157:11 | 177:7 | fairly 15:15 | feeders 63:6 | 151:8 | 42:17 43:12 |
| 163:18 | 178:20 | 22:4 212:5 | feel 117:12 | 179:22,24 | 172:4 186:1 |
| 182:7 | 199:16 | 220:7,14 | 117:12 | 182:24 | finds 222:4 |
| 185:17 | 202:16,19 | 239:21 | 197:14 | figured 61:3 | fine 13:7,10 |
| 186:12 | 204:15 | familiar | 244:17 | figures 40:9 | 13:11,14 |
| 190:5 | 207:16 | 17:23 104:8 | feels 215:9 | 49:3 59:10 | 14:14 22:17 |
| explaining | 212:5 | 127:4 | feet 30:6 | 61:4 | 48:3 65:11 |
| 183:11 | factor 22:18 | 171:24 | 243:18 | filed 214:21 | 114:3,15,16 |
| 184:13 | 37:7 52:21 | 246:4 | 245:20 | 215:2 | 115:2 |
| 186:16 | 53:5 61:19 | familiarly | felt 31:24 | 225:18 | 175:14 |
| explains | 66:21 67:5 | 224:17 | 180:21 | fill 13:15 | 214:6 222:4 |
| 134:5,11 | 67:17 69:2 | family 133:5 | few 15:24 | filled 103:21 | finish 150:10 |
| explanatory | 72:15 90:18 | 133:8 | 33:3 83:15 | filling 103:5 | fin 63:4 |
| 130:2,10 | 91:11 92:5 | fancy 81:19 | 105:14 | fills 14:12 | first 5:14 |
| explicitly | 96:18 | far 4:15 9:18 | 110:22 | filtered 60:10 | 35:2 56:8 |
| 121:24 | 132:10,11 | 12:12 18:1 | 156:9 157:6 | final 60:16 | 80:18 92:10 |
| 122:1,6 | 132:14,15 | 28:10 36:16 | 166:17 | 124:4,15 | 93:1 95:19 |
| explore 240:7 | 132:16 | 61:3 108:6 | 169:8 211:8 | 147:21,21 | 101:15 |
| exploring | 138:21 | 165:14 | 215:19 | 149:5 | 117:19 |
| 217:3 | 154:3 156:1 | 186:3 212:9 | 227:23 | finally 5:16 | 119:16 |
| express 6:13 | 167:1 | 225:20 | fewer 26:6 | 118:23 | 123:15 |
| extensive | 174:12 | 232:7 | 61:10,17 | 194:4 | 124:13 |
| 119:6,12,13 | 177:16 | fascinating | 203:23 | find 21:11 | 132:12 |
| extent 20:20 | 189:6 | 248:5 | field 43:15,17 | 25:18,20 | 137:18 |
| 27:24 53:13 | factors 17:2 | fast 231:19 | 58:9 118:12 | 44:8 50:3 | 143:15 |
| 115:10,13 | 17:5 18:13 | favor 216:19 | 119:16 | 52:4 55:12 | 144:2 170:6 |
| | 18:22 20:12 | | | | |

| | | | | | |
|----------------------|-------------|-------------|----------------------|-----------------------|----------------------|
| 187:19 | 80:24 81:9 | 157:10 | 202:21 | 221:24 | 53:2,4 |
| 188:11 | 81:11,24 | 159:6,9,11 | 203:4,9,10 | fit 180:2 | 114:23 |
| 201:18 | 82:3,9,11 | 160:24 | 203:11 | fits 180:24 | 171:11 |
| 205:24 | 82:12,13,22 | 161:1,9,9 | 204:2,10,13 | five 62:6,8,18 | 172:12,13 |
| 212:13 | 83:5 84:2 | 161:17,21 | 204:20,23 | 62:20 70:12 | 172:18 |
| 214:16 | 84:10,22 | 162:4,10,21 | 205:8 206:9 | 70:21 71:3 | 173:4,12,21 |
| 215:21 | 85:3,4,8,18 | 163:4,19,20 | 206:23 | 111:15 | 173:23 |
| 227:23 | 86:1,14,15 | 164:4,12,13 | 207:10 | 123:5 | 174:2,11,13 |
| 241:1 248:6 | 86:16,17,18 | 164:16 | 208:8,12,14 | 129:23 | 175:1,7 |
| fiscal 217:12 | 86:23 87:10 | 165:13,15 | 209:15,15 | 130:1,5 | 176:18 |
| fish 7:7,7,9 | 87:11 89:5 | 165:22 | 211:9,10,15 | 183:2 | 177:1,6,15 |
| 7:10,17 | 96:8 97:21 | 166:17 | 211:20 | 184:17 | 177:21,21 |
| 10:11,12,13 | 99:6 100:14 | 167:1,8,11 | 212:2,4,6 | 190:10,12 | 178:3,16,21 |
| 10:15,16 | 101:6 | 167:21,24 | 212:12,14 | 190:14 | 179:13,13 |
| 11:22 12:8 | 105:18 | 167:24 | 212:15 | 191:7,7 | 179:15,15 |
| 13:24 15:6 | 108:4,6 | 173:17 | 213:4,10,10 | 193:10 | 193:17 |
| 16:7 17:10 | 110:1,16,22 | 175:8 | 213:13,15 | 203:2,15 | 201:8 233:1 |
| 22:2,2,6 | 115:11,13 | 176:19 | 213:18 | 219:17 | 233:18 |
| 23:8,12,12 | 116:1 122:1 | 177:9 178:3 | 216:9,19 | 229:9 | 234:1 238:6 |
| 23:13,14,18 | 122:7,11,17 | 178:18,19 | 217:8,19 | 241:23 | flows 50:11 |
| 23:21 25:23 | 122:20,24 | 179:23 | 218:12 | fixed 74:13 | 50:12,15,21 |
| 25:24 26:4 | 123:14,16 | 180:2,3,4 | 219:11 | flashiness | 51:19 173:6 |
| 26:6,9 27:6 | 123:19,20 | 180:18 | 221:7,23 | 52:24 53:17 | 195:21,21 |
| 27:6,18,19 | 123:24 | 181:4,12,16 | 222:13 | 53:19 54:4 | 220:7,8 |
| 28:1,13,16 | 124:5 128:5 | 181:24 | 223:1 224:7 | 54:21,21 | 233:5,8 |
| 29:3 31:20 | 128:9,11,15 | 182:6,8,13 | 224:16,18 | 55:1,13,19 | 242:18 |
| 31:21 37:10 | 128:18,20 | 182:16,18 | 228:18 | flashy 55:11 | fluctuations |
| 43:19,21 | 129:1,2,3,7 | 183:5,10,17 | 229:10,11 | 55:20 56:5 | 136:6 |
| 45:14,15,19 | 129:12,21 | 183:22 | 229:15 | flood 196:14 | fluvial 14:22 |
| 45:20 46:3 | 130:3,8,19 | 184:3,7,14 | 230:8,10,15 | flooding | focus 70:10 |
| 46:4,4,6 | 130:22 | 184:18 | 232:21 | 196:10 | 94:16 |
| 51:21,23 | 132:5 133:2 | 185:16,23 | 233:21 | floodplain | focused |
| 52:6,21 | 133:21,21 | 186:4,8,12 | 234:9,9 | 193:20 | 226:17 |
| 54:13,22,24 | 134:6,9,14 | 186:17,24 | 239:13 | 194:8,15,18 | 228:1 |
| 55:2,8 | 136:13 | 187:4,10,17 | 244:4,20 | 195:8,14,16 | 242:14 |
| 56:13 57:2 | 137:21 | 187:22 | 245:4,7,12 | 195:24 | focuses |
| 57:7 60:1,7 | 138:1,16 | 188:6 189:8 | 247:10 | 196:3,3 | 230:18 |
| 60:8 61:16 | 139:14 | 189:10,12 | fisheries | 220:16 | focusing |
| 61:18,22 | 145:15 | 189:14,19 | 126:13 | floodplains | 66:18 92:13 |
| 62:2,19 | 147:7 | 191:16 | 131:4 170:9 | 194:11,23 | 119:11 |
| 65:4,8,9,16 | 149:17 | 192:15 | 170:12 | 195:4,7 | follow 42:2 |
| 65:21,24 | 152:7 | 193:13,24 | 183:7 185:9 | 196:6,7 | 47:10 52:19 |
| 66:2,21 | 153:19 | 194:10 | 198:6 | floods 116:16 | 82:17 83:21 |
| 67:13 71:17 | 154:21,23 | 196:22 | fishery 61:23 | 173:14 | 88:11 99:19 |
| 71:20 76:15 | 155:5,11,18 | 201:2,5,19 | 198:17 | flourish | 104:5 |
| 76:17,20 | 155:22 | 201:20,22 | 216:6,24 | 235:20 | 108:24 |
| 77:4,21 | 156:2,7,9 | 202:1,6,7,9 | 237:8 | flow 51:8,9 | 124:23 |
| 78:18,20 | 156:15 | 202:11,15 | fishing 170:1 | 51:10,17,21 | 137:12 |
| 79:18 80:11 | 157:1,3,6 | 202:17,19 | 170:4 | 52:3,20 | 164:6 177:4 |

| | | | | | |
|----------------------|---------------------|----------------------|-------------|-----------------------|----------------------|
| 204:21 | 163:7 | 127:13,14 | 15:6 16:24 | 184:6 185:8 | functional |
| 205:16 | 172:17 | 128:13,19 | 17:20 22:1 | 186:9 | 223:22 |
| 232:5 | 182:19 | 133:18 | 22:2,6,7 | 187:17,24 | 232:17 |
| following | 184:2 | 136:22 | 25:12 26:4 | 188:21 | 235:18 |
| 5:17 63:16 | 196:19 | 137:10 | 26:11 27:3 | 190:19 | functionality |
| 116:23 | 197:20 | 143:9 149:1 | 27:3,4,10 | 194:2,3 | 240:21 |
| 118:22 | 198:5 | 153:4 158:1 | 28:10,15 | 195:6,21 | functions |
| 193:2 | 207:19,23 | 158:14,21 | 30:16 32:17 | 198:15 | 236:3 |
| 214:10 | 208:10 | 158:23 | 32:18 33:10 | 199:21 | 240:16,19 |
| follows 118:7 | 210:2 | 160:2,9,14 | 33:23 35:6 | 200:12 | fundamental |
| 214:17 | 231:16,20 | 161:13 | 36:11,14 | 203:22 | 178:22 |
| follow-up 6:2 | 246:17 | 165:19 | 41:5 43:10 | 214:22 | 233:17 |
| 143:10 | 247:5,16 | 166:8 | 43:12,22 | 215:23 | 235:14 |
| food 23:14 | 249:10 | 168:19 | 44:3 46:12 | 216:2,10 | 240:6 |
| 45:21,23 | four 31:12 | 170:3,18,20 | 47:2 50:21 | 218:12,20 | funded |
| 149:15 | 36:18 42:22 | 171:22 | 51:20 55:9 | 221:9 | 105:21 |
| 203:19,23 | 47:13,17 | 176:16 | 57:9 59:11 | 222:23 | funding |
| force 47:12 | 76:3,4 98:5 | 177:18 | 60:11 62:3 | 224:1 | 107:16,16 |
| 245:2,6,9 | 110:21 | 178:14 | 66:14 67:11 | 226:20,21 | funky 99:17 |
| forced | 121:7 | 179:8 | 70:6 71:2,5 | 230:6,7,16 | further 48:10 |
| 106:10 | 185:18 | 185:11 | 74:16 75:4 | 230:17 | 76:9 108:10 |
| foregoing | 191:14 | 191:11 | 75:15 76:22 | 232:6 | 144:11,11 |
| 251:8 | 201:20 | 192:21 | 78:9,14 | 234:13 | 154:23 |
| forget 19:10 | 203:2,16 | 193:5,7,8 | 81:5 83:11 | 238:11 | 172:16 |
| forging 65:9 | 208:1 | 206:18 | 84:2 87:5 | 239:11 | 174:6 |
| formed | 217:11 | 208:20 | 97:9 100:3 | 240:9 244:7 | 175:23 |
| 222:24 | 228:16 | 210:1,7,9 | 108:7 | 245:15 | 185:2 200:2 |
| forms 228:17 | 231:11,13 | 211:3 222:2 | 111:17 | 246:12,18 | 207:6 211:4 |
| Forty-seven | 241:23 | 222:8 | 119:20 | 247:14 | future |
| 198:2 | 245:20 | 236:12,15 | 120:12,22 | 251:10 | 100:17 |
| forward 6:21 | fraction | 236:24 | 125:6 | front 12:4 | 107:4,5 |
| 153:2 217:7 | 114:4 | 237:4 | 126:16 | 26:13 37:22 | |
| 230:23 | France 15:18 | Fred 8:12 | 132:17 | 74:4 78:7 | G |
| found 7:16 | Franzetti | FREDRICK | 133:12 | 79:24 80:1 | G 4:11 |
| 12:5 20:23 | 39:13,18 | 2:16 | 134:6 135:3 | 86:5,13 | gaps 13:15 |
| 21:5 26:23 | 40:4,4,20 | free 34:22 | 135:14 | 87:19 97:4 | Gary 2:4 |
| 42:9,10 | 52:18 53:8 | 117:13 | 139:16 | 206:1 207:9 | 4:13 |
| 50:8 89:10 | 53:11,21 | frequent | 145:21 | fruit 110:13 | gathering |
| 89:13,18 | 54:3,10,17 | 97:16,17 | 156:15,17 | fruitful 24:19 | 111:11 |
| 107:12 | 68:11,11,15 | 207:19 | 156:18 | full 125:9 | gave 68:17 |
| 108:20 | 68:23 69:6 | frequently | 158:7 | fully 41:6 | 153:6 |
| 112:1,5 | 70:11 87:13 | 39:24 | 160:22 | 117:10 | 236:22 |
| 121:24,24 | 87:14,21 | 169:13 | 163:9 | full-time | gear 75:9,12 |
| 122:6 136:9 | 88:10 110:5 | 209:22 | 167:20 | 118:20 | gee 238:18 |
| 138:17 | 110:6,6 | friends 38:13 | 172:4,20 | function 62:6 | general 16:12 |
| 155:6,11 | 111:3 117:1 | 101:18 | 173:14 | 62:9,11,12 | 29:20 47:22 |
| 156:24 | 117:3,4 | from 4:17 7:2 | 177:2 180:9 | 62:21 | 48:13 64:24 |
| 159:15,24 | 124:24 | 12:2 13:7 | 181:24 | 145:20 | 65:1 76:21 |
| 162:3 163:2 | 126:3,5 | 13:10,23 | 183:13,15 | 196:13 | 111:5 |
| | | | | | 116:16 |

| | | | | | |
|-----------------------|---------------------|----------------------|----------------------|----------------------|---------------------|
| 156:24 | 69:7,9 | 63:19,22,23 | 144:5,7 | 125:12 | 216:24 |
| 208:8 | 74:18 78:1 | 82:19 83:14 | 145:5 150:9 | 126:2 | 217:1 224:2 |
| 241:14 | 89:22 108:3 | 83:24 88:5 | 152:24 | 127:10 | 236:9,11 |
| generalist | 129:22 | 89:22 | 153:5,24 | 129:3 | 237:8,11 |
| 63:6 | 144:3 179:9 | 106:13 | 156:5 157:4 | 135:10 | 240:9 |
| generalizat... | gill 203:5 | 110:20 | 164:1 168:6 | 138:18 | 241:21 |
| 229:17 | Girard 2:3 | 116:19 | 168:20 | 143:24 | greater |
| generally | 4:11 6:17 | 117:15 | 169:15,23 | 151:7 159:5 | 140:15 |
| 13:11,22 | 6:18 98:20 | 119:18,22 | 179:12 | 161:9 167:7 | 162:12 |
| 14:18 30:9 | 98:24 111:4 | 141:22 | 182:20,21 | 175:20 | 186:3 |
| 31:7 42:7 | 112:9,21,23 | 143:15 | 183:16 | 180:2,12,15 | 190:12 |
| 47:2 53:23 | 113:7 | 150:12 | 189:3,23 | 180:20 | 191:7 |
| 54:22 65:10 | 114:22 | 152:18 | 190:17 | 208:13 | greatest |
| 66:14 67:12 | 115:7,16 | 158:5 | 193:9 | 215:17 | 150:22 |
| 67:16 83:16 | 209:5 | 160:11 | 196:20 | 236:2 | 181:12 |
| 114:5,6 | give 38:9 | 164:15 | 198:1 | 244:18 | 188:5 |
| 119:10 | 42:22 53:12 | 192:19 | 206:19 | goodness | group 85:8 |
| 143:20 | 89:2 97:21 | 193:4,9 | 211:18 | 125:11 | 85:11 86:23 |
| 205:7,11 | 110:13 | 213:11 | 213:7 214:3 | Goose 59:15 | 123:24 |
| 227:12 | 125:10 | 225:19,22 | 214:4,5,22 | gotten 12:12 | 153:22 |
| 245:3,14 | 143:16 | 227:7 | 215:7 | governor | 202:11 |
| generated | 153:12 | 229:22 | 217:18 | 18:20 | 203:7 |
| 126:6 | 182:20 | 243:14 | 224:16 | grade 125:16 | grouped |
| 135:16 | 199:19 | 250:2 | 228:16 | 125:23 | 153:18 |
| generates | 210:7 | goal 127:10 | 229:21,22 | 126:1 | grow 64:11 |
| 92:18 | 219:13 | goes 40:13 | 231:10 | gradient | 64:14 |
| Generation | 236:22 | 121:21 | 233:9,20,23 | 125:14 | 234:16 |
| 5:10,15,21 | given 10:18 | 159:2 | 236:22 | gradients | growth 64:3 |
| 40:5 68:12 | 19:9 21:13 | 180:13 | 237:21 | 151:2 | guarantee |
| 110:7 | 41:14 87:7 | 189:12 | 238:20 | grading 49:6 | 240:21 |
| 116:21 | 134:8 | going 9:15,18 | 243:14 | Grand 2:6 | guess 11:12 |
| 117:5 | 139:10 | 22:5 23:7 | 244:16 | grant 107:16 | 42:14 50:13 |
| 158:10 | 154:4,16 | 24:24 28:5 | gold 249:4,9 | graphs 40:8 | 58:20 76:16 |
| Generation's | 161:10 | 32:11 48:11 | gone 10:8 | grateful 6:19 | 100:15,15 |
| 157:24 | 200:9 207:1 | 66:22,23 | 105:11 | gravel 13:14 | 175:23 |
| geo 248:15 | 221:6 | 68:4 71:13 | 107:13 | 14:12 65:8 | 208:16 |
| geographic | 222:22 | 71:23,24 | 111:24 | 66:15 93:9 | 230:6 |
| 16:1 248:16 | 230:21 | 87:5 88:14 | 228:8 | 93:10 233:6 | guys 9:1 |
| geological | giving 43:10 | 95:12 96:23 | 234:21 | 233:24 | 239:20 |
| 114:23 | 69:18 | 97:6,9 | good 4:1 6:18 | 234:7,10,11 | |
| geologist | go 5:10 9:15 | 108:1 117:5 | 25:18 26:19 | gravels | H |
| 230:21 | 10:7 11:15 | 121:6 | 38:13 41:22 | 114:13 | H 3:10 |
| geology | 22:7,19 | 124:20 | 42:4 43:23 | great 25:20 | habit 119:14 |
| 173:5 | 24:18 25:16 | 127:3,22 | 51:23 64:24 | 26:1,14 | habitat 7:11 |
| gets 22:16 | 26:16 28:5 | 129:6 | 65:2 68:3 | 60:15 | 13:5,8,12 |
| 149:5 | 34:21 37:12 | 130:13 | 76:11 92:4 | 117:18 | 14:4,21,22 |
| 189:14 | 40:24 45:3 | 131:16,17 | 97:1 101:22 | 130:11 | 14:22 15:22 |
| getting 66:13 | 52:13 53:22 | 132:16 | 102:1 117:3 | 198:16 | 16:1,3 17:2 |
| 68:19 69:2 | 60:13 61:4 | 143:11 | 118:8 | 216:6,6,24 | 18:14 19:16 |
| | | | | | 19:19 20:5 |

| | | | | | |
|-------------|-------------|-------------------|---------------------|----------------------|---------------------|
| 23:2,3,5,9 | 122:19,21 | 186:23,24 | 182:8 | health 10:16 | 183:22 |
| 23:20 24:8 | 123:6,8,12 | 187:2,4,10 | 199:23 | 61:23 66:21 | 197:2,4,7 |
| 27:13,21 | 123:15 | 187:15,18 | hand 6:4 | 159:6 164:4 | highest |
| 28:12 29:8 | 128:2,5,6 | 187:21 | handed 8:6 | 167:8 | 108:21 |
| 31:20,21 | 128:12,18 | 188:3,17,23 | hang 168:22 | 176:19 | 164:11,12 |
| 32:2 33:10 | 128:21 | 189:8 | happen | 178:17,18 | 164:13 |
| 37:16 38:19 | 129:13,21 | 191:13,14 | 150:14 | 226:24 | 165:15,17 |
| 41:11,16,23 | 130:3 | 192:2,4,9 | happened | hear 13:3 | 166:4 |
| 42:10,13 | 134:23 | 192:12,15 | 18:3 27:5 | 90:16 229:1 | highly |
| 46:10,11 | 135:2,4,9 | 193:16,16 | 38:11 | 247:23 | 135:19 |
| 48:5 52:5 | 135:10,15 | 194:11 | happens 66:4 | heard 14:11 | 137:2 |
| 53:20 54:19 | 136:2,10,15 | 196:19 | 66:5 195:22 | 113:19 | 174:14 |
| 56:17 59:24 | 137:20,23 | 197:19 | happy 12:24 | 227:9 | 247:17 |
| 62:1 65:8 | 138:2,15,23 | 198:24 | 90:9 224:14 | hearing 1:8 | him 34:12 |
| 65:17,20 | 139:1,13,24 | 199:2,3,7 | hard 216:15 | 2:2 4:3,20 | 229:4 |
| 66:17 67:22 | 141:5 | 199:10,10 | harder 90:19 | 4:21,22,24 | 238:20,22 |
| 67:24 71:15 | 143:19,24 | 199:11,15 | hardly | 6:19 7:3 | 239:1,3 |
| 71:17,20 | 145:9,13 | 199:17,20 | 207:19 | 8:11 35:18 | histogram |
| 72:22 77:2 | 146:18 | 200:9,24 | Harley 47:9 | 83:9 237:1 | 89:1 |
| 79:14,15 | 147:2,13,19 | 201:7,24 | 47:11,11 | hearings | historical |
| 83:18,23 | 148:1 | 209:4 | 48:1,13,18 | 77:12 185:4 | 212:20 |
| 88:7,8,23 | 149:18,19 | 210:15 | 48:23 83:20 | heat 77:6 | historically |
| 89:3,12,17 | 149:24 | 211:24 | 83:22 84:16 | 80:11 81:17 | 212:21 |
| 89:24 91:17 | 150:2,21 | 217:9,12,15 | 85:13,21 | 158:9 | history |
| 91:23 92:5 | 153:15 | 220:12 | 86:7 87:2 | heavily 21:20 | 120:20 |
| 92:5,6 94:5 | 154:1,20 | 226:11,15 | 87:12 104:4 | 241:12 | 174:1,9 |
| 94:7,17 | 155:15,22 | 226:18,21 | 104:6,11,16 | heavy 169:6 | 176:2 |
| 95:4,17,21 | 156:1 159:1 | 226:22 | 104:21 | held 1:7 4:23 | hit 119:19 |
| 96:1 97:15 | 167:17 | 227:2,16,24 | 105:4,9 | help 6:11 | hold 118:13 |
| 98:3,7 99:5 | 168:3 169:3 | 228:5 | 108:11,12 | 16:15 | holds 120:19 |
| 100:6,12,16 | 169:10,19 | 230:22 | 108:23 | 129:19 | hope 99:16 |
| 100:18,24 | 170:7,22,23 | 231:14,15 | 109:13,16 | helpful 36:5 | 216:13 |
| 101:3,24 | 171:3 | 232:6,8,12 | harm 216:5 | 38:14 88:2 | hopefully |
| 104:13 | 172:14,18 | 233:2,3,9 | harmful | 88:19 126:4 | 111:5 223:7 |
| 105:6,13,17 | 173:7,18 | 233:14,19 | 14:15 | helping | hoping 25:22 |
| 105:24 | 178:3,24 | 234:3,5,12 | having 57:10 | 107:4 | 164:18 |
| 106:9,19 | 179:21,23 | 234:12,15 | 69:23,24 | hence 135:21 | 192:20 |
| 108:15,16 | 180:1,17 | 234:19,19 | 97:7 106:15 | her 4:12 | horrible |
| 109:1 110:1 | 181:2,6,11 | 234:23 | 184:5 | herself 231:3 | 249:23 |
| 110:24 | 181:14,19 | 235:14 | 204:24 | high 29:8,17 | hospitable |
| 111:9,18 | 181:21,23 | 242:4,4,12 | 205:13 | 29:19 46:18 | 220:20 |
| 119:4,7 | 182:4,6,12 | 248:12 | 214:16 | 98:7 118:8 | hotel 29:3 |
| 120:1,6,18 | 182:16,24 | 249:18 | 221:8 | 131:7 | hotels 37:10 |
| 121:2,3,8 | 183:6,9,17 | habitats | head 18:3 | 140:23 | hour 1:13 |
| 121:12,14 | 184:20 | 173:2 | 45:9 56:14 | 198:4,7,9 | 40:16 117:7 |
| 121:17,19 | 185:6,9,13 | 232:22 | 158:12 | 198:13 | 156:19,19 |
| 121:20,23 | 185:16,18 | half 136:9 | 164:15 | higher | 162:22,22 |
| 122:5,8,10 | 185:21,23 | 137:22 | 213:16 | 126:17 | 163:16,17 |
| 122:14,17 | 186:2,3,21 | 138:5,22 | heading 8:5 | 166:16 | hourly 38:21 |

