

BEFORE THE 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)

RECEIVED
CLERK'S OFFICE
 MAY 20 2009
STATE OF ILLINOIS
Pollution Control Board

No. R08-9

REPORT OF PROCEEDINGS had before the
 ILLINOIS POLLUTION CONTROL BOARD held on May 5,
 2009, at 1:15 o'clock p.m. at the Thompson Center,
 Room-9-40, Chicago, Illinois.

1 A P P E A R A N C E S:

2

3 ILLINOIS POLLUTION CONTROL BOARD:

4 MS. MARIE TIPSORD, Hearing Officer

5 MR. THOMAS E. JOHNSON, Member

6 MR. ANAD RAO, Senior Environmental Scientist

7 LIN SHUNDAR

8 ALISA LIU

9 ILLINOIS ENVIRONMENTAL PROTECTION AGENCY:

10 Ms. Stefanie Diers

11 Ms. Deborah Williams

12

13 ENVIRONMENTAL LAW AND POLICY CENTER

14 33 East Wacker Drive, Suite 1300

15 Chicago, Illinois 60601

16 (312) 795-3707

17 BY: MR. ALBERT ETTINGER and JESSICA DEXTER

18 Appeared on behalf of ELPC, Prairie Rivers

19 Network and Sierra Club;

20

21

22

23

24

1 APPEARANCE CONTINUED:

2 BARNES & THORNBURG LLP

3 One North Wacker Drive, Suite 4400

4 Chicago, Illinois 60606-2833

5 (312 357-1313

6 BY: MR. FREDERIC P. ANDES

7 Appeared on behalf of the MWRDGC.

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

—
—
—

1 CHAIRMAN TIPSORD: Good afternoon. We
2 will take a break for half an hour to close
3 deliberating session. Mr. Andes, I believe,
4 we were on question number eight.

5 MS. ALEXANDER: Before we start, I
6 just wanted to mention we had an opportunity
7 during the break to find some information
8 concerning just some outbreaks that came up
9 earlier. We can present it now or
10 subsequently as people prefer.

11 CHAIRMAN TIPSORD: Why don't you go
12 ahead now.

13 DR. YATES: There is a report by the
14 Centers for Disease Control in the Morbidity
15 & Weekly Report, May 26, 2000, Volume 49,
16 number SS-34, and this is the entitled
17 "Surveillance For Waterborne Disease
18 Outbreaks-United States 1997 to 1998." And
19 there was an outbreak in July of 1997 in
20 Oregon in which individuals recreating in a
21 lake did contract infection caused by
22 schistosoma.

23 MS. ALEXANDER: I would add that
24 currently we have this as a PDF on our

1 computer access via wireless. We can
2 present it to the tribunal in whatever way
3 is most convenient as a public comment
4 subsequently.

5 CHAIRMAN TIPSORD: Yes, I would do
6 that. Sounds good.

7 MR. ANDES: Do we have any other
8 information since then, since 12 years ago
9 indicating outbreaks of schistosoma in the
10 U.S.?

11 DR. YATES: I have not had an
12 opportunity to review all of the waterborne
13 disease outbreaks in the United States just
14 during the lunch break.

15 MR. ANDES: And since you've got
16 involved in this matter, you have not seen
17 any information indicating torrents of
18 schistosoma in Illinois and the U.S., and
19 particularly not the CAWS?

20 DR. YATES: I have not seen any
21 outbreaks of schistosoma in the CAWS, no.

22 MR. ANDES: Do you have any
23 information as to what extent this infection
24 limit of 400 would address possible

1 Shistosoma present in the CAWS?

2 DR. YATES: No, I do not.

3 MR. ANDES: Okay. Before moving on
4 to question eight, I want to follow-up on a
5 couple of questions that we've talked about
6 before.

7 One of them was, I think there's
8 some confusion concerning the sampling
9 method used in the risk assessment, and this
10 is a Figure 2-3 from the Risk Assessment
11 Document.

12 CHAIRMAN TIPSORD: Which, again,
13 since this is a new transcript, that's
14 Exhibit 71, The Risk Assessment.

15 We just need one. I'll mark
16 this as an exhibit since it's all Risk
17 Assessment.

18 MR. ANDES: You might want to look
19 at it. Dr. Yates, you talked about the
20 small sizes of the samples that were
21 analyzed for purposes of risk assessment,
22 and I copied this table because I want to go
23 through with you the process and tell me is
24 it consistent with your understanding. But

1 I believe as noted in the Risk Assessment
2 Document, which this is a part of, that a
3 300 liter sample is taken and put through
4 this filter that is shown on the chart, that
5 the material that remains on the membrane in
6 the filter is then -- the membrane is
7 removed, the material on the membrane is
8 alluded, a sample is produced from that. So
9 in essence what we've done is concentrate
10 the 300 liter sample down to a smaller
11 sample. It's not just taking a little piece
12 of the 300 liters. It's concentrating the
13 300 sample to a smaller size, and that's the
14 sample that is actually taken off to be
15 analyzed. Is that consistent with your
16 understanding?

17 DR. YATES: Yes, sir.

18 MR. ANDES: So is there any reason
19 to believe that that concentrated sample
20 would be unrepresentative of the larger
21 sample it was concentrated from? Let me ask
22 it another way. Isn't that an EPA approved
23 sampling method?

24 DR. YATES: This is the EPA sampling

1 method. The point I was making is that you
2 have taken the large sample, couple hundred
3 liters, depending on the varying sample --
4 you take a couple hundred liters, you
5 concentrate