| | | | | | |
|----------------------|------------------------|---------------------|----------------------|----------------------|-----------------------|
| 39:2,9,14 | 123:23 | 219:6 251:1 | 70:15 72:6 | 105:17,19 | 70:17 71:4 |
| 40:9 | idea 108:6 | 251:14,22 | 72:12,16 | 108:16 | 73:20 |
| hours 243:18 | 122:12 | illustrates | 74:24 77:19 | 199:3 200:1 | 133:22 |
| human 64:22 | 126:21 | 185:20 | 89:5 96:18 | improveme... | 146:17,19 |
| 112:2,19 | 138:13 | image 34:9 | 96:23 | 79:15 83:24 | 153:7,8 |
| 113:14 | ideas 95:9 | 34:11 | 121:17 | 90:20 91:17 | includes |
| 114:11,21 | identificati... | 248:13 | 139:13 | 94:9,17 | 84:12 128:5 |
| 174:15 | 3:12 9:21 | imagery | 148:23 | 95:18,21 | 133:6 140:6 |
| 249:11 | 170:17 | 31:22 33:22 | 149:3 | 98:7 100:16 | 195:17 |
| hundred | 171:18 | imbedidness | 151:18 | 101:3 105:6 | 200:10 |
| 89:7,8,8 | 215:13 | 140:11 | 156:1 | 105:13 | 202:13 |
| 90:4 126:16 | 237:18 | immediate | 174:11 | 108:15 | including |
| 126:21 | identified | 4:10,16 | 176:18 | 168:7 | 15:16 27:17 |
| 127:5 138:7 | 11:5 15:23 | immediately | 177:9 178:3 | 198:24 | 32:9 68:16 |
| 216:12 | 26:8 47:13 | 179:21 | 178:17 | 199:2,7,9 | 119:21 |
| 223:7 | 85:4 89:4 | impact | 180:3,18 | 199:16,18 | 139:7 |
| 240:22 | 101:20 | 153:14 | 182:13 | 200:3,5,7,9 | 154:24 |
| hundreds | 149:3 182:5 | 181:12 | 183:6 | 231:15 | 156:18 |
| 23:24 40:14 | 199:11 | 211:19 | 186:24 | 233:21 | 185:15 |
| 148:19 | 207:21 | 239:13 | 187:4,9,17 | improveme... | 203:5 |
| hybrid | identifies | 242:19 | 187:20 | 93:22 99:5 | inclusion |
| 133:21 | 46:11 98:8 | impacting | 189:7 | 100:7 101:7 | 68:20 69:1 |
| hydrologic | identify 48:2 | 149:14 | 191:14 | 104:14 | 154:1 |
| 194:17 | 69:17,23 | impacts | 194:9,10 | 167:22 | 171:23 |
| 217:3 | 70:23 144:5 | 153:16 | 206:22 | 199:20 | incoherent |
| 241:16 | IDNR 133:9 | 193:14,23 | 227:15 | 231:14 | 231:12 |
| hydrological | IEPA 5:6,14 | 194:1 | 229:2,3 | 232:8,12 | inconsisten... |
| 241:7 | 5:19 6:15 | 240:20 | 232:22 | improves | 69:9 |
| hydrology | 9:20 35:6 | 241:18 | 234:5 | 183:14 | incorporated |
| 37:1,4,6 | 41:5 170:16 | impairment | 247:24 | improving | 123:18 |
| 52:23 | 171:16 | 199:2 | impractica... | 94:16 107:6 | increase |
| 170:24 | 214:3 | impairments | 196:15 | 168:4 | 13:19 90:17 |
| 171:4 194:9 | 215:12 | 199:8,10 | improvable | 183:21 | 130:2 |
| 238:6 | 237:17 | implement | 102:12,13 | Inaccurate | 131:13 |
| hypothetical | Ill 1:5 4:7 | 196:6 | improve | 158:2 | 189:21,22 |
| 101:7 | Illinois 1:1,9 | implication | 48:15 68:6 | inappropri... | 194:4 |
| hypothetic... | 1:11,12 2:6 | 209:13 | 91:22 96:1 | 222:4 | 199:20,21 |
| 91:10 | 2:7,11,14 | implications | 97:15 98:2 | include | 245:15 |
| 143:12 | 2:18 8:19 | 243:19 | 99:10 | 128:12 | increased |
| | 16:13,15 | imply 175:4 | 100:18 | 133:4 | 155:4,5,6 |
| I | 17:11,12 | import 49:3 | 101:10 | 136:15 | increases |
| IBI 123:17 | 33:18 63:5 | importance | 105:24 | 168:10 | 189:11,14 |
| 123:20 | 63:6 71:2 | 71:19 | 107:17,18 | 193:16 | 199:4 |
| 125:3,6,9,9 | 94:3 120:20 | 173:21 | 120:5 | 201:7 | 201:24 |
| 130:15 | 120:20 | 181:20 | 121:20 | 205:18 | incremental |
| 133:9 | 133:3,6,9 | important | 167:11 | 220:2 | 167:22 |
| 145:15,18 | 145:14,18 | 7:8 17:3 | 185:16 | 221:22 | indentations |
| 146:7,7,8 | 146:7 | 24:3 28:8 | improved | included | 190:20 |
| 146:10 | 165:24 | 37:4,6 | 99:6 102:15 | 39:21 64:3 | independe... |
| IBI's 15:14 | | | | | |

| | | | | | |
|---------------------|----------------------|-----------------------|----------------------|-----------------------|----------------------|
| 73:5 | 145:14 | 146:8 | inputs 50:18 | interplay | 101:3 |
| independent | 154:2,5 | indirect | inquire | 66:16 | investigation |
| 8:10 73:4 | 192:4,12 | 45:14,15 | 157:12 | 185:10 | 106:23 |
| 151:21 | 199:3,12,20 | 46:5 147:7 | insect 176:12 | interpret | involved |
| 175:18 | 200:24 | indirectly | insectivore | 20:8 126:15 | 101:6 119:3 |
| 176:1,4 | 201:7 | 23:20 45:19 | 11:6,13,22 | 137:4,5 | irreputable |
| 180:7 185:6 | 210:16 | 106:21 | 11:24 12:7 | 230:5 | 216:5 |
| 204:6 | indexes 62:3 | individual | insight | interpretat... | irrevocable |
| independe... | Indiana 94:3 | 40:15 143:2 | 120:24 | 34:17 225:8 | 196:4 |
| 121:3 | indicate | individuals | inspection | interpreting | Irwin 237:13 |
| index 15:11 | 73:16 135:8 | 61:13 | 32:4 | 249:17 | 238:18 |
| 15:12 16:11 | 143:19 | 115:19 | instead | interrupt | 239:19 |
| 16:12,14,19 | 204:18 | industrial | 143:15 | 88:11 | Island 59:15 |
| 17:10,14 | indicated | 36:15 | 144:17 | interstitial | issue 125:2 |
| 18:8,14,14 | 10:20,21 | industriali... | insult 175:12 | 233:10 | 149:10 |
| 18:21 19:2 | 245:18 | 21:20 | intact 240:12 | intolerant | 205:3 |
| 19:3,4,6,10 | indicates | inferred | integrity | 205:1,2 | issued 118:15 |
| 19:17,19 | 134:4 135:1 | 183:13 | 15:15 118:8 | 206:3,6,7 | issues 54:20 |
| 20:1 53:24 | 167:22 | inflows 13:6 | 123:17 | 230:10,12 | 238:15 |
| 54:8,15 | 180:15 | influence | 125:9 | 230:12 | 243:12 |
| 67:14,20,21 | 183:5 | 26:6 135:15 | 145:14 | 231:18,18 | it'd 116:5 |
| 68:9,13 | 185:15 | 172:18 | intended | 231:23 | i.e 202:2 |
| 70:10,13 | 201:20 | 176:1 | 6:11 172:21 | intro 127:23 | |
| 71:4 88:8 | 202:20 | influences | intense | 168:23 | J |
| 88:23 90:1 | 203:20 | 211:19 | 220:15 | 206:20 | J 2:21 170:7 |
| 90:14,15,24 | 208:3 | information | intent 86:14 | introduce | 170:8 |
| 92:13 101:9 | indicating | 33:1 50:24 | 195:20 | 236:6 | Jackson 2:14 |
| 102:1 | 134:21 | 51:12,14,15 | 235:12,12 | introduced | January 84:8 |
| 108:22 | 181:2 182:6 | 107:11 | intention | 97:13 174:5 | 121:9 |
| 120:18 | indication | 119:20 | 98:23 | introduction | Jennifer 5:19 |
| 121:23 | 68:2 82:7 | 162:9 | 173:20 | 169:22 | 230:24 |
| 122:6 123:2 | 135:4 | 236:18 | interact | 171:6 | 231:2 232:3 |
| 123:2,3,6 | indicative | infrastruct... | 221:22 | intuitive 55:3 | 246:4,6,15 |
| 123:16 | 131:3 | 107:14 | interaction | invasive | Joel 237:13 |
| 124:2,9,13 | indicator | ingested 46:2 | 173:4,6 | 216:9 | Johnson 2:4 |
| 124:15,18 | 11:9 51:23 | inherent | interconne... | 222:23,24 | 4:16 |
| 125:3,9 | 62:12 159:6 | 136:7 | 241:3 | 224:1 | joined 4:19 |
| 126:7 127:2 | 164:4 167:7 | Inland 170:8 | interested | 237:12 | joining 4:14 |
| 128:5 | 204:16 | 170:12 | 100:11 | 240:10,23 | judged |
| 129:13,24 | indicators | inorganic | 122:16 | 243:5 | 140:23 |
| 131:18 | 24:5 67:24 | 35:24 36:4 | interesting | inventorying | judgment |
| 132:13,22 | indices 15:14 | 36:10 41:20 | 89:21 248:4 | 107:1 | 10:24 41:22 |
| 133:21 | 15:23 16:1 | 42:6,10 | intermediate | invertibrate | 41:22 |
| 134:12 | 16:3,21,22 | 44:4,10,14 | 205:18 | 197:22 | 140:10,16 |
| 135:10 | 17:5,7 | 111:15 | intermedia... | inverted | 142:5 232:7 |
| 136:3 141:5 | 122:8,21 | 112:15 | 206:3,6,14 | 249:7 | judgments |
| 141:11,17 | 123:9 128:2 | 194:12 | internal | investigate | 126:8 |
| 143:14 | 130:15 | input 13:10 | 241:19 | 20:13 | jump 157:4 |
| 144:13 | 135:11 | 121:5 | interns 4:18 | investigated | 168:23 |
| | | | | | 179:12 |

| | | | | | |
|-----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| 95:14 | 160:18 | 234:10 | 178:17 | 47:7 103:3 | last 7:3,5 |
| June 184:16 | 168:5,15,20 | kill 244:4 | 190:14 | 104:9 | 8:11 11:5 |
| just 8:22 9:13 | 168:23 | kind 32:16 | 191:20 | 215:24 | 11:13 13:1 |
| 10:3,12 | 169:7 | 41:18 57:8 | 192:21 | 216:2,10 | 13:22 77:12 |
| 12:10 18:7 | 173:20 | 71:24 73:23 | 196:20 | 222:14 | 82:21 95:20 |
| 19:8 21:16 | 174:22 | 100:23 | 202:22 | 224:2 | 137:12 |
| 24:24,24 | 175:11,12 | 113:9 | 205:19 | 241:17 | 164:18 |
| 27:3 30:2 | 182:21 | 115:24 | 209:5 | Lakes 26:1 | 180:23 |
| 35:4 39:3 | 189:3,5 | 143:22 | 216:18 | 26:14 | 185:4 |
| 39:13 41:1 | 190:5,17,24 | 152:19 | 217:21 | 198:17 | 221:14 |
| 43:23 44:3 | 196:21 | 190:15 | 218:12 | 216:6,6,24 | lastly 141:3 |
| 49:14 50:14 | 205:4 | 197:13 | 223:11 | 216:24 | later 4:14 |
| 50:15,23 | 206:20 | kinds 161:6 | 227:4,10,14 | 217:1 224:2 | 5:22 14:21 |
| 51:12,15 | 207:5,12 | Klein 249:2,3 | 227:18,19 | 236:9 237:8 | 20:19 27:12 |
| 52:19 53:4 | 208:16 | 249:4,9,24 | 228:10 | 237:11 | 34:23,24 |
| 59:5,10 | 210:7 211:7 | knew 69:7 | 232:2 242:8 | 240:9 | 39:12 67:6 |
| 66:11 69:14 | 218:19 | 150:24 | 244:11,17 | 241:22 | 70:12 83:9 |
| 70:21 74:5 | 225:18 | knocked | 244:18 | land 196:9 | 96:23 |
| 74:10 78:7 | 226:7 | 226:7 | 246:1,3,14 | landform | laugh 5:18 |
| 79:11 80:9 | 227:22 | know 8:12,13 | 246:23 | 173:5 | LAW 2:13 |
| 80:19 83:16 | 228:9 229:3 | 12:17,24 | knowing | Lands 5:15 | lawfully |
| 88:6 93:3 | 229:6 | 21:18 22:9 | 21:10,23 | language | 118:15 |
| 98:20 99:20 | 231:11 | 25:13 30:22 | 48:9,10 | 229:21 | lead 99:5 |
| 101:1 | 233:24 | 31:2 33:15 | knowledge | large 28:22 | 105:24 |
| 102:17 | 234:7,18 | 34:8 37:22 | 19:1 48:14 | 54:6 58:22 | leading 219:8 |
| 104:6 | 235:5 240:2 | 38:10,12,23 | 100:20 | 64:10,24 | leads 113:12 |
| 108:23 | 240:13 | 39:14 42:24 | 135:17 | 65:1,6,13 | learned |
| 109:16 | 243:9 | 43:2 44:3 | 141:22 | 65:22 68:13 | 113:12 |
| 110:7 | juvenile | 45:8 48:20 | 175:18 | 68:16,21 | least 39:20 |
| 115:23 | 229:10,14 | 59:21 60:16 | 176:1,5 | 69:1,8,19 | 61:12 90:12 |
| 119:18 | 229:14 | 60:21 68:24 | 216:8 | 70:18 71:6 | 118:20 |
| 120:2 125:1 | | 68:24 72:12 | 226:10 | 71:7 93:9 | 143:15 |
| 125:5,20,23 | K | 75:7,24 | 230:7,18 | 102:14 | 151:20 |
| 127:6,19 | keep 57:10 | 76:4 78:4 | 242:5,6 | 103:1 | 178:22 |
| 128:14 | 170:3 | 78:21 83:5 | 246:10 | 106:22 | 216:22 |
| 129:2,3 | 174:19 | 91:15 92:16 | knowledge... | 121:11 | 241:10 |
| 131:19,21 | 189:3 224:1 | 96:2 103:9 | 75:21 94:1 | 145:21,22 | 249:19 |
| 131:24 | 229:6 | 108:18 | known | 190:18,21 | leave 175:24 |
| 141:10 | 235:18 | 110:2 116:4 | 145:14 | 191:1,2 | 231:12 |
| 143:23 | 236:2 | 116:11 | knows 59:17 | 196:8,16 | left 4:11,12 |
| 144:3,18 | 240:12 | 133:13,14 | Kohler | 202:13 | 4:12 165:14 |
| 146:21 | keeping | 139:19 | 170:14 | 203:5 235:3 | left-hand |
| 151:7,11 | 219:17 | 141:15 | | largely 173:3 | 10:11 |
| 152:12 | Keith 47:11 | 144:6 | L | 199:23 | Lemont |
| 153:11,17 | Kelly 120:16 | 148:18 | lack 64:16 | larger 56:16 | 215:18 |
| 154:9,14,17 | kept 60:21,22 | 153:6 | 106:7 109:6 | 57:3 124:13 | lend 92:21 |
| 157:4,12 | 61:19 | 157:21 | 109:12 | 182:17 | length |
| 158:15,22 | key 41:14 | 158:3,8 | 204:4 | 190:10 | 119:17,23 |
| 159:8 | 186:23 | 161:8 172:9 | laid 248:17 | 245:4 | 120:1 |
| | 187:2 | | lake 29:21 | | |

| | | | | | |
|-----------------------|-----------------------|----------------------|---------------------|-----------------------|----------------------|
| 176:11 | 92:2 103:18 | 228:17 | 120:4 | 12:3 24:2 | 228:22 |
| lesions 63:4 | 111:24 | 234:17 | 134:14,21 | 78:3,7,9 | lived 53:2 |
| 131:5 | 116:19 | light 29:12 | 198:23 | 96:22 99:17 | lives 55:12 |
| less 15:23 | 117:19 | 64:8 201:23 | 220:12 | 152:19,21 | living 224:12 |
| 22:14,15 | 127:21 | like 7:2 13:4 | limiting | 169:15 | LLC 1:24 |
| 26:8 29:21 | 131:19,21 | 15:20 18:14 | 135:5 167:1 | 205:17,24 | 2:24 3:24 |
| 29:23 30:9 | 165:24 | 19:1 28:24 | 189:6 | 206:1,9 | LLP 2:16 |
| 36:12 37:5 | 193:9 214:1 | 33:17 40:8 | 217:10 | 230:15 | loading |
| 39:24 92:2 | 216:13 | 40:11 42:4 | 228:5 | listed 13:2 | 114:15 |
| 97:16,17 | 235:15 | 49:18,19,20 | Limnotech | 60:9 62:10 | local 173:5 |
| 113:21 | 236:6 238:9 | 54:4 57:9 | 61:21 119:4 | 62:14 | localized |
| 115:14,24 | 245:4 246:9 | 82:9 88:17 | 135:21 | listing 70:21 | 21:13 22:4 |
| 116:1,5,5 | 248:7 250:7 | 91:9 94:13 | 140:1 | lists 62:17 | 220:10 |
| 145:19 | level 119:9 | 101:17 | 145:13 | 174:9 212:2 | located 154:4 |
| 163:19 | 136:5 | 102:6,6 | 155:20 | literally | 222:16 |
| 177:24 | levels 38:18 | 112:1 113:2 | 159:15 | 148:18 | location 34:6 |
| 183:2 184:9 | 46:15,17,23 | 116:13 | 161:16 | literature | 53:18 82:22 |
| 184:17 | 76:5,17 | 120:3 | 162:2 | 15:24 | 107:2 |
| 186:16 | 84:1,13 | 125:17 | 163:12 | 120:13 | 154:17 |
| 187:9 191:6 | 85:5,9,19 | 127:4 | 164:1 167:5 | 146:3 | 190:7 219:9 |
| 207:18 | 87:1 183:15 | 140:23 | 183:24 | 226:19 | 224:3 |
| 220:20 | 186:5 | 152:2 | 186:2 | 229:13 | locations |
| 245:17 | 202:17,20 | 172:22 | 199:17 | 245:21 | 21:6 27:21 |
| lessen 13:16 | 202:23 | 194:1 200:8 | 201:1 225:4 | litmus 190:15 | 83:1 114:1 |
| let 21:18 23:6 | 203:19,22 | 211:7 215:9 | 225:8,22 | little 10:4 | 213:15 |
| 24:16 43:4 | 204:4,11,13 | 235:7 239:5 | 226:3,8,11 | 21:9,11 | 241:8 |
| 44:21 61:15 | 204:15,24 | 241:4 | 228:3 242:4 | 28:6 29:7 | Lock 219:12 |
| 75:11 80:12 | 205:5,14 | 244:17 | 242:7 248:1 | 53:12 60:24 | 247:2 |
| 85:10 91:20 | 228:18 | likely 16:7 | Limnotech's | 64:4 65:12 | Lockport |
| 98:20 | 229:11,15 | 21:14 36:10 | 162:9,15,21 | 67:1 80:15 | 219:12 |
| 127:15,23 | 245:13 | 36:12 54:13 | line 73:21 | 88:6 95:15 | locks 247:7 |
| 143:12 | license 2:22 | 60:23 82:13 | 138:8,10 | 120:9 | long 10:3 |
| 144:21 | 118:13 | 85:7 129:13 | 160:7 | 127:22 | 145:10 |
| 146:15,16 | life 14:1 15:3 | 136:1 194:5 | 248:15 | 134:12 | 181:1,4 |
| 153:11 | 55:15 93:5 | 202:1 | linear 65:19 | 138:9 | 215:8,21 |
| 157:4 | 99:10,14 | limestone | 68:10,17 | 141:10 | 217:16 |
| 168:23 | 114:6 150:1 | 220:3 | 69:3,12 | 146:20 | 236:12 |
| 177:4 179:4 | 153:14,17 | limitation | 134:2 | 153:9 | longer 58:20 |
| 179:13 | 174:1,9 | 46:11 | 150:24 | 154:14 | look 6:21 |
| 207:12 | 176:2 | 109:13 | 151:18 | 157:9 | 7:14 17:16 |
| 230:5 232:5 | 193:13,15 | 135:1 | 182:3 | 164:18 | 18:12,15 |
| lettering 12:1 | 194:14 | limitations | 188:13 | 177:23 | 19:2 20:19 |
| letters 10:23 | 219:21 | 1:3 4:5 | 189:2,16 | 185:22 | 21:1 25:16 |
| let's 19:9 | 220:20 | 111:10 | lines 112:20 | 207:5 232:6 | 26:16 28:11 |
| 22:19 37:12 | 221:12,17 | 145:16 | 144:10 | littoral 220:5 | 30:13,14 |
| 55:11,19 | 221:23 | 170:23 | 185:4 245:2 | Liu 2:2 4:17 | 33:17 40:19 |
| 63:13,22,23 | 222:1,21 | 171:4 | 245:6,9 | 247:20 | 45:3 49:14 |
| 81:12 83:14 | 224:9,11 | limited 17:8 | links 203:19 | live 90:9 | 50:12,14 |
| 83:14 91:9 | 225:12 | 29:23 32:7 | list 10:10 | 221:1 | 51:2 52:24 |

| | | | | | |
|--------------------|----------------------|---------------------|---------------------|--------------------|----------------------|
| 55:21 60:13 | 211:2 223:3 | 166:5,18 | 45:10,18,21 | 106:7,14 | manmade |
| 61:8 69:15 | 238:18 | 192:14 | 45:23 46:2 | 218:2,9,10 | 28:9,17,19 |
| 75:8 78:2 | looking 31:5 | lucky 231:6 | 46:7 122:12 | 219:4,14 | 28:21 29:4 |
| 82:2 92:17 | 43:20 54:1 | ludicrous | 148:15 | major 50:11 | 37:9,11 |
| 93:1,7,12 | 72:21 78:19 | 92:3 | 149:2,12 | 85:19 88:9 | 95:24 96:8 |
| 93:14 98:6 | 79:23 88:19 | lunch 111:6 | 151:10 | 89:3 121:11 | 96:12,17,24 |
| 99:3 101:17 | 93:21 | 116:19 | 224:12 | 122:21 | 97:6,14 |
| 102:5 | 109:24 | 117:7 | 228:22 | 172:14 | 98:2 123:7 |
| 103:19 | 111:7 155:4 | L.A 1:24 | macrophyte | 173:7,15 | 137:6 |
| 104:16 | 165:6 179:5 | 2:24 3:24 | 49:10,11,12 | 192:4,15 | 142:20 |
| 113:13 | 198:18 | L3 249:2 | 49:20 50:3 | 220:8 | 153:8,10,11 |
| 126:14 | 208:16 | | 64:2 141:21 | 239:21 | 153:13 |
| 146:1 | 229:13 | M | 141:23 | 243:3,9,11 | 154:2,3,6,7 |
| 150:14 | 241:15 | M 10:1 | 173:12 | majority | 154:16 |
| 152:15 | looks 9:10 | 215:15 | 187:22 | 203:4 | 190:5 |
| 158:6 | 49:16,18 | 225:1 | 189:17 | make 7:2 | 191:18 |
| 160:12,21 | loss 193:16 | Mackey 3:6 | macrophytes | 14:17 18:11 | manually |
| 161:1 | lost 221:14 | 5:12,17 | 64:1,10,10 | 18:17 27:20 | 36:22 |
| 164:15 | lot 13:23 | 34:12,23 | 64:16,21,22 | 27:23 30:11 | many 13:4 |
| 200:8 | 58:20 90:19 | 76:8 210:11 | made 7:17 | 50:14 90:20 | 65:20 105:2 |
| 205:20,21 | 109:20 | 214:2,13,15 | 10:20 20:16 | 102:24 | 110:11,17 |
| 205:22,23 | 110:8,14 | 215:2,17 | 27:13 37:23 | 103:1,6 | 123:20 |
| 206:5 | 120:24 | 217:21 | 38:1,22 | 117:6 125:1 | 124:7,8 |
| 207:20 | 141:8 | 222:11 | 48:21 53:16 | 126:8 | 139:8 |
| 210:19 | 148:17 | 224:20 | 63:24 72:3 | 131:18 | 148:18 |
| 213:12 | 152:16 | 225:11 | 73:1 79:24 | 137:8 140:9 | 154:9,17 |
| 226:19 | 225:7,21 | 228:24 | 82:2 93:22 | 152:19,21 | 155:3,8 |
| 234:1,2 | 226:8 | 237:14 | 167:19 | 177:2,22 | 173:17 |
| 240:19 | 233:10,10 | 247:21 | 168:12 | 189:3 | 220:24 |
| 248:11 | 233:12 | 250:2 | 169:20 | 220:19 | 231:16 |
| 250:3 | 241:13 | Mackey's | 209:8 217:7 | 232:13 | 246:17 |
| looked 7:15 | Louder | 215:2 222:3 | 228:2 232:8 | 233:3 235:2 | map 212:5 |
| 16:20,21 | 84:15 | macroinve... | 236:11 | 235:4 | 248:9 |
| 20:2 21:2 | lousy 24:10 | 22:13,22 | magical | 236:16,20 | March 4:23 |
| 25:23 31:21 | low 139:7,11 | 23:1,10,11 | 190:23 | makes 34:11 | 5:5 |
| 39:10 40:8 | 139:21 | 24:4 45:13 | magnitude | 85:2 145:19 | Marie 1:8 2:2 |
| 40:10 53:12 | 140:24 | 147:3,6 | 119:9 | 235:7 | 4:2 |
| 53:13 61:14 | 155:8 157:1 | 148:14 | main 57:1,8 | 249:15 | mark 9:6 |
| 62:19 68:1 | 163:9,12,13 | 149:11,16 | 106:22 | makeup | 214:20 |
| 69:12 77:6 | 166:18 | 149:18,22 | 187:24 | 203:11 | marked 3:12 |
| 80:11 91:18 | 228:18 | 150:5 | mainly 98:17 | making 30:5 | 5:24 9:20 |
| 101:23 | 229:10 | 152:10,14 | maintain | 104:11 | 170:16 |
| 102:3 | lower 1:4 4:6 | 169:14 | 233:8 | managed | 171:16 |
| 137:19,23 | 126:18 | macroinve... | 240:15,17 | 174:3 177:7 | 215:12 |
| 138:15 | 246:19 | 20:6,15,19 | maintained | 177:8 | 237:17,23 |
| 141:21 | 247:1 | 20:24 21:2 | 218:6 | Management | Mary 191:5 |
| 150:4 | lowest 90:17 | 21:5,12,24 | maintaining | 170:7,9,13 | Maryland |
| 152:12 | 164:11 | 22:4,5,20 | 216:19 | manipulated | 16:2 |
| 159:11 | 165:15 | 23:5,6,8,17 | maintenance | 174:15 | match 138:8 |
| | | 24:5,10 | | | |

| | | | | | |
|---------------------|--------------------|---------------------|---------------------|---------------------|----------------------|
| 212:19 | 25:4 31:16 | 196:22 | measureme... | 151:15 | 10:12,19 |
| material | 32:7 41:10 | 208:11 | 30:5 32:18 | 169:5,6 | 25:23 26:7 |
| 194:13 | 46:5 47:6 | meant 25:5 | 46:22 74:13 | meter 28:14 | 61:15,16,17 |
| mathemati... | 49:9 58:6 | 50:18 87:2 | 74:15 140:9 | 30:19 49:23 | 61:22 62:1 |
| 131:22 | 59:1 64:5 | 140:6 172:2 | 142:8 | 58:1,7,10 | 62:2,4,19 |
| mathematics | 73:3 86:22 | 182:14 | measures | 58:12 | 77:3,5 |
| 90:19 | 89:9 91:21 | 190:1 230:7 | 24:7 30:15 | 154:10 | 81:11,24 |
| matter 1:2 | 96:3,3 97:1 | 235:10 | 30:16 46:21 | meters 28:14 | 82:3 123:18 |
| 225:15 | 97:16 106:8 | 241:2 | 52:23 90:24 | 29:23 30:1 | 123:19 |
| max 165:8 | 110:3 | measurably | 100:14 | 30:10 31:3 | 124:1,2,4 |
| 166:2 | 113:15 | 167:12 | 141:9 | 58:5,6,21 | 128:16 |
| maximum | 114:24 | measure 7:10 | 169:13 | 59:2 76:3,4 | 130:21 |
| 33:3 81:7 | 115:4 127:9 | 10:15,16 | 184:1,4,8 | 190:11,13 | 131:11 |
| 132:21 | 131:1 137:6 | 17:2 25:11 | 213:14 | 190:15 | 133:2 134:9 |
| 161:18,18 | 138:20 | 28:3 29:11 | measuring | 191:7,8 | 134:13 |
| 162:11,11 | 143:2 | 30:12,15 | 64:12 | 245:20 | 138:16 |
| 187:15 | 166:19,21 | 32:2 42:18 | 125:14 | method | 139:3,4 |
| 188:3,17 | 168:2 175:3 | 43:15 46:15 | 140:11 | 150:20 | 140:23 |
| 191:16 | 181:10 | 46:20 47:20 | 146:19 | methods 20:2 | 141:12 |
| may 1:12 6:1 | 182:10 | 53:19,20 | 165:20 | 120:10,11 | 148:15 |
| 22:10 23:13 | 184:6 188:2 | 56:18 61:14 | Melching | 145:23 | 152:7,16 |
| 37:24 42:12 | 190:3 | 64:13 67:14 | 178:13 | metric 7:10 | 154:21,23 |
| 48:7 74:16 | 194:14,16 | 68:3,7 | Member 4:12 | 7:18 10:15 | 156:7,10,18 |
| 76:22 100:9 | 199:6,10 | 98:15 | 4:13,13,15 | 11:21,24 | 156:24 |
| 117:9 | 202:5 | 125:11 | 6:11 | 12:8 26:9 | 157:6 159:9 |
| 134:21 | 222:18 | 141:22 | members | 26:11 27:6 | 159:11 |
| 140:18 | 223:17 | 142:15,21 | 133:4 204:3 | 27:7,9,9 | 160:24 |
| 164:6 | 235:17 | 144:11 | 204:11,13 | 42:12 50:21 | 161:1,17 |
| 167:23 | meaning | 147:7 | memo 84:7,9 | 64:2 65:22 | 162:10,21 |
| 174:2 | 32:20 41:14 | 148:11 | 84:9 85:15 | 71:20 124:5 | 163:3,6,19 |
| 177:23 | 122:4 | 168:10 | 85:17,22 | 128:6,11,20 | 163:20 |
| 195:23 | 123:21 | 169:6 | 86:5,12 | 129:1 | 166:18 |
| 199:18 | 145:22 | 184:12 | 207:9 | 130:19,22 | 167:21 |
| 200:1 | 156:12 | 193:24 | memory | 131:7,8 | 184:20 |
| 210:12 | 171:7 174:6 | 219:10 | 78:10 | 133:4,6 | 186:24 |
| 216:12 | 176:7 185:8 | measured | 152:24 | 147:12 | 211:10 |
| 218:8 | meaningful | 17:5 29:14 | 158:7 | 149:2 | Metropolit... |
| 224:11,12 | 110:13 | 42:1 43:16 | 190:17 | 152:14 | 99:13 |
| 229:17 | means 10:23 | 44:20 45:1 | mention | 155:3 162:4 | mg/L 183:2 |
| 230:24 | 11:20 12:1 | 51:17 73:8 | 29:22 | 163:4 | 184:17 |
| 245:8 | 35:11 49:5 | 114:1 | mentioned | 164:13 | Michigan |
| maybe 49:16 | 49:19 73:15 | 128:18 | 13:6 62:7 | 165:13,16 | 16:2 19:18 |
| 73:18 80:12 | 91:15 | 138:1,2,4 | 77:11 78:12 | 165:18,20 | 19:21 29:21 |
| 80:14 | 125:23 | 140:15 | 110:11 | 166:17 | 55:23 103:3 |
| 110:21 | 135:14 | 141:2 142:2 | 129:5 169:8 | 184:3,18,22 | 120:17 |
| mean 11:19 | 154:24 | 142:5 | 246:16 | 186:11 | 215:24 |
| 12:6 14:18 | 155:1,3 | 148:20 | metal 36:21 | 189:11,12 | 216:3,10 |
| 16:11 17:4 | 159:8 172:1 | measureme... | metals | 189:14,19 | 222:14 |
| 21:10 25:1 | 189:16 | 30:10 64:7 | 148:10,11 | metrics 7:7 | 224:2 |

| | | | | | |
|--------------------|----------------------|-----------------------|--------------------|--------------------|---------------------|
| Midwest | mind 70:20 | 178:8,11,13 | moral 118:8 | 237:5 245:4 | 197:16 |
| 5:10,15,21 | 192:22 | 179:2,2,23 | more 7:18 | 245:6 246:4 | 202:10 |
| 40:5,17 | 233:5 | 180:1,6,17 | 10:4,19 | 246:9 | 203:4,21 |
| 68:12 110:7 | mineral | 189:20 | 14:20 16:6 | 249:16,16 | 204:4,11,13 |
| 116:20 | 166:1 | modeling | 16:7 20:16 | morning 4:1 | 209:14 |
| 117:5 | 220:10 | 53:15 | 20:18 21:20 | 4:15 6:18 | 212:15 |
| 157:23 | mines 33:16 | 233:13 | 21:24 22:6 | 12:22 | 227:2 229:3 |
| 158:9 230:8 | minimize | models 51:18 | 23:17 27:11 | 146:20 | 240:13 |
| 230:16,19 | 135:14 | 51:20 180:7 | 30:1 40:22 | 147:12 | 241:15 |
| might 8:22 | 142:10,13 | moderate | 51:5 53:9 | 153:6,24 | 249:15 |
| 9:3,8 16:5 | 241:18 | 140:23 | 53:22 54:11 | 160:23 | mostly 42:21 |
| 18:21,24 | minimized | 220:7 | 54:13 55:1 | 161:16 | 196:9 |
| 45:2 68:5 | 240:20 | 230:10 | 55:13 65:10 | 168:12 | mouth |
| 77:11,19 | minnow | moderately | 70:13 72:16 | 215:17 | 202:13 |
| 83:16 90:22 | 11:16,21,23 | 230:12 | 74:22 81:2 | 248:3 250:9 | 203:5 |
| 92:4,6 95:3 | 12:1,6 | 231:18,22 | 82:13 83:9 | morphology | 207:17 |
| 97:1,2,5,8 | 202:14 | modification | 83:16 88:4 | 140:22 | move 10:17 |
| 97:10,15 | 203:6 | 193:19 | 102:6 104:2 | 220:4 | 52:12 83:22 |
| 98:2,6 99:9 | minnows | modificatio... | 109:20 | mosaic | 108:4,7 |
| 99:12 | 133:20 | 121:18 | 110:8 | 248:14 | 127:21 |
| 100:17 | minute | modified | 113:23 | most 18:4 | 132:14 |
| 101:17 | 159:21 | 176:2,10 | 114:13 | 21:13,14 | 136:23 |
| 102:5,21 | minutes | modify | 118:21 | 22:24 23:20 | 200:22 |
| 106:13 | 63:14 169:8 | 127:22 | 120:23 | 24:2 29:9 | 214:1 217:6 |
| 110:21 | misquoted | 164:2 | 129:14 | 29:16 31:5 | 219:12 |
| 115:8 121:5 | 73:2 | 233:19 | 130:9 | 36:1,3 | 224:21 |
| 131:19 | misread | modifying | 131:18 | 69:18 72:3 | moving 66:9 |
| 136:15 | 160:5,13,16 | 93:8 102:4 | 137:11 | 84:24 89:5 | 119:2 121:7 |
| 144:10 | missing 23:4 | moment | 140:20 | 90:11 92:12 | 123:5 |
| 200:8 | 230:8,11 | 177:5 | 141:10,17 | 92:20 | 124:21 |
| 204:18,20 | Mississippi | 182:21 | 149:3 156:1 | 102:16,19 | 130:14 |
| 210:21 | 236:8 | 210:8 | 156:8,12,23 | 108:16 | 133:1,19,24 |
| 211:19,19 | 237:11 | Monday | 159:7 | 122:16 | 134:16 |
| 221:9 | 240:8 | 12:22 | 175:10 | 130:15 | 135:7 |
| 232:20 | missumma... | 215:10 | 181:3 | 136:10 | 138:24 |
| 234:24 | 96:10 | monitor | 182:12 | 139:5 142:7 | 139:10,23 |
| 242:19 | mistake 73:1 | 39:24 | 183:6 | 142:10 | 145:6,12 |
| migrated | misunderst... | monitoring | 185:22 | 147:5 | 146:6,14 |
| 27:4 | 188:9 | 39:6 58:15 | 186:24 | 148:13,22 | 154:19 |
| migration | mitigate 26:5 | Monroe | 187:4 | 149:15 | 155:14 |
| 217:19 | 107:15 | 251:21 | 200:16 | 159:20 | 158:24 |
| mile 57:24 | mitigation | month | 205:9 | 163:17,20 | 161:14 |
| 119:17 | 100:2 | 161:20 | 210:12 | 169:13 | 162:7 |
| 219:7 | mix 147:19 | 218:10 | 214:23 | 173:10 | 163:24 |
| miles 244:2 | 149:24 | months 81:8 | 223:8 | 181:15 | 169:17 |
| million | mixed 191:4 | 81:8 166:3 | 227:15 | 187:16,20 | 170:21 |
| 243:17 | Mm-hmm | Moore 4:12 | 229:10 | 189:7 | 172:11 |
| Minarik | 11:18 | 5:22 9:3,7,9 | 233:12 | 191:14 | 173:22 |
| 37:17,19 | model 71:16 | 9:12 | 236:10 | 196:4 | 181:18 |

| | | | | | |
|--------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
| 183:23 | 189:2,16 | 137:17 | 234:16 | 170:4 | 15:20 35:4 |
| 185:12 | 223:22 | 145:20 | 235:15 | 180:23 | 41:5 144:8 |
| 186:7,20 | municipali... | 173:21 | need 6:2 | 200:22 | noted 121:14 |
| 192:1 | 107:10 | 174:13 | 64:11 69:4 | 204:20 | 136:16 |
| 197:18 | must 238:16 | 175:5 | 70:23 80:5 | nile 60:14 | notes 145:15 |
| 199:14 | MWR 60:1 | 176:14,20 | 104:19 | nine 104:1 | 251:11 |
| 201:17 | MWRD | 176:21 | 110:14 | 134:16 | nothing 19:1 |
| 207:24 | 40:17 | 178:19 | 117:24 | nobody 5:18 | 40:22 50:2 |
| 223:18,21 | myself 55:17 | 195:13 | 146:4 | 89:8 | 154:11 |
| 231:19 | 207:13 | 200:16 | 168:22 | none 7:21 | 161:4 |
| 241:13 | 244:14 | 227:3 | 233:3 | 9:19 17:1 | 190:23 |
| much 20:16 | mystery | 231:20 | needed 38:8 | 50:4 79:2 | 221:12 |
| 25:19 37:5 | 34:21 | 233:1 | 151:2,3 | 123:8 | noticed 7:14 |
| 47:4 49:11 | | nature 16:24 | negative 63:1 | 159:10 | 11:3 |
| 50:8 61:14 | N | 52:9 87:7 | 63:3 66:23 | 161:23 | noting |
| 83:5 96:5 | N 2:1 3:1 | 92:19 107:2 | 67:10 68:18 | 168:17 | 134:19 |
| 103:5 | 10:1,1 | 113:9 123:7 | 68:20 69:2 | 170:15 | notion 6:13 |
| 138:22 | 215:15,15 | 135:19 | 69:10,20 | 171:14 | November |
| 141:23 | 225:1,1 | 137:2 177:9 | 70:4 89:17 | 184:20 | 237:14 |
| 142:2 | nail 235:5 | 206:23 | 89:23 90:5 | 214:5 | number 8:12 |
| 155:12,21 | name 4:2 6:6 | navigation | 90:12 | 215:11 | 9:17 13:2,5 |
| 156:1 | 40:3 78:8 | 46:14 47:15 | 130:19,22 | 237:15 | 17:16,20 |
| 163:19 | 117:4 | 59:7 196:13 | 131:1,6,12 | 245:9 | 18:9 19:11 |
| 182:7 | 141:14,16 | 198:7,9,12 | 131:15,20 | nonhybrid | 19:12,13 |
| 184:21 | 171:9 | 201:8 | 132:8,15 | 60:7 | 21:6 26:14 |
| 185:8 | 215:17 | 220:15 | 189:10,21 | non-tolerant | 26:24 32:9 |
| 186:24 | namely | 223:17 | 196:23,24 | 166:1,4 | 39:19 42:9 |
| 187:4 | 145:16 | 232:18 | 197:6,9,11 | non-wadable | 42:11,13,16 |
| 191:21 | narrow | 238:6 240:2 | negatively | 19:16,19 | 43:11 44:9 |
| 213:22 | 134:20 | 240:16 | 65:14 66:2 | 146:4 | 53:24 54:6 |
| 233:20 | 135:3 | 241:5,12 | 191:15,23 | Non-wadea... | 54:7 57:19 |
| 238:16 | narrower | navigational | 196:22 | 120:18 | 57:23 58:9 |
| 240:12,15 | 153:9 | 95:23 | negatives | normalize | 60:8,24 |
| 240:17 | national | navigations | 131:14,17 | 127:3 | 61:13,18 |
| 242:17 | 121:4 | 198:4 | neglected | normally | 116:1 |
| 244:11 | native 133:3 | near 45:1 | 38:9 | 66:14 92:22 | 120:14 |
| 247:23 | 133:7,20,20 | 90:9 | Network | 99:19 | 124:14 |
| 249:16,16 | natural 15:2 | nearly 245:7 | 191:6 | north 2:6,17 | 133:2 140:6 |
| 250:6 | 37:5 57:1 | necessarily | never 190:22 | 17:17,20 | 140:14 |
| muck 220:10 | 84:17 85:14 | 41:16 42:2 | 191:3 | 26:1 33:24 | 141:8 |
| multiple | 92:19 102:6 | 42:3 43:22 | 194:24 | 34:6 49:15 | 148:14 |
| 65:19 68:10 | 112:3,9,14 | 85:10 96:2 | 235:19 | 49:21 52:13 | 154:7 |
| 68:17 69:3 | 112:17 | 139:21 | new 61:22 | 52:14 59:14 | 180:10 |
| 69:12 84:12 | 113:17 | 166:19 | 120:5 196:7 | 59:14 90:8 | 182:17 |
| 136:13 | 114:1,7,11 | 236:3 | 202:2 | 103:2 170:9 | 190:4,6,9 |
| 150:24 | 114:16,18 | 245:14 | 225:12 | 170:13 | 191:18 |
| 151:17 | 115:7,19,20 | necessary | news 25:18 | 241:21 | 202:14,22 |
| 182:3 | 116:2,8,17 | 106:12 | next 49:2 | notable 16:2 | 203:6 |
| 188:13 | 120:20 | 127:6 132:3 | 51:6 132:14 | note 6:10,14 | 219:17 |
| | 136:12 | | | | |

| | | | | | |
|--|---|--|--|---|--|
| 226:9,14,14 229:9 numbers 7:22 19:7 26:12 40:8 41:14,15,19 41:24 43:10 43:21 58:16 58:18 69:13 69:15 72:7 99:16 132:1 132:4 142:4 numeric 58:17 numerical 41:13 43:17 55:6 126:16 140:13 141:2 197:13 numerically 151:21 numerous 226:14,19 nursery 234:11,12 nutrients 98:19,21 194:21 | objectives 121:18 objects 31:23 obligate 230:12 231:18,23 235:5,9 observation 60:7 175:6 observations 33:11 45:11 85:2 observe 15:3 22:9 42:19 42:20 53:4 76:24 113:4 157:7 observed 50:4 54:23 65:22 69:19 84:17 86:15 86:17 113:11 138:4 156:11 202:11,12 203:7 207:10 208:11 209:15,21 observing 209:14 obtained 32:17 obviously 12:15 26:5 occupy 204:3 204:11,13 occur 15:1 84:20 86:18 113:3 195:21 196:10 235:22 occurred 61:1 165:13 244:2 occurrence 161:4,6 | 166:16 occurring 82:4 occurs 84:11 165:18 201:21 off 17:14 18:2 28:5 38:7 39:10 40:24 41:3 56:6,9,13 56:21,23,24 57:1,7 83:17 95:14 104:13 105:5 129:6 158:11 164:15 187:23 189:16 190:2,8 213:16 225:21 231:12 offered 118:5 offhand 8:14 office 7:15 236:16 Officer 1:8 2:2 4:3 5:1 35:18 official 251:13 often 93:11 105:24 106:9 Ohio 15:17 16:13 18:21 121:22 122:5 123:3 134:10 146:7,10 210:16 Ohio's 210:20 okay 11:12 11:15 14:2 14:3 22:19 25:3,15 | 26:18 29:6 30:19,24 42:23 44:1 44:8,13 45:8 49:2 49:14 53:21 56:1 57:10 58:8 59:5 60:6 61:9 62:16 68:15 71:13 78:12 79:21 81:1 81:12 82:9 87:21 88:2 89:7 90:15 99:16 117:17 119:11 126:24 127:13,20 128:13 131:10 139:23 141:10 149:8 160:15,17 169:17 172:8,23 173:22 195:10 203:1 210:13,24 214:7 216:18 221:3 229:5 229:7 232:4 235:2 237:20 246:16 old 249:6,8 older 238:16 once 65:21 195:12,22 214:23 234:13 237:22 one 2:17 6:7 7:18 8:16 8:18 10:19 | 14:18 16:6 22:2 25:22 27:8 28:7 38:4,16 41:19 42:4 42:15,16 43:5 44:8 51:20 52:15 52:23 53:9 53:22 54:10 54:20 55:7 60:19 67:2 72:15 74:5 74:10 76:14 81:15 83:4 92:3 94:11 94:12 95:13 95:18 97:19 102:10,13 106:9,22 108:7,12,23 110:16 117:23 118:3 120:17 121:17 122:18,22 124:2 125:2 126:16,20 127:4 128:3 132:12 133:1 137:11 138:15,21 144:18 145:23 149:3 152:14 155:4,12 165:24 169:16 177:5 178:22 183:14 184:21 198:8 203:3 203:17 208:4 215:21 | 218:16,19 219:5,15 223:2,14 224:1 225:18,19 226:10,14 229:20 234:18 238:1 239:8 240:1,10 241:16,24 243:17 245:8 246:9 ones 60:8 100:12 102:14 106:8 148:3 148:23 150:4 152:18 181:11 218:16 230:11 238:24 ongoing 106:13 107:23 216:16 217:2 online 219:15 only 15:23 25:22 27:7 27:8 61:5 62:20 77:5 105:14 110:16,18 121:22 122:5,22 130:15 135:14 149:12,21 163:18 176:11 180:9,20 183:11 184:6 185:22 194:9 223:24 |
| O O 10:1 215:15 225:1 Oakland 107:9 oath 7:1 object 34:17 221:11 242:22 objection 9:6 9:16,18 158:1 170:12 171:13 214:6,19 215:1 237:8 237:15 objectively 178:23 | | | | | |

| | | | | | |
|--------------------|-----------------------|-------------|---------------------|----------------------|---------------------|
| 238:17 | 140:3 | 26:2 33:12 | 211:5,19 | 226:7 | overwhelm... |
| 245:8 | 167:10 | 36:8 44:14 | 218:16,17 | 240:11 | 114:15 |
| 249:21 | 178:16 | 47:5 50:1 | 219:6,19,24 | 249:1 | own 17:14 |
| onto 83:22 | 185:5 223:5 | 52:5,8,13 | 220:4 | outcome | 25:21 37:13 |
| 119:2 | opportunity | 55:4 61:8 | 222:10 | 114:18 | 75:16 |
| 121:22 | 57:7 219:13 | 62:3 65:17 | 226:12 | output 51:20 | oxygen 38:18 |
| 124:21 | opposed 49:6 | 66:3,22 | 227:10,18 | 53:15 | 38:20 39:5 |
| 127:21 | 225:15 | 70:4 72:16 | 228:9,18 | outset 96:21 | 39:14,21 |
| 130:14 | opposite | 73:18 76:18 | 230:9,11 | outside 18:10 | 72:23 74:1 |
| 132:14 | 54:24 | 77:13 84:2 | 231:22 | 19:4,6 26:4 | 74:4 75:8 |
| 133:1,19,24 | 189:13 | 84:20,22 | 232:22 | 29:24 83:16 | 76:5 77:6 |
| 134:16 | 227:20 | 85:7,17 | 234:15 | 120:14 | 77:16 82:8 |
| 135:7 | options 240:7 | 86:8,16,19 | 235:9 241:8 | 179:6 | 154:22,22 |
| 138:24 | 240:19 | 91:24 92:5 | 246:20 | over 6:8 10:7 | 155:19,21 |
| 139:10,23 | oral 118:23 | 94:4,6 95:9 | 248:11,21 | 10:8 21:18 | 156:3,9 |
| 145:6,12 | orange 33:15 | 101:19 | others 21:21 | 23:7 29:7 | 167:21 |
| 146:6,14 | 33:22 34:5 | 102:5 | 46:19 47:1 | 66:9 76:20 | 168:15 |
| 154:19 | 34:7,21,23 | 104:13 | 63:7 77:10 | 106:8 | 182:13 |
| 155:14 | 247:21,23 | 105:6 | 77:19 | 110:18 | 183:2,11,14 |
| 158:24 | 248:1 | 107:24 | 140:20 | 117:7 | 183:21 |
| 159:2 | orangeish | 108:23 | 144:16 | 119:23 | 184:1,5,13 |
| 161:14 | 248:24 | 110:24 | 221:9,21 | 120:1 | 184:16 |
| 162:7 | oranges | 113:8 | ourselves | 138:16 | 185:21 |
| 169:17 | 129:15 | 115:14 | 152:21 | 143:18 | 186:5,18 |
| 170:21 | order 5:1 | 118:11 | out 8:22 | 164:17 | 187:1,11 |
| 173:22 | 217:6 | 122:10 | 13:20 19:8 | 181:4 | 211:11,16 |
| 180:13 | Oregon | 125:17,21 | 28:8,23 | 185:18 | 212:11 |
| 181:18 | 15:21 | 126:9,13 | 32:1 50:11 | 189:23 | 228:18 |
| 185:12 | organic | 135:10,15 | 54:5,19 | 199:12 | 229:11 |
| 192:1 | 35:24 36:4 | 136:3,19 | 60:10 68:4 | 225:22 | 239:12 |
| 200:22 | 36:12 42:21 | 138:5,12 | 69:22 95:18 | 227:7 228:8 | O'Hare |
| 201:17 | 71:8 194:12 | 140:22 | 96:18 97:21 | 228:14 | 100:3 |
| 207:24 | organisms | 147:24 | 102:22 | 229:1 | |
| 214:1 | 173:9 | 150:1 | 107:13 | 238:18 | P |
| Open 5:15 | 194:13,20 | 151:11 | 111:13,19 | 243:18 | P 2:1,1,16 |
| operation | 220:24 | 152:1,3 | 115:4 | 244:9 | 180:14 |
| 98:1 99:9 | 228:21 | 157:22,23 | 119:18 | overall 4:22 | page 3:3,7 |
| 217:23 | 234:16 | 158:9 | 125:18 | 32:19 38:18 | 13:5 14:21 |
| 218:1,23 | organizatio... | 167:24 | 144:3,4,7 | 42:12 89:3 | 14:24 15:10 |
| operational | 226:17 | 168:4,6 | 146:3 | 136:11 | 20:5,8 29:7 |
| 217:17 | original | 169:19 | 149:24 | overflows | 29:22 31:11 |
| 218:7,17 | 77:24 | 177:24 | 151:8,10 | 48:14 | 33:14 35:22 |
| 219:4 223:7 | 113:24 | 179:6 184:4 | 152:4,6 | 246:12 | 37:16 41:8 |
| operations | 130:1,9 | 184:8 | 173:20 | overhanging | 45:8 46:10 |
| 95:23,24 | Orth 170:8 | 188:23 | 177:15 | 50:5,8 71:6 | 49:3 50:10 |
| 96:4,12 | other 6:8 | 191:4 | 182:15 | 187:16 | 54:19 56:5 |
| 97:6,14 | 13:18 15:12 | 203:22 | 189:19 | 188:4,18 | 59:5,24 |
| 99:12 | 19:3,13 | 204:4,11 | 217:22 | 189:9,13 | 60:6 62:7,9 |
| opinion | 22:3 25:9 | 209:9,9 | 218:1,22 | 220:13 | 62:10,15,24 |
| | | | | | 63:24 64:23 |

| | | | | | |
|-------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| 65:13 71:15 | 231:11,13 | 142:10 | 218:13 | 162:10 | 80:23 |
| 73:3 76:14 | 243:15 | 153:15 | 225:20 | 163:18 | 160:20 |
| 76:14 77:1 | 246:16 | 196:4 | 247:6,8 | 165:7,8,18 | 161:20 |
| 78:13 80:9 | pages 37:2 | 197:17 | path 249:6 | 165:21 | 162:13 |
| 84:9 85:21 | 61:24 | 210:14 | pathogens | 166:2,6 | 243:18 |
| 88:5,6,24 | 121:13 | 220:9 242:7 | 218:22 | 180:16 | 244:1 |
| 98:8 111:8 | 122:3 | 242:20 | pattern 73:9 | 181:3,23 | periodic |
| 118:3 | 155:16 | 243:2 | 73:13,16,20 | 182:7 183:1 | 239:11 |
| 121:21 | 168:21 | partially | 234:2,4,19 | 183:4,10,11 | periods |
| 123:13 | 194:22 | 195:13 | 234:24 | 184:8,10,13 | 27:24 28:1 |
| 124:22 | 236:14 | 216:14 | patterns | 184:15 | 99:23 181:4 |
| 127:24 | paired 212:3 | participants | 176:3,10,12 | 185:18 | 217:23 |
| 133:24 | pairs 180:9 | 214:6 | PCB 169:4 | 187:16 | 244:9 |
| 134:16 | 180:20 | participating | PCB's 148:6 | 188:4,18 | permanent |
| 135:7 137:9 | paper 37:2 | 107:9 | 148:9 | 189:12 | 194:19 |
| 139:1,23 | 172:17 | particular | 150:16 | 194:24 | 217:4 223:9 |
| 154:19 | 174:8,18,20 | 19:9,11 | penetrate | 199:21 | persistence |
| 156:6 | 174:21 | 49:21 59:3 | 64:8 | 216:12 | 174:5 |
| 158:24 | 175:13 | 65:17 72:8 | people 7:14 | 223:7 | person 61:7 |
| 165:2 | 249:9 | 74:1 81:13 | 32:10 95:9 | 240:22 | 118:7 |
| 167:16 | papers 15:19 | 95:7 165:22 | 101:5 | percentage | 140:16 |
| 168:24 | 124:9 | 173:18 | 107:24 | 49:6,10,12 | 229:3 |
| 169:18 | paragraph | 205:7 238:2 | 127:4 | 50:6,7 | personal |
| 170:21 | 123:15 | 249:11 | 131:18 | 81:10 90:17 | 251:11 |
| 172:24 | 180:13,23 | particularly | 219:17 | 90:20 | personally |
| 173:6,10,13 | parameter | 28:18 55:20 | 221:22 | 160:23 | 75:19,20 |
| 173:17 | 98:16 | 155:19 | per 57:24,24 | 165:22 | 105:12 |
| 174:17 | parameters | 240:9 | 132:4 | percentages | 176:8 |
| 179:20 | 77:9,14 | 249:17 | 180:19 | 140:9 | perspective |
| 181:18 | 169:2,9 | particulars | 228:1 | perch 60:17 | 232:7 |
| 182:3,22,23 | paraphrased | 45:11 | 241:11 | 60:21,22 | Phone 251:22 |
| 183:23 | 172:3 | partly 136:24 | percent 11:6 | 61:6,9,12 | photograph |
| 185:12 | paraphrasi... | partners | 11:13,22,24 | 63:8 | 34:2 248:13 |
| 186:21 | 154:14 | 219:6 | 12:7 49:17 | perfect 138:6 | 248:17 |
| 187:13,19 | parentheti... | parts 1:5 | 49:20 63:3 | perform | phrase 87:3,5 |
| 188:16,22 | 171:7,20 | 22:1 29:18 | 65:13,22 | 106:14 | 137:4 |
| 192:2 | part 10:24 | 29:20 47:1 | 71:5 81:6 | 219:14 | 154:24 |
| 193:10 | 14:5 22:2 | 47:5 56:7 | 81:14,17,24 | performed | 155:2 199:9 |
| 194:6 | 23:21 33:9 | 71:7,8 | 82:1 129:7 | 167:5 | 202:9,15 |
| 195:10 | 33:18,23 | 127:18 | 129:11 | 188:11 | phrased |
| 196:1,17 | 37:23 38:1 | 238:21 | 134:5 136:1 | perhaps | 136:24 |
| 197:18 | 44:23 47:6 | pass 29:12 | 136:10,11 | 22:16 82:16 | phrases |
| 198:2,21,21 | 48:7 67:3 | 118:23 | 136:20 | 83:11,11 | 202:6 |
| 199:14 | 79:4,7 | 247:11 | 137:14,16 | 100:21 | physical |
| 200:23 | 95:19 | passing 57:9 | 137:17 | 113:21 | 27:12 |
| 201:17 | 106:10 | 194:3 | 138:7,22 | 117:14 | 121:19 |
| 203:2,15,17 | 117:15 | password | 156:20,22 | 122:11,11 | 128:6,21 |
| 207:24 | 121:10 | 38:8 | 159:9,12 | 224:5 | 134:22 |
| 217:11 | 140:16 | past 36:15 | 161:17 | period 78:17 | 135:2 |

| | | | | | |
|----------------------|----------------------|-----------------------|---------------------|----------------------|----------------------|
| 136:10,15 | 247:1 | 74:10 81:15 | 125:13 | 90:11 91:9 | 148:19 |
| 172:14,18 | plan 217:22 | 100:16 | 131:4 135:5 | 91:11 | post 105:21 |
| 173:7,13 | plans 102:24 | 131:21 | 143:19,24 | 130:15 | pot 148:21 |
| 181:20,23 | 103:1 235:3 | 147:10 | 144:16,18 | 131:13 | potential |
| 182:12 | 235:3 242:3 | 173:20 | 157:3 | 132:1,11,11 | 45:4 64:15 |
| 183:5,9,17 | plant 35:23 | 174:11 | 177:24 | 132:12 | 90:17 |
| 185:18 | 36:2 41:19 | 211:15,16 | 197:21 | 155:10,11 | 102:12 |
| 186:2,23 | 52:15 | 244:6 | 209:2,4,5 | 188:5 | 108:21,22 |
| 187:2,20 | 241:21 | pointed | 231:2 246:6 | 189:20 | 124:3 135:1 |
| 188:23 | planting | 182:15 | poorer 23:13 | 197:9 | 193:14 |
| 191:14 | 200:15 | points 37:10 | 25:9 111:22 | positively | 198:23 |
| 192:8 | plants 64:11 | 74:14 199:4 | 112:7 | 65:15,15,24 | 199:18 |
| 198:24 | 64:12,13 | 211:15 | 154:22 | 154:21 | 239:13 |
| 217:9,15,19 | 157:24 | POLICY | 155:21 | 155:1,2 | potentially |
| 219:19,22 | 158:10 | 2:13 | 198:5 | 156:7 | 93:22 |
| 220:18 | played | political 16:4 | poorly 26:9 | 187:21 | 136:21 |
| physically | 186:16 | 16:8 | 156:8 | 189:18 | 144:16 |
| 246:20 | plays 206:22 | polling 36:20 | popping | 191:24 | 179:15 |
| physiological | please 6:5,7 | Polls 237:13 | 148:16 | positives | power 130:2 |
| 194:2 | 6:10 22:7 | 238:19 | population | 131:16 | 130:11 |
| pick 190:18 | 41:9 70:24 | 239:19 | 84:11 99:6 | possess | 158:10 |
| picked 34:23 | 117:12 | pollutants | 105:18 | 118:10 | practical |
| picture 242:2 | 119:2 122:3 | 20:22 21:1 | 176:13 | possession | 148:21 |
| 248:1 | 123:21 | 21:3,5 36:8 | populations | 118:17 | 240:13 |
| piece 168:20 | 145:17 | pollution 1:1 | 22:13 45:13 | possibilities | practically |
| pier 97:10 | 150:18 | 1:9 20:8 | 231:17 | 91:2 240:4 | 135:5 |
| 142:21 | 154:23 | 208:2 | portion | possibility | practice |
| piers 28:21 | 156:12 | 209:11,16 | 29:24 | 92:17 93:8 | 118:14 |
| 153:20 | 159:6 | 209:19 | 102:20 | 93:12 96:14 | 213:17 |
| pile 30:23 | 169:21 | polygons | 107:12 | 97:20 102:4 | Prairie 5:9 |
| 31:2 234:7 | 171:5,6 | 249:18,19 | 117:15 | 104:17 | 5:14,20 |
| piling 200:11 | 174:6 | pool 92:22 | 136:11 | 232:15 | 191:6 214:4 |
| pinpoint | 182:10 | 173:2 | 195:5 | 235:4 | 224:22 |
| 68:19 | 195:15 | 232:15,23 | 241:14 | 239:21 | precaution... |
| place 78:17 | 196:5 200:2 | pools 15:1 | portions | possible | 219:10 |
| 80:23 88:16 | 202:5 204:7 | 92:19 | 107:11,17 | 34:15,17 | preceding |
| 95:7 108:7 | plot 73:12 | 102:16,19 | 107:18 | 36:13 63:10 | 81:8 |
| 112:1 | plots 142:1,2 | 144:9 | 238:6 | 72:14 83:19 | precisely 8:8 |
| 166:17 | plug 69:14,15 | 173:19 | 246:21 | 91:22 | preclude |
| 196:12 | plus 131:20 | 233:7 | posed 92:13 | 119:24 | 102:18 |
| 223:6 231:4 | 132:8 | poor 22:12 | positive | 147:19 | preconceived |
| 247:15 | pocket 56:6,9 | 23:1,9,10 | 12:19 63:1 | 148:1 151:4 | 6:13 |
| places 25:9 | 56:11,20 | 25:1,3,4,8 | 63:7 66:21 | 206:12,15 | preconcept... |
| 25:10 26:13 | 57:12,14,16 | 25:14 43:23 | 66:22 67:10 | 240:7,13,16 | 101:16 |
| 98:13 | 57:23 71:6 | 43:23 47:15 | 67:17 68:18 | 240:19 | predator/p... |
| 211:11 | 190:20 | 112:11 | 68:19 69:2 | 241:15,18 | 84:16 |
| 241:15 | point 16:10 | 113:6 114:5 | 69:9,21 | 246:22 | predicated |
| Plaines 1:4 | 16:16 28:15 | 114:6 115:8 | 70:4 89:9 | 247:4,7 | 199:23 |
| 4:6 246:19 | 54:18 74:5 | 115:9,12 | 89:12 90:6 | possibly | predicted |

| | | | | | |
|-------------------------------|----------------------------------|----------------------------------|---------------------------------|------------------------------------|---------------------------------|
| 73:8 137:24 138:1 | presently 104:22 | 155:17 160:6 182:2 | 107:4 | produced 7:13 11:2 | proper 248:16 |
| predictor 154:23 | presents 38:23 | 182:23 183:24 | private 107:15 | 17:17 37:21 | properly 97:12 |
| 155:21 | presumably 60:14 61:11 | 187:14 188:16 | probable 247:17 | 39:20 220:23 | 237:21 |
| 157:3 | 247:14 | 193:10 | probably 8:12 78:21 | professional 10:24 118:9 | property 107:15 |
| predominant 44:18 | pretty 39:18 | 194:7 | 79:13 85:9 | 118:15 | proportion 63:5 114:3 |
| predomina... 43:2 | 56:4 94:1 | 195:11 | 87:9 96:21 | profession... 118:18 | 114:8 202:3 |
| preferably 100:12 | 152:24 | 196:1,18 | 116:6 | profile 74:5 | proposals 99:22 100:4 |
| preference 173:18 | 191:21 | 197:19 | 120:22 | 74:17 | 100:6 |
| 207:18 | 212:8 | 198:3,22 | 130:8,11 | profiles 212:11,17 | proposed 1:4 |
| preferences 207:11 | prevalent 55:2 | 199:15 | 222:11 | profiling 74:19,20 | 4:7 78:16 |
| prehearing 4:22 | prevent 107:23 | 200:23 | 234:21 | 212:19 | 80:13,22 |
| preliminary 236:7 | 200:13 | 201:18 | problem 14:14 32:13 | program 95:14 | 81:6,13,17 |
| 237:10 | 216:9,23 | 203:2,12,16 | 36:9 66:12 | programs 88:16 | 100:10 |
| preparation 239:4 | 236:9 | 208:1 | 94:10 98:8 | progression 146:18 | 156:21,23 |
| prepared 104:2 | 237:12 | 214:20 | 223:9 227:1 | progriv... 118:21 | 158:17,20 |
| prequel 88:17 | 240:23 | 215:20 | problems 14:13 57:10 | project 100:13 | 159:2,5,10 |
| presence 90:6 91:10 | prevented 218:12 | 219:16 | 64:15 107:3 | 105:21 | 159:13,19 |
| 131:5 | preventing 195:21 | 231:13 | 107:22 | 106:12 | 160:5,8 |
| 140:12 | 215:23 | 239:10 | proceed 5:11 | 237:9 | 161:19 |
| 153:21 | 216:2 | 243:14,21 | proceeding 4:4,22 | prospective 111:18 | 162:11 |
| 204:15 | previous 166:3 | primarily 100:11 | 39:16 | protect 106:12 | 167:6,12 |
| present 14:23 | previously 64:9 77:12 | 203:23 | 121:11 | 100:13 | 199:19 |
| 15:5 60:9 | 109:6 | 220:9 | 129:10 | 105:21 | protected 221:8 |
| 68:9 90:12 | 120:10 | 226:17 | 161:20 | 106:12 | 221:8 |
| 130:4,11 | 169:11 | 227:24 | proceedings 1:7 63:17 | 237:9 | protection 2:6 222:23 |
| 142:24,24 | 181:22 | 230:21 | 116:24 | projects 94:19 | protocol 121:15 |
| 143:3 144:5 | 195:2,7,24 | 242:15 | 193:3 | 100:23 | 122:19 |
| 162:9,20 | 196:8 | primary 77:8 | 214:11 | 101:4,13,16 | 140:2,4 |
| 175:4 | 237:23 | 199:2,7,10 | 251:7,9 | 104:1 | protocols 19:19 |
| 179:16 | prey 204:5 | 240:20 | process 36:21 | 105:13,24 | 121:12 |
| 190:22 | pre-filed 84:5,8 | 241:12 | 54:6 109:5 | 107:14 | 122:9 146:2 |
| 191:2 | 88:12,14,14 | principal 150:16,19 | 123:19,20 | 200:19 | 146:5 |
| 206:24 | 95:13 | 151:12 | 123:23 | 233:4,15 | 226:15 |
| 235:8 | 108:13 | Principles 171:10 | 124:3,4 | prologue 96:6 | 227:3 |
| presented 192:12 | 111:8 | 248:24 | 150:10 | promise 31:12 | provide 38:5 |
| | 117:22 | 249:8 | processed 34:12 | promote 174:4 | |
| | 118:3 128:1 | prior 117:14 | 198:16 | propellers 97:20 | |
| | 134:1,17 | prioritize 107:5 | processing 34:10 | propellor 194:1 | |
| | 135:8 | prioritized 107:13 | produce 7:6 | | |
| | | prioritizing 130:15,19 | | | |

| | | | | | |
|----------------------|------------------------|-----------------------|---------------------|----------------------|---------------------|
| 78:5 83:17 | 242:18 | 68:4 72:19 | quantity | 158:2,22 | 6:10,21 |
| 120:24 | 248:15 | 77:3,5,8,14 | 57:20 60:10 | 159:22 | 8:19 9:23 |
| 124:9 132:5 | putting 32:8 | 77:22 78:21 | 138:12 | 160:6 | 13:2 25:21 |
| 133:17 | 107:22 | 79:19 89:3 | 187:23 | 162:19 | 37:13 51:5 |
| 152:15 | 175:10 | 94:9,15,16 | 190:1 | 164:2 167:3 | 52:13 60:19 |
| 153:1 | 217:17 | 98:16 109:1 | question 6:2 | 167:16 | 74:22 76:9 |
| 169:16,21 | 232:15 | 110:24 | 6:3 20:16 | 170:4,21 | 83:23 88:3 |
| 171:5 | P.O 2:7 | 111:1 131:4 | 24:20 25:20 | 176:17 | 88:4 95:13 |
| 187:24 | | 136:4 145:9 | 32:16 35:18 | 179:20 | 95:21 99:17 |
| 192:7 | Q | 155:5,18,21 | 35:22 37:12 | 181:18 | 108:1,10,13 |
| 194:11 | QHEI 122:24 | 156:2 159:3 | 42:3 48:12 | 185:12 | 117:6,8,17 |
| provided | 128:4,9,18 | 159:17 | 49:2,4 | 187:13 | 166:10 |
| 39:1 107:11 | 134:5,8,11 | 161:19 | 50:13 51:6 | 189:24 | 169:16 |
| provides | 134:19,21 | 162:12 | 52:11,19 | 191:12 | 211:4,5,8 |
| 217:5 | 135:1,3,12 | 164:12 | 62:23 63:23 | 192:19 | 215:19 |
| public 14:5,7 | 135:13,16 | 167:6,12,23 | 71:23,24 | 194:6 | 219:16 |
| 79:5,8,12 | 139:3,6 | 168:4,5,9 | 73:1,2 | 196:17 | 222:10 |
| 79:15 | 140:1,4,5 | 176:19 | 76:16 83:24 | 197:23 | 225:21 |
| 121:10 | 141:11,13 | 178:19,24 | 84:3,19,21 | 198:21 | 236:16 |
| 139:2 | 141:18 | 180:12 | 85:12 88:12 | 199:14 | 244:16 |
| 155:16 | 143:16,16 | 181:12 | 88:14,15,20 | 200:22 | 247:19 |
| pulsing 221:1 | 143:22 | 183:8 186:3 | 89:21 92:23 | 203:1 | quick 108:24 |
| 224:15 | 144:8,22 | 187:9 188:5 | 97:12 98:5 | 206:19,20 | quite 96:9 |
| 245:11 | 145:4,7 | 192:14 | 99:21 | 207:24 | 180:20 |
| pure 143:5 | QHEI's | 208:8,14 | 101:21 | 210:10,24 | 228:15 |
| purely | 128:15 | 209:3,4,6 | 104:1,7 | 221:13 | quote 46:11 |
| 221:17 | qualificatio... | 211:20 | 108:14 | 222:17,22 | 117:24 |
| purpose 83:4 | 117:21,23 | 213:3,9,14 | 110:4 111:5 | 223:24 | 118:2 |
| 117:16 | qualifying | 213:18 | 111:6 | 224:6 226:3 | 121:22 |
| purposes | 178:16 | 227:15 | 113:24 | 226:9 227:9 | 122:2 |
| 37:11 43:11 | qualitative | 228:1 | 116:14 | 227:17,23 | 123:16 |
| 72:1 104:23 | 28:2,6 | quantified | 117:11,14 | 228:12,15 | 133:2,3 |
| 133:21 | 41:21 43:13 | 32:19 | 117:19 | 229:4,19 | 134:2,7,18 |
| 144:16 | 70:14,22 | quantify | 119:2 123:5 | 230:3,24 | 134:23 |
| 223:17 | 121:23 | 31:19 33:1 | 123:12 | 231:1,21 | 135:20 |
| push 120:8 | 126:8 140:7 | 119:22 | 127:16,24 | 232:2 | 140:2,2 |
| pushing | 140:10,20 | 154:3 | 129:4,5,10 | 234:22 | 156:7,11 |
| 36:21 | 140:24 | quantitative | 129:23 | 235:6 | 159:2 |
| put 6:20 32:1 | 141:4,6,9 | 28:7 50:22 | 133:1,24 | 239:10 | 163:13 |
| 80:1 91:12 | qualitatively | 53:19 101:8 | 134:16 | 246:10 | 167:18 |
| 112:24 | 36:23 | 122:5 140:2 | 135:7,24 | 247:21 | 168:1,24 |
| 143:13,14 | quality 1:2 | 140:4,6,18 | 136:16 | 248:22 | 169:20,21 |
| 147:23 | 4:4 7:12 | 141:1,13,15 | 137:1,2,11 | questioned | 170:23 |
| 148:21 | 16:13 37:20 | 141:18 | 137:13 | 5:13,19 | 171:1 172:4 |
| 149:23 | 41:11,13,17 | quantitativ... | 138:24 | questioning | 172:13,15 |
| 196:12 | 41:23 44:2 | 50:20 | 143:10 | 117:9 160:7 | 172:24 |
| 212:8 | 45:2,22 | 126:11 | 145:12 | 185:5 | 173:10,13 |
| 234:23 | 52:5,6 53:3 | quantities | 146:16 | questions 5:6 | 173:17 |
| 236:18 | 54:12 55:2 | 141:2 | 153:5,9 | 5:10 6:7,9 | 174:6,10 |
| | 58:15 68:2 | | | | |

| | | | | | |
|---------------------|----------------------|--------------------|----------------------|---------------------|----------------------|
| 179:24 | 77:3 126:23 | 28:14 31:12 | 151:23 | 222:12 | 220:3 |
| 180:24 | 131:20 | 52:2,4,5 | 177:19 | recognized | red 248:24 |
| 181:5,21 | 132:1,21 | 56:6,7 88:9 | 178:20 | 14:19 23:9 | redirecting |
| 182:1,3,9 | 134:20 | 89:3 92:20 | 196:21 | 23:16 68:1 | 103:2 |
| 182:15 | 135:3 | 177:15 | 197:14 | 141:5 223:1 | reduce |
| 183:3,8,9 | 143:18 | 178:6 192:4 | 223:4 | recognizing | 107:14 |
| 185:14 | 154:10 | 192:15 | 225:20 | 146:24 | 124:1 |
| 187:14,18 | ranging | 195:12 | 227:21 | recollection | 176:12 |
| 187:20 | 163:9 184:5 | 198:4,6,8 | 234:5 | 25:13 75:6 | reduced |
| 188:1 190:1 | rank 187:8 | 199:12 | 242:16,19 | 86:13 87:5 | 98:14 |
| 191:14 | Ranken | 248:8 | reason 13:18 | 87:19 | reducing |
| 194:7,14,23 | 121:23 | reactional | 16:5 20:13 | recommend | 124:3 |
| 195:12,15 | 122:2 | 221:12 | 22:10 91:3 | 109:11 | redundant |
| 196:2,18 | 135:13 | read 6:1 | 91:12 | 221:7 | 64:4,6 88:4 |
| 197:20 | ranking | 30:21 71:23 | 183:20 | recommen... | 95:19 |
| 198:3 199:1 | 126:16 | 72:1 76:2 | 212:10 | 109:9 | reevaluated |
| 199:5,6,8 | Rao 2:3 4:16 | 80:13,17,20 | 218:18 | recommen... | 7:21 |
| 202:4,6,7,7 | rapid 53:2 | 88:20 99:21 | 249:4 | 238:10 | refer 31:8,10 |
| 203:3,9,11 | rare 160:10 | 113:12 | reasonable | recommen... | 39:3 79:11 |
| 203:18 | rarely 159:16 | 127:15,23 | 16:5 145:8 | 231:15 | 87:16 |
| 204:6,8 | rate 80:21 | 129:6 | reasons | reconnect | 164:19 |
| 207:12,15 | rates 78:15 | 168:23 | 70:14,22 | 103:2 | 188:10 |
| 208:2,5 | 78:15 | 172:22 | 94:4,6,7 | record 6:10 | reference |
| quoted 13:9 | 114:23 | 206:19 | 119:15 | 6:12,15 | 10:22 12:2 |
| 188:12 | rather 52:3 | 207:12,15 | 141:4 | 14:3,4 | 45:7 122:1 |
| quotes | 121:2 140:9 | 231:10 | 147:23 | 37:23 38:1 | 122:6 |
| 172:20 | ratio 33:4 | 238:13,23 | recall 29:17 | 40:2 41:1,3 | 135:14,20 |
| | 63:6 166:1 | reading | 47:2 52:16 | 41:4 47:16 | 168:12 |
| R | 166:4 | 43:13 44:2 | 53:16 55:21 | 63:19 70:21 | 189:15 |
| R 2:1 72:7 | rationale | 93:24 99:20 | 55:24 56:1 | 70:24 72:1 | 206:4,9 |
| 134:3 135:9 | 16:18 72:3 | 175:10,13 | 56:14 60:12 | 80:20 | 222:20 |
| 135:11 | reach 32:22 | 229:19 | 60:18 74:12 | 133:14 | referenced |
| 138:19 | 49:13,24 | 235:6 | 78:8 86:2 | 158:15 | 174:10 |
| 155:7 157:1 | 56:18 57:21 | reads 33:21 | 92:24 109:4 | 160:18 | 248:15 |
| 163:8,12,13 | 58:2,7,10 | ready 9:23 | 113:24 | 169:22 | references |
| 180:11,14 | 58:13,21 | 63:18,19 | 132:23 | 171:6 | 12:3 120:12 |
| 180:19 | 72:10,10 | 117:2 193:4 | 142:3 | 175:11 | 146:3 |
| 181:1 182:5 | 109:1,1,21 | 193:6 | 157:19 | 193:5 | 169:20 |
| 182:15 | 109:21 | 214:12 | 206:11 | 211:15,18 | referred 30:3 |
| 184:3,5,17 | 110:20,20 | 215:14 | 213:17 | 213:12 | 36:8 203:8 |
| 197:2,4,7 | 154:8 199:1 | real 101:5 | receipt | 236:18 | referring |
| 197:15 | 199:7,9 | realistic | 118:22 | records | 19:18 37:13 |
| radar 242:14 | 219:7 | 199:18 | recent 237:5 | 170:2 | 45:8,9 53:1 |
| raise 6:4 | 220:21 | really 17:3 | recently 61:6 | recreational | 54:5 85:1 |
| ran 69:16 | 223:18 | 24:6 33:14 | Reclamation | 221:17 | 86:12 87:17 |
| Randolph | 244:4 | 37:7 56:21 | 99:13 109:3 | 222:1,7,21 | 88:24 121:9 |
| 1:11 | reached | 57:4 72:21 | 246:2 | recruitment | 139:6 160:4 |
| random | 219:9 | 92:23,24 | recognize | 174:3 | 160:7 |
| 73:13 | reaches | 127:5,10 | 8:23 9:1 | rectangular | 174:18 |
| range 69:13 | | | | | |

| | | | | | |
|-----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|
| 188:19,22 | regarding | 147:13,22 | relationships | 232:23 | 139:1,24 |
| 200:23 | 62:24 83:23 | 150:24 | 84:17 155:6 | rememberi... | 145:13 |
| 203:1,12,15 | 95:17,21 | 151:18,20 | 155:18 | 9:17 | 147:23 |
| 209:8 | 108:14 | 156:14 | 162:17 | remind 6:24 | 154:20 |
| 217:11 | 161:14 | 157:1 167:4 | 163:3,14 | removal | 155:15 |
| refers 10:22 | 162:7 | 167:20 | relative | 193:20 | 156:6 159:1 |
| 13:9 14:22 | 166:11 | 168:14 | 47:16,20 | 196:11 | 167:17 |
| 14:24 29:8 | 171:3 | 179:23 | 125:17,20 | 200:3,10 | 168:13,24 |
| 37:17 44:21 | 172:12 | 180:1,5,17 | 179:6 | removed | 169:19 |
| 56:23 63:23 | 173:23 | 180:24 | 181:20 | 67:11 152:2 | 170:22 |
| 65:6,19 | 182:24 | 181:3,22 | 192:8 | 199:24 | 175:10,24 |
| 76:14 87:6 | 193:10 | 182:4,16,18 | 197:16 | removing | 175:24 |
| 188:12,13 | 199:15,17 | 183:1 185:8 | 202:3 | 98:21,21 | 179:21 |
| 188:16 | 200:3 | 185:17 | 208:17 | 102:6 | 181:19 |
| 189:1 190:9 | regime 173:5 | 188:14 | 226:24 | 193:21 | 182:24 |
| 197:2 | 173:21,23 | 189:2,16,20 | relatively | repeat 12:16 | 185:13 |
| 202:10,16 | 174:11,14 | regulated | 112:2 113:5 | 21:16 | 186:10,21 |
| 205:4 | 175:7 | 220:9 | 134:19 | 117:17 | 187:19 |
| 207:12 | 176:18 | regulatory | 138:18 | 229:4 | 191:13 |
| Refinery | 177:6,15 | 162:13 | 153:1 155:7 | repetition | 192:3 |
| 215:19 | 178:16,21 | rejected | 156:9 157:6 | 25:21 | 193:16 |
| reflect 36:7 | 179:13,15 | 211:2 | 163:14 | repetitive | 197:20 |
| 172:21 | 193:17 | relate 78:18 | 180:2 183:6 | 224:6 | 199:16 |
| reflected | 234:2 | 80:24 | 187:9 204:2 | report 1:7 | 200:9 |
| 90:14,15 | regimes | 239:10 | 204:9,22 | 8:11 13:6 | 211:24 |
| reflecting | 171:11 | related 36:12 | 220:5,6 | 14:4,21 | 221:4 |
| 64:2 147:18 | 174:2 176:2 | 51:24 65:24 | 243:16 | 15:10 20:6 | 227:14 |
| reflection | 177:21 | 66:2 75:8 | relevant | 22:21 29:8 | 231:15 |
| 90:24 | 233:1 | 76:5 106:21 | 139:12 | 37:17,17,19 | 237:6,9,23 |
| reflective | region 84:18 | 107:20 | reliable | 37:20 38:23 | 238:3,7,11 |
| 212:21 | 84:20 85:14 | 170:24 | 110:13 | 45:9 46:10 | 238:23 |
| reflects 66:16 | 87:9,16 | 171:4 | 111:1 | 54:19,20 | 239:20 |
| 66:18,20 | 142:3 | 173:13 | relied 212:21 | 60:1 62:1 | 248:1,12 |
| 90:5 138:5 | regional 86:8 | 191:21 | rely 45:20 | 71:15 77:2 | 250:2 |
| refuge 30:7 | regionally | 207:10 | remain 168:1 | 79:14,15 | reported |
| 56:13 57:3 | 86:1,19 | 244:22 | 218:17 | 83:24 88:7 | 2:20 59:9 |
| 57:7 65:7 | 87:3,5,16 | relates 32:12 | remainder | 91:18,23,24 | 251:6 |
| 187:24 | registration | 117:20 | 154:14 | 95:18,22 | reporter 6:8 |
| regard 27:12 | 118:14,16 | relating | remains | 98:8 100:16 | 84:14 251:6 |
| 80:15 | regression | 169:19 | 183:18 | 100:24 | REPORTE... |
| 105:16 | 65:18,20 | relationship | 217:16 | 101:20 | 1:24 2:24 |
| 122:4 124:6 | 66:3 67:3,5 | 23:8 55:8 | remeander | 108:15 | 3:24 |
| 135:11 | 67:8 68:10 | 77:21 78:20 | 102:17 | 120:16 | reports 8:16 |
| 140:21 | 68:17 69:3 | 79:18 | remember | 121:2,3,8 | 39:7 121:9 |
| 141:7 | 69:12 70:2 | 122:14,17 | 8:7 100:8 | 121:12,21 | 226:20 |
| 153:10 | 70:5 71:16 | 162:4 163:7 | 112:17 | 121:21 | represent 6:6 |
| 159:14 | 73:7,11,18 | 163:22 | 126:23 | 122:22 | 41:21,24 |
| 182:11 | 134:2 | 166:15,24 | 164:19 | 123:13 | 44:2 57:11 |
| 186:7 243:9 | 137:20 | 184:2 197:8 | 229:6 | 124:11 | 131:14 |

| | | | | | |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| 132:4 | resembles | 98:13 | 230:13 | 180:22 | 236:8 |
| 146:23 | 200:16 | 137:21 | 231:19,23 | 188:20,24 | 237:11 |
| 147:1 | reside 46:1 | 139:4 168:6 | 231:23 | 189:1 | 240:3 241:8 |
| representat... | residual 73:5 | 180:20 | 232:15,23 | 197:10 | 246:19 |
| 53:17 85:5 | 183:1 | 183:21 | 235:5,9 | 206:8 | 247:1 |
| 92:14 | residuals | 185:15 | riffles 15:1 | 208:20 | rivers 5:9,14 |
| 123:14 | 73:4,7,12 | 199:3 202:1 | 92:15,16,18 | 222:8 | 5:20 15:2 |
| 203:21 | 138:11 | resulted | 93:1,5,10 | 223:14,15 | 93:11 |
| representat... | resources | 184:13 | 102:16,19 | 227:8 231:8 | 113:14 |
| 27:6 36:23 | 144:13 | resulting | 144:9 173:2 | 248:17 | 146:11 |
| 114:2 142:7 | respect 20:14 | 70:9 | 173:19 | rightly | 191:6 194:7 |
| representat... | 77:4 123:1 | results 40:16 | 233:7 | 142:11 | 214:5 |
| 35:6 119:1 | 126:14 | 66:13 67:9 | right 4:15,16 | right-hand | 224:22 |
| represented | 129:4 | 69:18 88:8 | 4:17 7:14 | 165:9 | 227:1 |
| 26:10 41:6 | 133:19 | 110:14 | 8:23 9:1 | rigorous | RNA 221:3 |
| 132:6 | 143:13 | 111:2 112:5 | 10:10 12:9 | 119:6,12,14 | road 131:19 |
| 202:17 | 154:2 | 134:3,19 | 14:16 17:15 | riparian | 247:2 |
| 203:19 | 172:17 | 136:18 | 19:21 34:4 | 220:16 | rock 114:14 |
| 204:16 | 203:17 | 139:11,21 | 34:20 39:3 | riprap | 207:17 |
| representing | 227:2 243:4 | 151:2,19 | 40:12 42:5 | 191:18 | 209:18 |
| 41:13 61:17 | 243:7,22 | 179:3 | 42:6,14 | river 1:4 4:6 | rod 36:21 |
| 84:12 85:9 | respectfully | 183:14 | 48:9 49:6 | 15:17,17,18 | role 23:11 |
| 204:23 | 162:23 | 187:3,8 | 49:18 52:12 | 15:21 16:13 | 186:16 |
| represents | respects | 207:2,6 | 52:15 53:22 | 16:14,15 | 206:23 |
| 34:5 50:6,7 | 116:2 | 244:7,7,10 | 55:16 56:3 | 17:11,11,11 | ROM 39:15 |
| 57:19 58:12 | respond 72:2 | resume 94:1 | 58:21,23 | 17:12,18,19 | Ronald 170:7 |
| 85:19 86:24 | 104:2 | 105:12 | 61:11 63:13 | 17:19,21,22 | rotenone |
| 204:2,9 | response | resuspension | 63:14,22 | 18:3 29:24 | 218:21 |
| reproduce | 8:18 23:18 | 46:14 47:15 | 67:7 70:11 | 30:1 33:18 | 219:1,7 |
| 235:16 | 69:24 70:2 | retained | 70:16 79:6 | 34:1 42:8 | 244:1,3 |
| reproduced | 84:18 | 104:20 | 87:11 88:16 | 44:4 47:4,6 | Rouge |
| 174:20 | 166:10 | returned | 89:10 90:4 | 47:7 74:9 | 106:17,20 |
| reproductive | 221:20 | 7:15 | 91:3,19 | 101:19 | 106:23 |
| 62:11 | 222:3 | revealing | 93:7 97:4 | 103:20 | round 7:5 |
| requested | responses | 31:13 | 100:19 | 104:7,9 | route 241:12 |
| 8:18 | 174:10 | review | 109:19 | 106:17,20 | routinely |
| require 32:3 | responsible | 121:11 | 115:22 | 108:21 | 26:14 46:21 |
| 196:8,11 | 118:21 | 238:21 | 116:19 | 112:1 | routing |
| 231:19 | 238:3,5,22 | reviewed | 125:19,22 | 121:12 | 94:19,22 |
| required | rest 93:5 | 40:13 121:4 | 132:19 | 139:15 | rule 115:3 |
| 31:9,15 | 189:21 | 122:21 | 147:9 149:4 | 172:15 | rulemaking |
| 121:19 | restoration | revised 8:1,3 | 150:14,15 | 173:1,9 | 1:3 6:21 |
| 194:13 | 93:12 233:2 | rhetorical | 154:18 | 192:14 | 167:7 |
| requireme... | 233:3,4,14 | 35:20 | 155:14 | 194:18 | 169:23 |
| 118:6 | 234:6 | richness | 160:13 | 195:9 | 212:24 |
| requires | restore 106:9 | 62:13 | 161:3 | 199:22 | 222:19 |
| 223:11 | 196:6 | rifle 92:5,6 | 174:23 | 200:5 | run 43:22 |
| researchers | result 22:12 | 92:21 | 175:3 178:9 | 201:12 | runoff 13:7 |
| 175:6 | 46:12 55:4 | 139:15 | 178:10 | 210:3 234:1 | 36:11,13 |

| | | | | | |
|---------------------|---------------------|----------------------|----------------------|----------------------|---------------------|
| 46:13 47:14 | 36:24 61:1 | 108:19 | scope 109:14 | 225:11 | 46:15,17 |
| 136:6 | 110:22 | 137:8,15 | 200:19 | 237:13 | 47:18 48:7 |
| runon 71:24 | 161:7 | 141:17 | score 88:8 | se 132:4 | 48:15 |
| runs 15:1 | 212:15 | 177:3,19 | 101:10 | 228:1 | 106:24 |
| 33:23 | 213:10 | 204:24 | 108:22 | 241:11 | 107:3 |
| R08-09 1:2 | 243:16 | 209:12 | 125:17 | seasonal | 114:12 |
| R08-9 4:9 | sampling | 233:20 | 126:17 | 194:11 | 136:4 |
| | 27:18 51:11 | says 13:5 | 131:7,12,14 | Secchi 29:14 | 146:15,17 |
| S | 51:18,21 | 41:8 50:5 | 132:13,15 | 30:13,14 | 147:3,13,18 |
| S 2:1 3:10 | 53:18 56:6 | 64:2 71:16 | 139:5,11 | 64:1,3,5,7 | 149:4,13,14 |
| safe 226:2 | 56:18 57:20 | 73:2 144:18 | 140:17 | 64:13 | 149:19,23 |
| saith 214:17 | 58:2,7,10 | 158:19 | 141:8 199:4 | second 11:13 | 150:4 |
| salmon 26:20 | 58:12,21 | scale 41:13 | 199:21 | 41:1 47:14 | 152:11 |
| 26:24 61:2 | 59:3 81:9 | 102:15 | 219:17 | 62:17,20 | 169:2,9 |
| same 18:22 | 83:1 110:17 | 126:21,22 | scores 88:23 | 101:23 | 194:4 |
| 20:22 21:7 | 110:18 | 127:3,5,9 | 89:1,2,8 | 165:9 | 197:20 |
| 29:13 30:12 | 120:2 128:9 | 131:21 | 90:10 101:9 | 168:22 | 201:8 |
| 30:15 46:23 | 154:8 | 132:8,9,9 | 126:6,18 | 170:9,13 | sediments |
| 77:16 82:22 | 161:21 | 143:18 | 128:4,9 | 188:13,15 | 13:10,11,23 |
| 83:2 85:10 | 211:10,15 | 196:16 | 132:21 | 191:12 | 21:15,19 |
| 85:22 86:18 | 211:17,21 | 200:20,21 | 134:20 | secondary | 22:24 45:12 |
| 86:20 91:18 | 211:21 | Scalewski | 135:3,16 | 159:17 | 46:12 47:24 |
| 112:5 123:2 | 212:2,4,6 | 35:7 | 139:6,7,8 | Secondly | 48:2,3 |
| 123:20 | 212:17,18 | scan 31:11,18 | 139:22 | 144:4 | 114:3,15,16 |
| 124:4,7 | 213:4,10,13 | 33:22 120:7 | 140:8 | seconds | 115:2 |
| 126:21 | 213:16,18 | 242:13 | 143:17 | 227:23 | 146:24 |
| 132:7 137:9 | 213:19 | 248:8,14,15 | 144:24 | section 32:19 | 148:11 |
| 139:4 143:5 | 244:7,8 | 249:6,15 | 192:4,12 | 121:21 | 169:7 |
| 151:6 177:6 | sand 44:15 | scans 248:9 | 201:24 | 123:13 | 224:13 |
| 180:13 | 241:11 | scatter 73:12 | scoring 140:3 | 167:17 | 228:23 |
| 181:6 183:4 | sands 114:13 | scenario | 140:7 | 172:12 | see 11:15,17 |
| 185:4 | Sanitary | 241:24 | 144:23 | 173:23 | 18:21 22:8 |
| 192:22 | 44:13 | scenarios | 166:17 | 181:19 | 30:21 31:1 |
| 211:11 | 192:13 | 241:24 | 178:23 | 185:14 | 32:13 34:3 |
| 213:13,15 | 195:3 198:8 | schedule | 179:18 | 186:20 | 34:18 35:1 |
| 222:11 | 199:13 | 4:24 5:1 | Scott 2:19 | 193:15 | 40:9,10 |
| 227:7,12 | 201:15 | 32:9 218:10 | 3:2 5:3 | sections | 44:13 51:22 |
| 238:15 | 210:4 220:1 | 246:7 | screen | 169:19 | 62:20 73:20 |
| sample 11:22 | 240:1 241:6 | scheme | 242:14 | 238:3 | 73:21 76:17 |
| 42:19 43:1 | 246:17 | 208:17 | screened | sediment | 76:19 84:1 |
| 43:2 49:13 | 247:6 | 249:24 | 152:4,6 | 13:7,13,14 | 84:22,24 |
| 49:23 | saw 40:7 | scientific | screening | 14:14 21:3 | 85:6,11,20 |
| 111:12 | 54:11 55:4 | 120:12 | 143:23 | 22:11,17,23 | 86:17 88:24 |
| 142:1,2,6 | 67:9 75:1 | 146:3 | script 28:5 | 23:2,18,19 | 90:9 92:22 |
| 165:22 | 114:3 | Scientist 2:2 | scrutiny | 23:23 24:3 | 105:22 |
| sampled 28:1 | saying 18:7 | 2:3 | 142:12 | 25:7 35:23 | 112:13 |
| 243:23 | 22:8 24:19 | scientists | Scudder 3:6 | 36:19,21 | 113:2 |
| 244:1 | 43:5 67:1 | 119:17 | 5:12 214:15 | 42:1,12,19 | 114:13,17 |
| samples | 81:19 | 120:14,22 | 215:2 | 42:21 44:11 | 114:19 |
| 36:18,19,20 | | | | | |

| | | | | | |
|---------------------|------------------------|----------------------|---------------------|---------------------|----------------------|
| 115:18 | 178:23 | 184:16 | 233:23 | 190:21 | sideways |
| 122:18 | 179:17 | sequence | 248:8 | 231:14 | 31:5 |
| 129:13 | 242:16 | 15:1 | sewage 37:10 | short 53:2 | Sierra 5:9,15 |
| 144:4 | Seine 15:17 | sequences | 241:21 | 216:22 | 5:20 |
| 165:10 | select 123:19 | 232:16,24 | sewer 246:12 | 243:18 | sights 142:6 |
| 172:8 | 142:6 | sequencing | sewerage | shorthand | signature |
| 186:11 | selected | 92:22 | 52:14 | 251:5,7 | 251:13 |
| 202:24 | 123:18 | sequentially | sewers | show 22:13 | significance |
| 205:7 209:6 | 148:5,12 | 124:1 | 239:11 | 22:14,15 | 88:22 89:1 |
| 212:8 | 169:9,12 | series 249:10 | shading | 50:2 73:12 | 157:5 |
| 213:12 | selecting 70:9 | seriously | 249:11 | 156:10 | 166:11 |
| 230:5 | self-sustain... | 175:11 | shallow | 163:21 | 185:19 |
| 245:21 | 204:17 | 241:10 | 44:24 71:7 | 187:4 197:8 | 191:9 204:7 |
| 248:10,18 | semiqualit... | serve 4:3 | 99:23 | 229:14 | significant |
| 248:19 | 140:19 | 56:12 105:4 | 139:15 | showed | 52:20 54:11 |
| 249:13,16 | semiquanti... | set 69:14,15 | 220:4 | 31:12 | 130:6,7 |
| seeing 9:19 | 140:19 | 96:5 124:2 | shape 32:20 | 105:18 | 151:1,19 |
| 144:3 | SEM's | 124:4 | 34:16 173:1 | 137:22 | 155:9 |
| 170:15 | 148:10 | sets 122:13 | share 123:2 | 157:6 189:7 | 156:10 |
| 171:14 | Senior 2:3 | 134:3 | 124:6 | showing 32:5 | 157:7 |
| 215:10 | sense 64:4 | setting | sheer 194:2 | 71:19 197:6 | 159:12 |
| 237:15 | 85:13 86:7 | 196:16 | sheet 30:23 | shown 61:9 | 161:24 |
| seek 57:3,7 | 113:11 | settle 13:20 | 31:1 99:20 | 130:8 | 162:3,17 |
| seem 56:2 | 119:8 | 48:5,11 | 200:11 | 176:11 | 163:2,7,21 |
| 69:17 | 140:17 | setup 142:1 | shelter 65:7 | 179:24 | 166:15,23 |
| 148:16 | 141:1 | seven 43:1 | She'll 231:7 | 228:5 | 168:7 |
| 207:21 | 143:16,24 | 62:4 84:10 | shield 57:6 | shows 10:10 | 177:16 |
| 235:7 | 181:17 | 110:18,22 | shift 131:24 | 66:19 128:8 | 180:16 |
| seemed 147:4 | 204:3,10 | 127:24 | ship 44:14 | 180:2 | 183:16 |
| 190:22 | 249:22 | 129:5 | 59:18,21 | 181:23 | 184:9 198:5 |
| seems 40:18 | sensitive | 131:13 | 192:13 | 182:4 212:6 | 202:1,2 |
| 91:17 | 229:10 | 183:4 | 195:3 198:8 | shutdown | 204:12,14 |
| 116:13 | sentence | 184:14 | 199:13 | 241:2,2 | 224:8,10 |
| 196:15 | 80:13,18,19 | 194:22 | 201:15 | shutting | significantly |
| seen 33:16 | 86:11 87:16 | 195:10 | 210:4 220:1 | 239:24 | 182:17 |
| 39:7,9 | 95:20 | 196:17 | 220:19 | 240:5 241:5 | silt 35:24 |
| segment | 180:24 | 198:2 | 221:10,22 | side 10:11 | 36:4,10 |
| 19:11 57:24 | 231:10,12 | several 7:14 | 240:1 241:6 | 31:11,18 | 41:20 42:6 |
| 58:4,11,22 | 235:6 | 15:16 20:3 | 241:11 | 33:6,22 | 42:10 44:4 |
| 59:2 72:6 | 238:23 | 27:16 30:6 | 246:18 | 49:15 52:14 | 44:10,14 |
| 72:13 74:1 | 239:2 | 33:2 77:10 | 247:6 | 120:7 | 65:11 |
| 90:18 110:9 | separate | 119:15 | shipping | 153:24 | 111:15 |
| 110:9,14,15 | 146:16 | 139:13 | 193:13,14 | 199:24 | 112:15 |
| 154:4 | separation | 142:3 | 223:18 | 200:4 | 220:10 |
| segments | 217:4 236:8 | 152:17 | Shore 49:15 | 241:21 | 233:10,11 |
| 58:4 72:4,8 | 237:10 | 169:18 | 49:21 52:13 | 242:13 | silts 114:4 |
| 72:15,16 | 240:8,22 | 171:2 172:2 | 59:14 90:8 | 248:7,9,14 | similar 9:11 |
| 143:17 | 241:16 | 205:13 | 103:2 | 248:15 | 17:12 18:18 |
| 177:23,24 | September | 217:2 | shoreline | 249:6,15 | 20:7 21:5 |

| | | | | | |
|----------------------|----------------------|----------------------|---------------------|--------------------|----------------------|
| 21:12 76:17 | 129:4,11 | sloping 102:7 | 78:8 82:11 | 141:22 | 137:15 |
| 84:1 85:14 | 130:1 | sludge 35:24 | 82:12 83:17 | something | 148:8 160:5 |
| 85:17 86:8 | 179:24 | 36:5,12 | 91:3,12 | 8:10,17 | 171:24 |
| 190:4 | 181:2,6,11 | 42:22 71:9 | 95:4,8,9 | 23:4 24:19 | 207:3 213:8 |
| 200:18 | 181:14 | small 56:11 | 97:10 | 25:11 27:11 | 221:16 |
| 219:24 | 189:19 | 60:9,24 | 100:14 | 42:4 48:9 | 228:24 |
| 229:15 | 194:6,22 | 102:24 | 103:7 | 49:5,19 | 231:23 |
| similarity | 197:18 | 145:21,23 | 105:18 | 55:23 56:24 | sort 21:13 |
| 20:14 | 208:1 | 167:23 | 106:3 | 57:9 66:12 | 24:5 31:24 |
| simply 34:16 | 218:10 | 180:10 | 110:15,23 | 67:13 68:5 | 41:21 44:2 |
| 47:22 | 229:19 | 191:3 | 112:1 117:6 | 73:17 83:6 | 50:18 70:3 |
| 148:20 | size 56:16 | 201:23 | 122:10 | 84:5 91:4,6 | 92:21 102:8 |
| 175:5 | 66:14 | 207:17 | 124:8 126:8 | 91:9 92:11 | 107:23 |
| 208:11 | 142:21 | 235:3 | 130:22 | 102:5,15 | 109:24 |
| simultaneo... | 154:12,15 | 243:17 | 138:3,13 | 109:16 | 110:20 |
| 148:10 | 173:1 | 245:7 | 139:2 | 112:19 | 111:4,10 |
| 151:14 | 190:18,23 | smaller 54:7 | 140:10 | 124:17 | 114:24 |
| 169:5 | 200:19 | 114:4 | 141:12,20 | 125:4,4 | 138:5 194:3 |
| since 35:7 | 244:22,24 | 190:20 | 142:12 | 175:19,19 | 240:8 |
| 59:22 | 247:10 | SNR 2:9 | 144:14,15 | 200:16 | 248:23 |
| 127:22 | sizes 142:4 | soft 224:12 | 153:12,21 | 237:22 | sought |
| 133:11 | skip 45:3 | software | 156:7 | sometimes | 107:16 |
| 218:4 | 50:10 51:7 | 34:11 | 172:20 | 55:5 65:23 | source 23:14 |
| single 10:15 | 61:21 62:23 | solely 136:7 | 174:9,24 | 66:1,4 | 45:24 |
| 66:18 185:6 | 64:23 71:13 | solids 46:21 | 177:23 | 69:20,20 | 194:12 |
| 185:8 | 76:13 121:6 | 47:3 48:7 | 196:11 | 131:16 | sources 45:21 |
| sinuosity | 124:20 | solution | 197:6 | 195:19 | 47:17 158:9 |
| 144:8 | 130:13 | 223:9 | 199:16 | somewhere | South 2:10 |
| site 28:11 | 153:5 157:5 | some 7:17,22 | 200:14 | 49:16 91:13 | 44:9 100:1 |
| 33:21 74:5 | 182:20 | 11:4 13:19 | 204:18 | 232:16 | 103:20 |
| 74:6,9 75:4 | 189:23 | 15:18 18:4 | 205:18 | sonar 31:11 | 108:20 |
| 75:4 81:13 | 193:9 198:2 | 19:13 20:20 | 220:9 | 31:18 32:4 | 192:14 |
| 81:16 106:6 | 228:16 | 21:19 23:13 | 222:10 | 33:22 45:11 | 199:22 |
| 160:24 | skipping | 23:16 25:9 | 224:11 | 120:7 | 200:4 |
| 161:10 | 156:5 | 25:24 26:13 | 229:9,14,14 | 242:13,21 | 201:12 |
| sites 68:5 | 182:21 | 32:2 33:5 | 232:20 | 248:8 249:2 | 210:2 240:3 |
| 76:16 100:2 | slightly 7:23 | 33:12 40:7 | 233:6,19 | 249:2,6 | Southeast |
| 135:14,20 | 49:4 92:2 | 45:20,24 | 235:1,13 | soon 63:11 | 47:12 |
| 157:17,20 | 164:2 | 46:3,19 | 236:16 | sorry 12:21 | space 248:16 |
| sitting 234:7 | slim 235:22 | 51:13,20 | 239:21 | 14:6 17:19 | spaces |
| situation | slip 26:15 | 52:2,7 55:4 | 240:7 | 21:16 24:17 | 233:10 |
| 113:9 | 105:4,8 | 56:7,13 | 247:14 | 37:12 40:17 | spacing |
| 114:23 | slips 100:1 | 57:5 58:4 | somebody | 41:10 53:8 | 245:1,10 |
| 115:24 | 103:19 | 58:19 63:24 | 160:19 | 53:22 57:15 | spatial 27:22 |
| situations | 104:8,12,17 | 64:19,22 | somehow | 84:14 88:10 | 173:15 |
| 81:21 | 104:22 | 66:9,19 | 38:8 147:1 | 105:11 | spawn |
| six 67:22 | 105:1 | 67:16 68:3 | someone 68:6 | 116:10 | 234:10 |
| 70:9 111:8 | slope 200:12 | 68:8 72:14 | 102:21 | 124:24 | 246:19 |
| 123:12 | 200:13 | 73:18 75:16 | 109:9 127:2 | 130:24 | spawners |

| | | | | | |
|---------------------|---------------------|----------------------|-----------------------|----------------------|----------------------|
| 166:2,4 | 240:10,24 | 155:7 157:2 | 70:6 | statement | 51:11,18,22 |
| spawning | 243:6 | 163:8,12,13 | stands 16:5 | 13:9 14:24 | 58:16 81:5 |
| 65:9 234:14 | specific | 180:11,14 | start 13:4 | 30:2 47:22 | 83:1 86:22 |
| 246:18 | 10:22 14:17 | 180:19 | 21:18 23:7 | 63:24 65:13 | 110:17 |
| speak 6:7 | 15:11,14,22 | 181:1 182:5 | 31:1 88:19 | 86:14 122:4 | 111:13,14 |
| 54:3 55:17 | 16:4,11,11 | 182:15 | 116:20 | 123:22 | 111:15,20 |
| 213:7 | 16:14,19 | 184:4,5,17 | 124:13 | 139:18 | 112:4 120:2 |
| speaking 6:8 | 18:8,14 | 197:2,4,7 | 144:9 | 160:19 | 128:10,11 |
| 35:4 225:10 | 26:4 27:12 | 197:15 | 147:11 | 167:18,19 | 134:21 |
| 243:20 | 28:20 74:13 | SS 251:2 | 165:7 | 168:2 | 139:5 |
| 247:1 | 87:3 104:1 | stability | 192:18 | 172:24 | 156:17 |
| special | 106:6 109:5 | 173:3 | 214:7,8 | 175:2 | 159:20 |
| 223:11 | 115:18 | 201:22 | 215:21 | 181:10 | 211:10,22 |
| specialize | 153:17 | 202:7,15,20 | 250:8 | 182:14 | 212:2,3,4,6 |
| 230:22 | 157:20 | stabilization | started 67:21 | 188:12 | 212:7 213:4 |
| species 7:7 | 175:1 | 200:13 | 213:1 | 204:8 | 213:16 |
| 7:17 10:11 | 195:20 | stabilize | starting | 235:12,13 | statistical |
| 10:18,18 | 210:15 | 107:21 | 214:4 | statements | 43:18 66:11 |
| 11:4,21 | 241:3 | stable 86:24 | state 1:10 6:5 | 76:14 171:3 | 68:9 70:6,8 |
| 26:6,8,10 | specifically | 200:12 | 19:14,20,22 | 182:11 | 71:5 109:7 |
| 26:15 27:3 | 8:18 27:2 | staff 4:18 | 84:10 118:2 | 188:2,10 | 110:12,23 |
| 27:8 45:20 | 60:19 69:22 | 6:11 11:1 | 118:16 | states 20:6 | 130:10 |
| 61:8,18 | 92:24 | stages 194:14 | 121:22 | 45:9 118:18 | 151:7,24 |
| 62:12,12 | 107:20 | 234:17 | 133:12 | 123:16 | 186:22 |
| 63:5 84:12 | 135:11 | stagnant | 134:2,18 | 172:12 | 187:1,7 |
| 115:18,20 | 203:16 | 52:3,8,9,15 | 159:2 | 173:24,24 | statistically |
| 133:3,7 | 227:6 238:9 | stand 238:19 | 180:13 | 179:24 | 51:24 81:11 |
| 173:17 | specifics | standard | 182:2 | 180:24 | 110:11 |
| 174:1,5 | 100:8 | 81:7,10,14 | 183:23 | 187:20 | 130:7 151:1 |
| 202:2,3,11 | specifies | 81:17 | 187:14 | 191:13 | 151:19 |
| 202:15,19 | 174:24 | 156:21,23 | 194:23 | 203:3 | 155:8 |
| 203:4,6,10 | spend 93:5 | 159:10,19 | 195:11 | 226:16 | 156:10 |
| 205:1,17,18 | spot 22:6,6 | 159:22,23 | 196:2,18 | statewide | 157:7 |
| 206:2,14 | spots 82:14 | 162:12 | 197:19 | 16:1 | 159:11 |
| 208:5,7,12 | 82:14 | 226:23 | 198:3 | State's | 162:16 |
| 209:10,17 | 119:19 | standards | 201:18 | 169:16 | 163:2,7,21 |
| 210:5 | spread 174:4 | 1:2 4:5 | 203:17 | station 28:16 | 166:15,23 |
| 215:23 | spreadsheets | 78:17 80:14 | 208:2 219:6 | 36:16,19 | 180:15 |
| 216:2,9 | 40:14 | 80:22 81:18 | 239:9 | 40:15 42:2 | 197:21 |
| 222:14,23 | Springfield | 158:17,18 | 243:16 | 59:3 74:16 | 198:5 |
| 222:24 | 2:7 231:5 | 158:20 | 251:1 | 74:16 | statistics |
| 224:1 229:9 | square | 159:3,5,13 | stated 45:20 | 110:17 | 67:23 81:20 |
| 229:11 | 190:10,13 | 159:17 | 77:2 85:15 | 138:16 | status 128:12 |
| 230:8,15 | 190:14 | 161:19,20 | 139:2 156:7 | 202:13 | stay 143:17 |
| 231:16 | 191:7,7 | 167:6,12 | 168:24 | 203:7 | staying 153:9 |
| 232:9,10 | squared 72:7 | 241:22 | 181:21 | 211:21 | stays 13:20 |
| 235:1,15,19 | 134:4 135:9 | standing | 183:3 | stations | steep 220:5 |
| 236:10 | 135:11 | 118:9 143:6 | 185:14 | 27:18 39:22 | 233:18 |
| 237:13 | 138:19 | standpoint | 194:7 232:1 | 39:23 40:17 | steepening |

| | | | | | |
|------------------------|----------------------|----------------------|--------------------|----------------------|----------------------|
| steepness | 170:7 173:8 | 28:10,11,18 | 15:8 20:17 | subject | 206:22 |
| 33:6 | 194:18 | 29:4 31:13 | 25:22 26:5 | 142:12 | 207:11,18 |
| stenographic | 195:9 | 97:2 142:20 | 27:3,16 | subjected | 207:22 |
| 251:10 | 220:12 | 145:20 | 28:9 29:5 | 224:15 | 249:19 |
| step 248:7 | streams 15:2 | 173:12 | 37:11 43:16 | subjective | substrates |
| steps 69:5 | 113:14 | 200:10 | 48:10,21 | 142:13 | 64:20 69:8 |
| 98:6 | 145:18,21 | 233:9 | 60:4,7,17 | submerged | 93:8,9 |
| Steven 1:10 | 145:21,22 | 234:15,23 | 62:5 64:2 | 30:4 31:19 | 111:22 |
| 2:21 251:5 | 145:23 | 242:18 | 94:17 96:19 | 49:9,20 | 112:10 |
| 251:20 | 146:12 | structures | 106:22 | 64:10 | 116:3 |
| stick 28:23 | 173:16 | 28:20,21,23 | 107:7,10 | submitted | 140:12 |
| 153:11 | 194:8 227:1 | 31:20 37:9 | 108:4,20 | 8:10 121:9 | 220:10,11 |
| still 7:1 19:20 | Street 1:11 | 37:11 57:6 | 119:4,5,9 | subpart | 231:20 |
| 88:5 115:14 | 251:21 | 95:24 96:8 | 119:18,23 | 172:11 | 248:11 |
| 144:21 | stresses | 96:13,17,24 | 120:16 | Subquestion | subsurface |
| 166:14,15 | 194:3 | 97:7,15 | 121:8,17 | 135:18 | 31:13 120:6 |
| 166:24 | stressor | 98:2 102:7 | 122:18 | subsequent | subtracted |
| 180:10 | 217:10 | 153:7,8,10 | 123:13 | 168:13 | 131:9 |
| 205:12 | stressors | 153:12,13 | 127:7 | 200:13 | 132:16 |
| 218:8 | 168:4,6 | 153:17 | 128:10 | subsequently | succeed |
| 223:21 | 201:2,6 | 154:2,4,7,8 | 136:18 | 77:11 | 87:11 |
| 226:9 | stretch 42:8 | 154:16 | 139:24 | 198:16 | success |
| 240:21 | 44:5 49:21 | 173:13 | 145:13 | substances | 176:13 |
| stole 237:20 | 74:9 220:19 | 190:5 | 153:15 | 14:15 | successful |
| stone 13:14 | stretches | 191:19 | 154:20 | substantial | 106:1 |
| stop 91:20 | 44:19 50:1 | 220:13 | 155:20 | 76:20 | 195:23 |
| 130:24 | Strike 68:24 | 248:12 | 159:15 | substantially | sudden 52:20 |
| 188:15 | stripe 11:16 | struggling | 178:20,21 | 184:9 191:2 | sufficient |
| storm 13:6 | 11:20,23 | 149:9 | 182:5 | substrate | 25:6 40:9 |
| 13:10 36:7 | 12:1,6 | studied 83:6 | 185:13 | 13:13 36:17 | 40:10 109:7 |
| 36:13 94:11 | strong 53:5 | 108:8 119:8 | 186:2 | 36:19 41:13 | 109:12 |
| 196:14 | 148:17 | 119:19 | 187:18 | 44:19,22,23 | 111:1 120:3 |
| 220:8 | 151:2 164:4 | 120:23 | 190:7 | 45:1,2 | suggest 45:11 |
| 223:20 | 177:1 197:2 | 160:19 | 196:19 | 64:24 65:2 | 45:14 159:4 |
| 232:19 | stronger | 176:8 | 201:19 | 65:6,14,23 | 163:13 |
| 240:18 | 197:8 | 186:11 | 206:21 | 68:2,4,13 | 239:20 |
| straight | strongest | studies 62:3 | 225:4,22 | 68:16,21 | suggested |
| 73:21 92:20 | 67:23 184:2 | 66:17 | 226:3,9,10 | 69:1,19 | 45:15 97:5 |
| 138:7 153:2 | 184:7 | 119:10 | 227:16 | 70:18 71:7 | suggesting |
| 230:23 | strongly 55:8 | 123:21 | 228:3,9 | 71:8 93:13 | 201:21 |
| straighteni... | 66:6 148:13 | 209:9,9 | 239:2,3 | 111:7,10,12 | suggests |
| 193:19 | 151:15,16 | 225:8 | 240:7,11 | 111:14,21 | 45:19 85:23 |
| strategies | 151:23 | 226:19 | 242:7,8 | 112:4,6,14 | 204:1,8 |
| 174:1 | 169:13 | 227:10,22 | 243:5 | 113:5,19,20 | suitability |
| Stratton 35:7 | 196:21,24 | 228:10 | stuff 13:20 | 114:5,6,14 | 27:16 |
| stream 93:11 | 197:11,14 | 229:14 | sub 136:23 | 115:15 | suitable |
| 107:17,19 | structurally | 243:1 | 221:18 | 140:8 166:1 | 145:19 |
| 114:8 | 85:24 | study 7:12,22 | Subdocket | 173:3 | suitably |
| 140:12 | structure | 10:16 14:17 | 4:10,21 | 193:20 | 210:12 |

| | | | | | |
|------------------------------------|-----------------------------------|--------------------------------|--|-------------------------------------|---------------------------------------|
| Suite 2:11,17 251:21 | 91:21 96:9 96:20 110:2 | 13:21 48:9 suspicion | 140:3 144:3 145:11 | 8:2,4,7,7,15 10:10,17 | 218:1,11,22 251:11 |
| summaries 39:8 | 124:24 125:1 130:5 | 27:4 sustainable | 147:1 150:23 | 11:2,10 12:13 44:17 | taking 19:5 218:16 |
| summarizes 38:24 63:24 | 132:23 137:9 | 233:3 swim 15:6 | 151:5,11 157:14 | 50:17,19 62:10,15,24 | 231:4 talk 83:14 |
| summary 50:11 71:16 | 150:12 152:24 | 22:2 57:2 switching | 166:20 168:1 177:2 | 63:2 71:14 71:16 | 85:22 204:22 |
| 111:11 160:18 | 172:1 177:3 189:4 | 214:2 sworn 6:24 | 177:6,8 179:6,18 | 114:23 133:8 | 217:12 talked 22:17 |
| 192:3,7,9 | 207:14 222:19 | 214:13,17 system 1:3 | 210:17,20 218:15 | 138:24 139:24 | 111:12 160:22 |
| sunfish 133:3 133:4,7,20 | 224:14 233:4 | 4:6 15:11 15:14 16:6 | 228:6 232:13 | 161:15 162:8 | 164:19 193:18 |
| 202:15 203:6 | 235:10,11 236:18,20 | 16:11,19 18:8,13 | 233:17 235:19 | 170:22 171:3 172:3 | 196:23 222:22 |
| sunken 28:24 31:23 32:6 | 248:23,24 surface 30:17 | 20:7,14,23 21:3,6,8,12 | 236:3 239:22 | 172:5,5,11 173:22 | 222:22 talking 19:5 |
| 91:10 | 44:18 46:13 47:14 245:8 | 21:14,19 22:1,3 | 241:14,19 242:11 | 174:8,17,24 192:1,7,12 | 40:12 55:14 93:18 |
| sunlight 64:11,16 | surprised 96:16,20 | 24:11 25:9 26:14 29:9 | 243:3,11 246:13 | 203:17 206:2,10 | 115:10,16 115:17 |
| superimpo... 34:1 | 112:13,17 113:8,16 | 29:16,20 32:3 36:5 | 247:15 systems | 207:9 212:1 tables 152:23 | 158:16,17 176:23 |
| supplement 212:18 | 114:7 surprising | 45:5 46:18 46:23 47:5 | 16:23 37:5 47:24 86:19 | 162:20 Table's | 214:24 218:2 |
| support 171:2 | 21:11 38:13 113:1,4,21 | 50:19 57:1 72:23 74:14 | 87:8 102:17 112:9,14 | 162:19 take 17:20 | 224:10 225:19 |
| 182:12 | 113:23 134:11 | 86:22 87:7 87:9 92:19 | 145:17 172:15 | 18:21,22 39:22 49:8 | 227:22 229:1 |
| 185:24 | 208:15 Survey | 93:20 95:4 102:18,19 | 173:21 174:3,4,13 | 63:11,13 86:4 99:18 | 232:14 talks 137:2 |
| 206:21 | 120:20 survive 54:14 | 102:20 104:7,9,14 | 175:5 176:14,20 | 109:20 110:8 | Tanner 2:3 4:11 |
| 207:3,7 | 234:13 235:16 | 104:19 106:11,11 | 176:21 178:20 | 138:10 192:19 | Task 47:12 technical |
| 215:22 | Susan 40:4 68:11 110:6 | 106:24 107:2,12 | 227:3 system's | 215:20 242:9 248:7 | 225:19 227:22 |
| 216:1 221:7 | 117:4 suspect | 112:2,17 113:2,18 | 194:9 system-wide | 86:4 99:18 109:20 | 229:1 232:14 |
| 225:12 | 224:11 237:3 | 114:1,2,11 114:16,18 | 30:11 71:17 92:11,13,14 | 110:8 138:10 | 232:14 talks 137:2 |
| supported 120:11,13 | 247:11 suspended | 115:1,8,19 119:19,20 | 130:4 ----- | 138:10 192:19 | Tanner 2:3 4:11 |
| supporting 85:24 | 46:11,15,17 46:21 47:3 | 120:2,23 125:15 | T T 3:10 10:1 | 192:19 215:20 | Task 47:12 technical |
| 139:14 | 47:23 48:1 48:15 194:4 | 132:6 134:14 | 215:15 225:1 | 215:20 242:9 248:7 | 4:17 10:22 20:2 84:7,8 |
| 224:8 | suspension | 136:14 | tabbed 40:14 table 7:6,13 | 242:9 248:7 taken 1:10 | 85:15,17,22 120:12 |
| supports 115:11 | | | | 242:9 248:7 27:1 63:15 | 120:12 175:22 |
| suppose 82:11 | | | | 74:8,13,16 76:18 82:22 | 249:4 technique |
| 106:21 | | | | 84:2 98:6 116:22 | 243:24 techniques |
| sure 10:5 27:20,23 | | | | 161:7 193:1 211:12 | 43:19 107:22 |
| 39:18 46:10 | | | | 212:12 214:9 | 246:5 technologies |
| 50:14 52:10 | | | | 217:22 | 120:5 |
| 53:10 83:8 | | | | | |

| | | | | | |
|----------------------|---------------------|----------------------|----------------------|--------------------|-------------------|
| technology | temporary | territory | 200:23 | 93:5 107:12 | 172:3 |
| 31:9,15 | 56:12 | 118:17 | 201:18 | 121:4 | 193:18 |
| tell 33:19 | 194:19 | Tesher 2:10 | 203:3,13,16 | 130:10 | 194:1 |
| 69:7 80:14 | 216:23 | 3:8 215:16 | 208:1 | 152:2,3 | 196:12 |
| 81:2 88:19 | ten 10:12,14 | 215:18 | 210:11 | 172:4 | 227:13 |
| 100:5 | 42:4,15,16 | 221:20,21 | 213:23 | 196:13 | 233:19 |
| 109:10 | 43:5 44:2 | 222:9 | 214:19,20 | 207:11 | 240:1,11 |
| 117:13 | 63:14 98:8 | 224:19 | 215:2 | 209:11,12 | 241:4,4 |
| 126:1 137:3 | 107:9 | test 73:5,6,6 | 217:12 | 245:6 | 242:21 |
| 149:9 158:6 | 131:11 | 190:15 | 219:18,21 | themselves | think 4:18 |
| 158:7,12 | 132:13 | tested 31:11 | 225:7,9,11 | 41:15 92:21 | 10:6 12:11 |
| temperature | 135:7,18 | 184:1,9 | 225:14,15 | 93:23 97:1 | 14:20 16:3 |
| 39:20,23 | 187:13 | testified | 231:13 | theological | 21:18 26:19 |
| 77:17 78:1 | 188:16 | 181:7 211:9 | 239:4 243:2 | 116:14 | 29:9 33:17 |
| 78:2,14 | 196:1 | 214:23 | 243:7,10,15 | thermal | 34:4,10,14 |
| 80:14,20 | 243:15,15 | 227:13 | 243:15,21 | 176:10 | 35:17 37:5 |
| 81:5,7,14 | tenant 240:6 | testify 5:22 | testing 112:4 | thing 29:13 | 37:8 38:8 |
| 82:7,21 | tend 114:13 | 82:20 | tests 61:23 | 31:24 54:22 | 38:14 39:24 |
| 83:5,9 | 205:9 226:6 | 161:16 | text 97:4 | 65:2 68:3 | 43:14 46:9 |
| 156:8,11,15 | term 113:7 | testifying | texture | 72:1 80:12 | 49:2 50:13 |
| 156:19,20 | 153:11 | 5:12 | 111:23 | 93:2 96:23 | 53:1 55:6 |
| 156:21,22 | 172:9 181:1 | testimony 5:5 | 112:7 | 101:23 | 60:19 63:18 |
| 157:3,8,11 | 191:23 | 5:7,24 6:22 | thank 6:22 | 102:8 | 66:12,16,23 |
| 157:13,15 | 198:13 | 7:3,5,23 | 48:23 54:17 | 107:23 | 67:3 72:2 |
| 157:18 | 216:23 | 8:16 12:16 | 71:10 87:12 | 129:3 131:6 | 74:15,17 |
| 159:3,9,14 | 240:5 241:2 | 29:18 48:4 | 98:24 99:1 | 149:21 | 76:8,13 |
| 159:16,19 | termed 128:4 | 77:15 84:6 | 105:9 111:3 | 194:4 | 77:11 78:3 |
| 161:18,19 | terms 41:10 | 84:8 96:11 | 126:3 137:7 | 226:23 | 78:13 80:3 |
| 162:11,12 | 52:5,6 69:9 | 111:8 | 153:3 | 227:7 | 82:1 83:15 |
| 162:23 | 80:10 84:19 | 117:14,22 | 158:13 | 232:22 | 85:1 87:4 |
| 164:3,11 | 86:9 110:1 | 118:3 128:1 | 161:12 | 239:8 | 90:23 91:14 |
| 165:14,15 | 119:5 | 134:2,18 | 166:7 167:3 | 240:14 | 92:10 96:7 |
| 166:18 | 125:17 | 135:8 153:6 | 170:18 | things 36:8 | 96:11 97:5 |
| 168:16 | 126:8 | 155:17 | 172:8 | 43:11 55:7 | 101:19 |
| 176:2 | 140:23 | 162:5 164:3 | 179:11 | 55:20 66:22 | 102:14 |
| 186:10,15 | 142:19 | 166:10,11 | 184:24 | 67:2 73:10 | 105:8 |
| 187:3,5,8 | 153:8 | 175:16 | 193:7 | 92:3 96:22 | 110:16 |
| 211:11,17 | 177:15 | 179:14 | 206:17 | 101:11 | 112:18 |
| 212:11 | 178:24 | 182:3,23 | 211:3 | 102:1 | 113:10 |
| temperatur... | 179:5 | 183:24 | 213:20,22 | 122:18 | 114:19 |
| 82:9 163:17 | 204:24 | 187:14 | 213:24 | 131:15,22 | 115:1,14 |
| 163:20 | 205:6,13 | 188:16 | 215:5 | 138:12,15 | 116:16 |
| 164:12 | 206:2 | 193:11 | 220:17 | 139:20,21 | 119:12 |
| 166:5 | 223:12 | 194:7,23 | 226:7 | 140:14,22 | 121:6 |
| temporal | 226:24 | 195:11,11 | 235:23 | 141:8 144:1 | 124:20 |
| 27:22 | 230:9 | 196:2,18 | 247:23 | 144:5,10 | 125:24 |
| 173:15 | 233:17,20 | 197:19 | 250:5 | 146:1 | 126:4 |
| temporarily | 242:6,9,12 | 198:3,22 | their 6:15 | 147:24 | 127:16 |
| 218:6 | 243:5 | 199:15 | 52:9 88:16 | 151:9,11 | 129:22 |

| | | | | | |
|-----------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| 130:13 | 144:10 | 124:22 | 81:10,14,17 | 171:12 | 208:19,19 |
| 133:10 | 192:22 | 128:1,3,8 | 82:3,21 | 192:18 | 208:22,23 |
| 135:24 | 233:14 | 131:12,14 | 106:8 | 193:4 211:5 | 209:16,17 |
| 136:12,18 | 242:17 | 134:1,1,17 | 138:16 | 213:6,21 | 209:19 |
| 136:24 | thinks 9:3 | 134:17 | 156:21,22 | 214:1,12,18 | 210:4 |
| 141:3 142:9 | third 14:13 | 147:17 | 159:9,12 | 215:5,10,14 | 231:22 |
| 142:17 | 47:14 156:6 | 148:5,12 | 160:20,23 | 221:14,19 | 235:19 |
| 144:1 | 159:1 | 153:18,19 | 161:1,5,10 | 222:6 | tolerating |
| 146:20 | Thirty | 155:16 | 161:17 | 224:21 | 209:1 |
| 147:10 | 169:18 | 163:3,6 | 162:10 | 228:24 | tomorrow |
| 148:20 | Thomas 2:4 | 169:1,7,8 | 164:18 | 229:5 237:7 | 231:7 |
| 150:8 | 4:15 | 169:12 | 165:8 166:2 | 237:20 | tonnage 59:6 |
| 152:14 | THORNB... | 182:22 | 183:2 | 250:7 | 59:8,9 |
| 153:23 | 2:16 | 183:24 | 184:15 | Tipsord's | 198:15 |
| 160:10 | thorough | 198:22 | 211:6 | 137:12 | tool 17:7 |
| 161:15 | 105:1 | 201:11 | 212:12 | tires 32:6 | 18:19 |
| 164:17 | thoroughly | 202:20,23 | 213:9,13,18 | tissue 46:1,4 | 143:23 |
| 166:22 | 228:16 | 228:15 | 217:5,24 | title 37:22 | 248:9 |
| 167:3 | though 17:24 | 245:20 | 218:7 219:8 | 41:15 | top 10:12 |
| 168:12,21 | 24:15 44:17 | through 13:1 | 227:11 | 236:19 | 11:7,16,20 |
| 168:22 | 51:22 76:21 | 29:12 42:15 | 243:1,10,18 | today 4:10,19 | 11:23 12:1 |
| 169:17 | 87:20 95:11 | 42:16 46:6 | 243:24 | 5:18 6:22 | 12:6 18:2 |
| 172:21 | 132:24 | 60:3,5 | 244:9 | 117:6 | 33:23 56:13 |
| 174:9 | 139:7 141:7 | 78:14 94:20 | times 110:11 | 176:24 | 96:22 127:9 |
| 175:21 | 141:12 | 94:23 | Tipsord 1:9 | 183:15 | 158:11 |
| 179:12 | 163:8 225:6 | 105:12 | 2:2 4:1,2 | 196:9 | 164:15 |
| 182:20,21 | 231:14 | 149:5 | 6:23 8:6,21 | 225:19,21 | 165:7,21,23 |
| 189:24 | 232:23 | 152:18 | 9:5,8,10,13 | 232:14 | 213:16 |
| 191:20,22 | 241:20 | 192:20 | 9:22 12:10 | 239:4 243:8 | 248:17 |
| 197:22,24 | thought 24:2 | 193:17,21 | 12:18,21 | Today's 4:20 | total 46:21 |
| 198:1 | 24:9 70:14 | 193:21 | 14:3,8 35:3 | together | 47:3 148:6 |
| 207:11 | 72:5 89:21 | 223:18,21 | 35:19 40:2 | 212:8 | 148:6,9,9 |
| 210:11 | 90:22 109:5 | 234:17 | 40:24 41:4 | told 6:15 | 150:15,15 |
| 211:8,23 | 117:8 | 241:5,14 | 47:9 48:24 | 238:21 | 169:4 |
| 212:4 | 127:21 | 247:7,11 | 63:13,18 | 249:22 | touched |
| 215:20 | 137:7 | throughout | 70:23 71:11 | tolerance | 73:24 83:15 |
| 216:22 | 142:11 | 24:11 25:8 | 79:4,17 | 205:6 | 88:5 153:23 |
| 220:24 | 147:11 | 44:4 46:18 | 80:4 82:19 | 206:10 | Touhy 49:16 |
| 222:6,12 | 150:11 | 46:23 84:11 | 83:20 87:13 | 209:8,10,11 | towards 12:7 |
| 223:5,9 | 160:4,6,10 | 135:4 | 87:22 104:4 | 209:12,13 | track 180:22 |
| 225:17 | 173:14 | 201:21 | 108:11 | 229:15 | traffic 59:7 |
| 228:14 | 175:19 | throw 233:6 | 110:5 | tolerances | 59:14,18,21 |
| 234:6 | 223:4 237:5 | thunder | 116:18 | 208:3 | 97:17 136:5 |
| 238:12 | three 24:7 | 237:20 | 117:1 | tolerant 20:8 | 241:5,13 |
| 241:1,3 | 36:2 41:20 | ties 232:24 | 136:22 | 63:5 205:1 | trained |
| 246:24 | 44:10 76:3 | tilapia 60:14 | 137:7 | 205:2,10,12 | 144:23 |
| 247:4,8 | 76:4 95:19 | time 5:18 6:7 | 164:21 | 206:3,3,6 | 145:7 |
| thinking | 95:20 99:19 | 6:20 66:9 | 165:2 | 206:13,14 | training |
| 12:18 | 121:4,6 | 76:20 81:6 | 170:11 | 208:4,7,12 | 215:22 |

| | | | | | |
|-----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|
| 230:22 | 142:10 | 160:18 | 151:22 | 209:2 | 196:21 |
| transcribed | tries 106:9 | 175:12 | 155:16 | 249:14 | 214:3 217:1 |
| 251:11 | trophic 62:12 | 177:21 | 156:23 | | 218:5 228:8 |
| transcript | 84:12 85:5 | 178:1,2 | 162:13,20 | <u>U</u> | 245:24 |
| 13:1 251:9 | 85:9,19 | 186:7 | 173:5 174:8 | UAA 167:7 | understan... |
| transcription | 86:24 | 196:21 | 174:17 | ubiquitous | 20:11 46:24 |
| 7:16,20 | 202:16,20 | 197:10 | 182:3,19 | 86:22 | 60:2 75:3 |
| 11:10 | 202:23 | 225:20 | 184:9 | 114:17 | 117:20 |
| transfer | 203:19,22 | 226:24 | 187:14,20 | ubiquity | 120:6 183:7 |
| 236:9 | 204:4,11,13 | 227:7 | 188:3,10,11 | 85:22 | 218:14 |
| 237:12 | 204:15,23 | 249:18 | 188:17,23 | ultimate | understood |
| 240:23 | 205:5,13 | TSS 47:3 | 189:7,17,20 | 70:13 | 189:4 |
| transform | trouble | tumors 63:4 | 217:4 | ultimately | undertaking |
| 131:20,21 | 153:10 | 131:5 | 228:15 | 37:3 48:2 | 109:17 |
| transient | true 60:23 | turbid 29:21 | 236:10 | 51:16,22 | underwater |
| 204:19 | 77:7 97:3 | turbidity | 240:23 | 67:10,14 | 30:3,20 |
| translate | 135:17,20 | 13:19,21 | 243:17 | 68:6,8 | undesirable |
| 42:3 | 135:23 | 14:12 29:9 | 244:7 245:9 | 147:20 | 46:4 111:17 |
| translated | 163:16 | 29:10,11,17 | type 93:6 | 150:23 | 111:20 |
| 33:7 43:16 | 251:8 | 29:19 32:13 | 101:13 | unable 13:3 | uneffected |
| 43:17 | trunks 31:23 | 36:9 46:22 | 109:7 | 176:24 | 114:21 |
| traversed | Trustees | 64:8 77:17 | 111:21 | unchanged | unexpected |
| 119:17 | 118:10,13 | 98:7,14,15 | 130:15 | 168:1 | 114:18 |
| treated 46:13 | try 23:15,21 | 168:10,16 | 180:6 | 183:18 | unfavorable |
| 47:14 244:3 | 26:5 47:16 | turn 6:3 | 200:14 | uncommon | 64:20 |
| treating | 68:6 92:12 | 107:13 | 226:10,23 | 105:22 | 219:20 |
| 94:15 | 110:22 | turned 28:8 | 233:9 | under 7:1 | unhappy |
| treatment | 117:7 121:5 | 96:18 | 234:18 | 19:20 80:13 | 13:3 |
| 52:14 94:12 | 132:20 | turns 151:10 | types 35:23 | 86:1 130:4 | uniform 44:9 |
| 241:21 | 142:12 | twelve | 69:13 81:20 | 130:11 | 220:6 |
| tree 31:23 | 144:14 | 245:20 | 86:18 | 251:11 | uniformity |
| 32:5 168:14 | 147:4 | twice 97:21 | 115:15 | underlie | 32:21 |
| trees 220:14 | 149:13,22 | two 11:6 13:5 | 153:7,13,18 | 38:18 | uniformly |
| trial 251:7,10 | 149:24 | 14:13 18:17 | 153:20 | underlying | 22:12 24:10 |
| tributaries | 151:8 | 26:8 27:8 | 173:18 | 39:9 66:13 | 25:1 46:18 |
| 15:8 50:12 | 165:24 | 30:17 41:20 | 226:15 | underscore | 244:19 |
| 50:15,21 | 180:7 | 61:5,17 | 227:13 | 189:5 | unimpacted |
| 51:2 99:4 | 229:21 | 67:2 69:5 | 232:12,21 | understand | 112:2,19 |
| tributary | 231:11 | 79:13 90:21 | 233:14 | 7:1 43:9,10 | 113:14 |
| 51:5,9 | 233:19 | 95:18 101:2 | 234:5,15,23 | 43:12 52:10 | 114:11 |
| trick 152:12 | 237:21 | 101:11 | 235:1 | 71:18 80:10 | unique |
| 210:24 | trying 8:21 | 106:8,22 | 242:10 | 87:15 | 124:17 |
| tried 13:1 | 19:8 30:6 | 110:18,21 | 248:12,21 | 100:15 | United |
| 23:22 52:24 | 80:9 82:6 | 119:2 | typical 180:6 | 126:4 | 118:17 |
| 53:16 69:17 | 88:11,18 | 122:13 | typically | 132:20 | universe 91:2 |
| 101:4,17 | 119:8 132:3 | 133:8 134:3 | 47:4,23 | 136:17 | 230:18 |
| 102:18 | 144:7 | 134:5 | 114:19 | 147:11 | University |
| 106:15 | 147:10 | 138:18 | 122:9 | 178:15 | 120:19 |
| 120:8 | 152:12 | 144:17 | 202:24 | 179:11 | unlikely |
| | | | | 191:22 | |

| | | | | | |
|---------------------|------------------|---------------------|----------------------|----------------------|----------------------|
| 26:20 | 67:8 74:17 | 33:11 38:17 | 232:17 | 131:23,24 | 89:4,5 |
| 201:23 | 92:2 93:10 | 38:22 39:1 | USGS 11:16 | 140:13 | 101:24 |
| 226:4 | 97:16 | 53:14 54:8 | using 11:24 | 155:7 157:2 | 124:14 |
| unmanaged | 101:22 | 56:19 59:18 | 18:16 24:5 | 163:8,12,13 | 128:7,21 |
| 86:2 | 102:17 | 61:14 62:2 | 30:11 34:19 | 164:13 | 129:5,11,13 |
| unnecessary | 104:12 | 62:19 65:17 | 43:18 45:10 | 184:5 | 129:21,24 |
| 64:14 | 105:3 113:7 | 66:3 67:2,3 | 52:1 77:14 | 197:15 | 130:3,6 |
| unrelated | 115:8 120:7 | 74:11 77:15 | 89:4 95:24 | variability | 134:3 140:7 |
| 127:11 | 122:19 | 81:4 82:1 | 96:12 97:14 | 76:15,18,23 | 147:17,20 |
| unreliable | 124:2 | 93:3 104:22 | 121:14 | 84:2,22,24 | 149:24 |
| 66:7 67:11 | 126:20 | 105:8 107:7 | 122:20,23 | 129:12,14 | 150:2,21,21 |
| 70:6 | 127:3 | 110:19 | 124:14 | 134:5,22 | 151:3,17,20 |
| unstable | 129:12 | 112:18 | 132:10,18 | 135:2 136:2 | 151:22 |
| 204:19 | 135:22 | 119:12 | 132:19 | 136:7,12,14 | 152:1,3 |
| until 6:2 | 143:15,22 | 120:10 | 140:23 | 137:17,22 | 175:1 181:2 |
| 91:14 223:8 | 144:17 | 122:22,23 | 158:22 | 157:10 | 181:7,11,15 |
| unusual | 145:4,19,24 | 123:19,20 | 180:1 209:8 | 163:18 | 182:5,7,18 |
| 76:19,23 | 147:12 | 123:23 | 243:23 | 177:14 | 185:10,16 |
| 123:9 | 169:2,9 | 124:5 126:7 | 249:24 | 181:4,15 | 186:23 |
| update 218:5 | 177:21 | 130:21 | usually 92:18 | 182:8 183:4 | 187:2,15,21 |
| updated | 179:2 191:8 | 132:18 | 93:10 127:1 | 184:14,21 | 188:17,24 |
| 133:11 | 192:22 | 135:13 | 163:19 | 185:17,22 | 189:8,18,19 |
| Upper 26:1 | 198:14 | 140:3 | | 186:9,12,17 | 191:4,15,22 |
| 33:24 90:8 | 206:2 | 147:24 | V | 201:9 | variation |
| 216:23 | 209:12 | 149:21 | vacillating | variable 54:4 | 22:14,15 |
| upstream | 210:16,20 | 150:20 | 70:3 | 54:12 65:16 | 76:20 132:6 |
| 28:15 | 210:21 | 154:6 | valid 118:13 | 66:7,19,20 | 132:7 |
| 218:20 | 218:21 | 168:15 | validate 31:9 | 68:13,16,21 | 134:12 |
| urban 13:7 | 221:12,17 | 172:9,10 | 31:15 180:7 | 69:1,19 | 138:3,10,14 |
| 13:11,23 | 221:17 | 178:8 180:4 | validated | 70:7 122:15 | 150:22 |
| 14:19 36:11 | 222:1,1,7 | 190:15 | 121:16 | 148:9 | 157:11 |
| 46:12 47:13 | 222:14,18 | 191:23 | validation | 149:20 | variations |
| 47:24 136:6 | 222:20 | 198:13 | 180:5,21 | 151:8,9 | 62:20 |
| 196:16 | 223:1,2,12 | 201:19 | 212:18 | 154:6 178:3 | varied |
| usage 198:12 | 223:14 | 202:10 | Valley 15:21 | 180:1 185:7 | 151:12 |
| use 9:14 | 225:12 | 219:1 | valuation | 185:9 | varies 44:14 |
| 11:12 17:10 | 232:21 | 223:14,16 | 32:3 147:2 | variables | variety 70:14 |
| 18:9 19:12 | 240:5 248:9 | 223:19 | value 109:12 | 23:3 24:8 | 86:24 91:22 |
| 19:23,24 | 249:15 | 241:2,12 | 125:15 | 28:3 33:2,8 | 94:11 235:4 |
| 20:1 23:24 | useable | 244:13 | 131:9 134:4 | 33:10 36:17 | various |
| 24:1,13 | 131:18 | 249:1,6,7 | 135:9 144:4 | 43:20 54:1 | 25:23 39:7 |
| 25:10 26:11 | used 7:11 | useful 139:3 | 165:13,16 | 54:7,14 | 40:17 71:19 |
| 27:19 30:3 | 10:14,16 | 249:20 | 180:14 | 57:20 65:17 | 71:20 76:15 |
| 36:22 44:17 | 19:17,21 | uses 36:20 | 184:4 197:3 | 65:21 66:3 | 85:9 98:13 |
| 50:19,21 | 20:2,3,4 | 57:5 104:19 | 197:4,7 | 66:17 67:22 | 101:19 |
| 51:20 53:18 | 24:8 27:18 | 106:7,13 | values 30:17 | 68:8 69:13 | 107:16 |
| 53:20 54:15 | 28:12 29:1 | 222:21,21 | 43:18 73:8 | 69:14,17 | 147:22 |
| 61:22 62:4 | 31:18,20 | 223:22 | 126:15 | 70:5,9,13 | 154:3,16 |
| 64:12 67:4 | 33:1,2,6,8 | 224:1 | 128:12 | 71:3 73:19 | 163:24 |
| | | | 130:16,20 | | |

| | | | | | |
|----------------------|----------------------|--------------------|---------------------|---------------------|----------------------|
| 184:1 | 157:1,9 | 243:24 | 189:3 | 242:19 | 227:15 |
| 194:13,13 | 178:23 | volumes | 214:21 | 248:23 | 228:1 |
| 204:23 | 180:10 | 244:9 | 221:1 229:4 | waste 223:20 | 231:19 |
| 245:13 | 185:8 | | 233:2,15 | 232:18 | 232:18,19 |
| vary 17:4,6 | 208:13 | W | 235:2,4 | 240:18 | 240:17,18 |
| 21:19 22:6 | 213:22 | Wabash | 236:2 237:4 | water 1:2,3 | 240:18 |
| 24:14,22 | 215:21 | 15:17 | 238:11 | 4:4 7:11 | 243:17,23 |
| 25:2,3,6 | 219:24 | Wacker 2:10 | 240:17 | 13:10,21 | 243:24 |
| 43:20 74:16 | 235:21 | 2:17 | 241:16 | 16:12 18:9 | 244:9 246:2 |
| 75:4 | 241:12 | wadable | 247:20 | 18:10 19:9 | 247:23 |
| vegetation | 247:23,24 | 145:17,18 | wanted 23:15 | 28:10,23 | waterbodies |
| 71:6 102:8 | 249:20,20 | 145:23 | 24:1 27:19 | 29:12 30:16 | 15:5,12,16 |
| 187:16 | 250:5 | 146:11 | 27:20,23 | 36:8,13 | 18:18 76:18 |
| 188:4,18 | vessel 194:1 | wait 6:2,4 | 88:15 | 37:20 44:19 | 84:3,20,23 |
| 189:9,13 | vessels 194:3 | 150:14 | 100:19 | 58:15 64:9 | 84:24 85:7 |
| 193:21 | viable 85:24 | 159:21 | 108:13 | 65:23 72:19 | 86:8 94:23 |
| 200:14 | 115:11 | wakes 194:2 | 137:8 | 77:3,5,8,13 | 125:18,21 |
| 220:13 | 116:1,5 | walk 238:11 | 142:12 | 77:22 78:20 | 179:6 |
| verify 33:6 | vicinity | wall 30:23 | 147:1 | 79:19 91:7 | waterbody |
| version 11:11 | 219:23 | 31:2 102:4 | 148:22 | 93:6 94:8 | 15:22 16:6 |
| versus 28:6 | video 30:4,20 | 120:18 | 149:19 | 94:11,15,16 | 16:8,16 |
| 72:22 80:11 | 119:21 | 142:15 | 150:23 | 98:15 99:10 | 18:16 28:19 |
| 160:24 | 120:7 | 151:16 | 151:8 172:6 | 99:13 | 48:16 76:22 |
| 165:8 166:2 | view 192:8 | 191:17 | 190:18 | 102:20 | 76:23 95:3 |
| 191:23 | viewed 119:6 | 200:4 | 212:20 | 104:14 | 114:20 |
| 232:9 | views 192:9 | walls 33:7 | 240:12,15 | 109:1,2 | 116:2 |
| 243:24 | violation | 199:24 | wants 35:1 | 110:24 | 176:18 |
| 245:23 | 160:24 | 220:2,5 | 124:2 | 114:23 | 178:17 |
| vertical | 161:2,5,6 | 233:18 | warm 82:14 | 120:5 | 179:5 207:1 |
| 102:4,7 | 161:10 | want 6:14 | warmer 82:9 | 127:10 | 226:12 |
| 142:15 | violations | 9:13 10:3,7 | Wasik 5:19 | 136:4,5 | 227:16 |
| 151:16 | 157:13,16 | 12:16 19:23 | 20:15 38:3 | 155:18 | 230:9 |
| 191:17 | 157:18 | 23:24 35:4 | 39:12 74:22 | 159:3,17 | 245:13 |
| 199:24 | 158:16 | 50:14 67:1 | 76:9 104:2 | 161:19 | waters 19:4,6 |
| 200:4,10 | 159:23 | 68:6,7 73:9 | 230:24 | 162:12 | 26:2 31:5 |
| 220:2 | Virtually | 73:20,21 | 232:3 246:4 | 167:6,12,22 | 33:16 92:5 |
| very 6:19 | 220:13,16 | 74:17 76:16 | 246:15 | 168:4,5,9 | 127:8 |
| 7:23,23 | visibility | 83:24 88:6 | wasn't 51:23 | 183:7 | 183:15 |
| 17:8 25:4 | 29:23 30:1 | 89:22 95:10 | 55:7 61:14 | 194:20 | 222:15,18 |
| 37:4 40:18 | 30:8 31:2,4 | 96:5 103:16 | 61:18 72:10 | 196:14 | 223:13,21 |
| 88:2 92:20 | 32:7 120:4 | 104:6 | 74:2 94:16 | 209:2,6 | 246:20 |
| 99:17 | visual 32:4 | 112:23 | 125:12 | 211:20 | watershed |
| 105:22 | 33:11 34:9 | 122:18 | 127:6 132:3 | 213:3,9,14 | 109:24 |
| 106:6,16 | vitae 117:22 | 125:1 | 143:2 | 213:18 | 114:20 |
| 134:12,14 | voice 229:6 | 136:23 | 152:13 | 217:18 | waterway |
| 135:10 | voltages | 137:1 | 158:22 | 220:6 | 1:3 4:6 |
| 139:7,11,16 | 245:10 | 143:11,13 | 159:19 | 222:20 | 223:19,23 |
| 139:21 | volume | 144:11 | 210:24 | 223:2,2,14 | 242:16 |
| 151:18 | 243:17,22 | 146:23 | 242:14,17 | 223:20,20 | waterways |
| | | 148:2 177:2 | | | |

| | | | | | |
|---------------------|----------------------|-------------|---------------------|---------------------|---------------------|
| 84:18 85:14 | 145:2 147:8 | 98:17,21 | 172:3 | wetland 95:3 | 229:13 |
| 85:18 93:23 | 150:5 151:3 | 99:23 100:9 | 176:24 | wetlands | while 24:19 |
| 195:13 | 178:23 | 100:10 | 177:5,21 | 93:15,19 | 25:18 28:5 |
| 217:11 | 194:12 | 101:2,7,13 | 178:1,2 | 94:2,19,20 | 39:19 151:9 |
| way 6:15 | 212:22 | 101:24 | 179:2 | 94:23 98:13 | 167:18 |
| 11:8 17:22 | 242:17 | 107:8,9 | 180:10,21 | 98:18 100:1 | 203:22 |
| 18:9 23:16 | 249:1 | 109:8,17 | 182:19 | 103:6,22 | 214:2 218:4 |
| 23:22 26:3 | went 12:24 | 110:18 | 184:9 | we'll 9:1,23 | 218:16 |
| 48:8,10 | 29:7 42:8 | 111:9,11 | 187:16 | 14:20 20:18 | whistling |
| 51:13 57:13 | 53:24 | 114:2,4 | 188:22 | 27:11 51:7 | 97:20 |
| 67:16 70:1 | 113:24 | 116:24 | 189:8,18 | 52:17 56:4 | white 34:4 |
| 81:19 89:2 | 143:18 | 117:8 120:4 | 190:5,20,21 | 76:13 83:8 | 170:8 249:7 |
| 97:22 | 147:19 | 120:11,13 | 190:24 | 112:3 | whole 20:23 |
| 105:18 | 164:17 | 120:16,23 | 191:8 193:3 | 116:19 | 58:22 59:2 |
| 108:19 | were 11:3,4,5 | 121:1 | 195:1,6,12 | 214:8,12 | 72:1,23 |
| 125:14 | 16:23,24 | 122:16,19 | 198:4 | 215:21 | 106:11 |
| 136:24 | 17:1,3,5,11 | 122:21 | 199:11 | 222:4 | 109:24 |
| 137:19 | 17:13 18:20 | 124:10 | 203:12 | 224:21 | 144:18 |
| 150:1 166:9 | 20:2,4,6,7 | 127:2 | 204:18 | 231:11 | 166:20 |
| 216:23 | 21:3,4,5,12 | 129:22 | 207:21 | 237:14 | 185:21 |
| 241:17 | 22:24 24:2 | 130:6 | 208:6,9,12 | 250:2,8 | 206:20 |
| 242:3 249:8 | 24:6,7,10 | 131:17 | 210:2 | we're 9:15 | 225:22 |
| ways 10:13 | 24:18,22 | 134:13 | 211:10,12 | 12:18,19 | wide 69:12 |
| 83:15 | 26:10,24 | 137:8,9,13 | 211:15 | 35:3 38:13 | 77:2 199:1 |
| 106:12 | 27:7,8,13 | 137:15 | 212:9,11 | 41:8 43:19 | 199:7,9 |
| 125:6 175:8 | 28:1,13,21 | 139:6 142:3 | 214:11 | 63:18 66:8 | widely 19:21 |
| weak 155:7 | 30:5 33:7,8 | 142:4 143:3 | 219:3,11 | 66:13 72:21 | widening |
| 163:14 | 37:10 40:8 | 143:4 | 227:22,24 | 77:1 78:19 | 195:19 |
| 167:20 | 40:10 43:18 | 147:10,17 | 232:8 233:6 | 80:9 96:9 | width 32:20 |
| web 203:24 | 48:14 50:4 | 148:3,3,6 | 238:3 241:4 | 125:2 | 33:5 34:2,5 |
| website 38:3 | 54:1,13 | 148:12,13 | 241:15 | 158:16 | 34:5 |
| 38:7 | 55:20 61:6 | 149:14 | 242:3,18,21 | 176:23 | wife 249:22 |
| week 5:23 | 61:10,16,17 | 150:1,2,4,5 | 243:1,8,10 | 205:17 | WILIAMS |
| weight 60:15 | 62:2,14 | 150:10,16 | 247:5 | 209:14 | 116:7 |
| 165:8 | 63:17 64:11 | 151:3,9 | weren't 23:7 | 214:2,24 | Willamette |
| Welcome | 65:17 66:3 | 152:1,1,2,4 | 32:11 40:9 | 230:16,17 | 15:21 |
| 6:18 | 67:9,22,23 | 152:5,6,16 | 68:9 120:3 | 236:24 | Williams 2:8 |
| well 18:1 | 68:18 70:5 | 152:17 | 129:24 | 238:14 | 25:19 35:1 |
| 21:1 23:19 | 70:14,21 | 153:7,13,20 | 132:3 | 241:17 | 35:4,5 41:5 |
| 32:21 34:20 | 71:5 72:18 | 154:17 | 147:20 | 247:22 | 70:20 71:1 |
| 39:23 45:14 | 73:16 77:3 | 155:4,6,8 | 151:12 | we've 46:9 | 71:1,10 |
| 51:15 58:18 | 77:6,8 | 156:17 | 179:5,10 | 49:15 63:3 | 79:2,13 |
| 68:3 76:9 | 78:14 80:21 | 157:1,17,18 | 227:24 | 63:8 77:13 | 82:17,20 |
| 77:18 90:6 | 82:3,4,5,5 | 158:21 | 228:2 248:3 | 77:15 95:14 | 150:8 152:5 |
| 91:16 92:2 | 89:22 91:18 | 159:13,23 | Wessell | 167:1,14 | 152:9,20 |
| 92:10 95:2 | 91:23 93:21 | 161:1,7,9 | 120:16 | 193:18 | 153:3 164:6 |
| 101:1 106:5 | 94:8,19 | 163:9 169:2 | West 1:11 | 222:22 | 164:9,17,22 |
| 107:10 | 96:16,17 | 169:8,11,12 | 2:14 251:21 | 227:4 228:8 | 165:1,3,4,6 |
| 119:11 | 97:7 98:5,9 | 169:13,15 | wet 249:8 | 228:14 | 165:12 |

| | | | | | |
|----------------------|------------------|---------------------|----------------------|----------------------|----------------------|
| 178:11 | 137:5 | wonder | 151:17 | 139:11 | 219:18 |
| 184:19,24 | 141:24 | 191:6 | 176:9,15 | 165:18 | 246:16 |
| 205:16,21 | 142:17,22 | wondering | 212:19 | 166:6 | 112 54:19 |
| 206:5,12,17 | 143:1,8 | 28:4 84:4 | 240:5 | | 64:23 65:13 |
| 221:11,16 | 148:5,8 | woody 34:15 | Wow 231:6 | 0 | 114 71:15 |
| 221:24 | 150:7,13,19 | 34:18 170:8 | wrap 111:6 | 0 132:9 199:4 | 117 73:3 |
| 236:17 | 152:8,13,22 | word 86:4 | writing 10:21 | 0.014 180:14 | 119 179:20 |
| willing 32:10 | 157:19 | 99:18 115:8 | written | 0.02 134:4 | 12 81:8,8 |
| wind 54:14 | 158:5,11 | 171:23 | 118:23 | 182:19 | 139:23 |
| 124:14 | 160:1,11 | wording | 238:14 | 184:6 | 161:17,20 |
| window | 161:3,11 | 112:18 | wrong | 0.04 163:9 | 162:21 |
| 219:13 | 164:8,14 | words 113:8 | 103:16,17 | 0.08 184:6 | 166:3 211:9 |
| winter 82:10 | 165:5,11,17 | 119:11 | 137:15 | 0.21 163:9 | 12a 144:21 |
| witness 3:2,6 | 166:6 | 204:12 | wrote 231:13 | 0.27 182:19 | 12.0 143:18 |
| 7:4 8:3,9,15 | 168:11 | 218:17 | 238:19 | 184:4,18 | 120 181:19 |
| 9:24 43:7 | 171:19 | 220:4 | | 0.29 180:11 | 123 182:23 |
| 47:19 48:6 | 175:21 | 227:18 | X | 180:14,19 | 124 77:1 |
| 48:17,20 | 176:4,7,14 | work 18:4 | X 3:1,10 10:1 | 0.45 135:12 | 185:13 |
| 52:22 53:14 | 177:11,17 | 106:10 | 41:9 215:15 | 0.48 135:9 | 187:19 |
| 54:2,9,16 | 178:7,10,12 | 107:8,21 | 225:1 | 182:6,16 | 188:22 |
| 54:18 57:17 | 179:7 | 109:9,14 | | 0.5 29:23 | 125 191:13 |
| 67:7 68:14 | 184:23 | 151:17 | Y | 30:1,9 31:2 | 13 49:17,20 |
| 68:22 69:11 | 185:3 | 210:15,19 | Y 41:10,12 | 31:3 | 108:14 |
| 70:16,19 | 191:10 | 218:9 | 42:15 43:14 | 0.51 181:1 | 145:12 |
| 71:3 78:6 | 205:4,9,15 | 219:14 | 49:5,9 50:7 | 0.7 138:19 | 199:4,14 |
| 80:6 82:24 | 205:19,23 | 225:3 226:8 | 57:11,11,19 | 084-004675 | 138 88:5,7,24 |
| 84:21 85:16 | 206:8,15 | 230:22 | 59:6 | 2:22 251:23 | 139 192:2 |
| 86:4,11 | 208:21 | 233:13,13 | yeah 143:2 | | 14 146:14 |
| 87:4,18 | 209:2,7,20 | 242:13 | 149:11 | 1 | 200:23 |
| 89:19 90:2 | 209:23 | 243:21 | 202:23 | 1 128:8 | 14th 84:8 |
| 94:21 98:22 | 211:13,23 | 249:15 | year 81:9 | 1:00 116:20 | 141 186:21 |
| 101:1,15 | 212:13 | worked | 110:19 | 10 132:17 | 15 136:19 |
| 102:11 | 213:2,11 | 105:12,14 | 204:20 | 170:7,14 | 201:17 |
| 104:10,15 | 214:16 | 105:15,15 | yearly 82:13 | 10th 5:5 | 16 111:13 |
| 104:18,24 | 215:9 | 105:16,20 | years 118:20 | 10:00 6:16 | 153:5,9 |
| 105:7 106:2 | 227:21 | 106:17 | 183:4 | 35:7 | 16th 1:12 |
| 106:5 | 229:7 230:1 | working | 184:14 | 100 1:11 | 168 88:20 |
| 108:18 | 230:20 | 17:14 | yellow 60:17 | 62:10,15 | 17 32:16 |
| 109:4,15,19 | 232:11 | works 19:10 | 60:21,22 | 131:21 | 154:19 |
| 109:22 | 233:22 | worried 29:6 | 61:6,9,12 | 132:9 | 170 3:14 |
| 110:2,10 | 235:21 | worse 46:19 | yielding | 1021 2:6 | 171 3:15 |
| 112:8,16,22 | 238:5 239:7 | worth 134:18 | 144:24 | 104 236:14 | 18 155:14 |
| 113:1,10,20 | 248:2,6 | wouldn't | 145:8 | 106 123:13 | 19 35:22 |
| 114:10 | 250:4 | 21:10,23 | Z | 107 62:24 | 61:24 156:5 |
| 115:3,12,22 | 251:13 | 78:9 82:15 | Zalewski 2:5 | 109 63:24 | 19276 2:7 |
| 116:4,11,15 | witnesses | 93:1 96:16 | 4:14 | 11 128:6,21 | 1989 122:2 |
| 125:7,19,22 | 214:22 | 96:21 | Zenz 5:22 | 129:13 | 1999 169:21 |
| 127:11 | woken | 109:11 | zero 44:1 | 135:8 | |
| 128:17 | 238:13 | 111:1 | 127:4 139:8 | 137:11 | 2 |
| | | | | 138:24 | 2A 218:8,18 |

| | | | | | |
|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|
| 218:20 | 179:23 | 28C 168:23 | 4-12 57:18 | 457 3:16 | 135:3 |
| 219:3 | 180:3,4,9 | 284 14:5,8,9 | 4-4 50:5 | 215:3,11,13 | 57 73:1 |
| 2B 218:7,18 | 180:17 | 79:5,8,12 | 4-7 170:22 | 458 3:17 | 154:19 |
| 218:20 | 212:17,22 | 79:16 | 171:3 | 237:16,18 | 156:6 |
| 219:3 | 237:9,14 | 121:10 | 172:12 | 237:24 | 158:24 |
| 2nd 214:21 | 238:14 | 139:2 | 173:23 | 46 35:22 | 167:16 |
| 215:3 | 2010 84:8 | 155:16 | 4-8 51:6 | 39:15,17 | |
| 2-4 139:24 | 121:10 | 29 169:17 | 4-9 51:6 | 40:1 197:18 | <hr/> 6 <hr/> |
| 2.4.1 121:21 | 251:15 | | 4.13 59:6 | 47 37:2 | 6 130:13 |
| 20 13:5 61:24 | 2011 1:12 | <hr/> 3 <hr/> | 4.2.2 193:15 | 199:21 | 6a 124:20 |
| 81:14 128:9 | 4:23 215:4 | 3-1 161:15 | 4.3 49:3 | 474 3:13 9:6 | 6th 121:9 |
| 131:20,20 | 215:5 | 3-2 162:8 | 4.4 49:3 | 9:16,18,19 | 6-6 179:24 |
| 132:8,8,16 | 21 14:21,24 | 3-3 162:19 | 4.8 51:11 | 9:21 12:11 | 6-9 183:1 |
| 132:16 | 37:8 76:14 | 3-4 162:19 | 4.9 51:11 | 48 6:19 37:2 | 6.2 62:24 |
| 156:5 | 111:19 | 3.1.2 80:13 | 40 61:21 | 129:7,11 | 6.2.1 123:13 |
| 163:18 | 158:24 | 3.3.3 167:17 | 132:9 | 156:19 | 6.4 71:15,16 |
| 180:9,20 | 214-8310 | 30 58:9,10 | 191:12 | 162:22 | 181:20 |
| 200 28:14 | 2:18 | 301 1:5 4:7 | 400 28:14 | 163:16 | 6.4.2 185:14 |
| 2000 133:9 | 215 3:8,16 | 302 1:5 4:8 | 49:23 58:1 | 181:23 | 6.5 73:11 |
| 133:10 | 217 2:8 | 303 1:5 4:8 | 58:4,6,7,10 | 182:7 | 6.6 179:22 |
| 2001 59:18 | 22 121:13 | 304 1:5 4:8 | 58:12,21 | 183:10 | 60 139:1 |
| 71:18 75:15 | 161:14 | 31 20:5,8 | 59:2 154:10 | 198:21,21 | 60603 251:22 |
| 78:14 81:4 | 224 3:9 | 50:10 | 41 29:7 192:1 | 48th 4:21 | 60604 2:14 |
| 156:16 | 23 162:7 | 170:21 | 419-9292 | 49 63:23 | 60606 2:11 |
| 159:4 | 233 2:10 | 172:11 | 1:24 2:24 | 199:14 | 2:18 |
| 160:20 | 237 3:17 | 312 1:24 2:12 | 3:24 251:22 | 493 172:24 | 62 41:8 76:13 |
| 180:2 | 24 37:12 | 2:18,24 | 42 29:22 | 494 173:6,10 | 84:1,19,21 |
| 181:24 | 78:13 80:9 | 3:24 251:22 | 31:11 | 495 173:13 | 62794-9276 |
| 212:16,23 | 156:19 | 32 179:20 | 192:19 | 173:17 | 2:7 |
| 214:21 | 162:19,22 | 33 181:18 | 193:9 | 497 174:17 | 63 168:22 |
| 215:3 | 163:16 | 34 134:20 | 43 33:14 | 174:22 | 64 45:8 |
| 2002 171:1,1 | 25 121:21 | 135:3 | 193:10 | | 168:24 |
| 171:8 | 122:3 | 182:20,21 | 44 194:6 | <hr/> 5 <hr/> | 65 46:10 |
| 172:13 | 163:24 | 199:21 | 4400 2:17 | 5-1 60:7 | 169:18 |
| 173:24 | 258 237:15 | 35 1:5 4:7 | 447 5:8 | 5.2 62:10,15 | 67 49:4 |
| 180:2 | 26 45:3 | 136:11 | 45 62:23 | 5.5 219:7 | 68 88:15,20 |
| 2004 59:19 | 121:13 | 182:22 | 196:17 | 244:2 | 69 83:15 |
| 59:22 | 122:3 167:4 | 36 185:12 | 452 9:10 | 50 126:1 | |
| 121:23 | 27 45:3 | 37 186:7 | 12:18 | 136:1 | <hr/> 7 <hr/> |
| 2007 71:18 | 139:23 | 38 186:20 | 454 9:4,7,8 | 137:14,16 | 7 124:21 |
| 75:15 78:14 | 167:16 | 199:21 | 9:12,14 | 181:3 | 7a 127:16,19 |
| 81:4 156:16 | 183:3,11 | 39 62:2 | 10:8 12:12 | 200:22 | 7c 130:13 |
| 159:4 | 184:8,13 | 187:13 | 12:13 | 51 201:17 | 7f 133:1 |
| 160:20 | 28 15:10 | 189:24 | 455 3:14 | 52 203:1 | 7th 4:23 |
| 181:24 | 103:21 | 238:17 | 170:15,15 | 53 2:14 | 7-7 192:2,7 |
| 212:16,23 | 111:12,13 | | 170:17 | 54 37:16 | 192:13 |
| 251:21 | 111:19 | <hr/> 4 <hr/> | 456 3:15 | 206:19 | 7.2 88:8 |
| 2008 37:19 | 112:4 114:1 | 4-1 41:9,12 | 171:14,15 | 55 207:24 | 70 90:19 |
| 75:15 | 168:20 | 139:1 | 171:17 | 56 71:13 | 136:10 |
| | | 4-11 57:12,18 | | 134:20 | 137:16 |

138:22
75 19:10,11
125:16,23
126:2 127:9
194:24
773 2:15
78 50:10
119:17
7800 2:11
782-5544 2:8

8

8 251:21
8.1 186:20
80 132:9
81 170:21
818-4825
2:15
85 56:5
876-2380
2:12
89 59:5

9

9 3:4,13
9:00 1:13
95 59:24
97 60:6
98.6 180:16
99 62:7,9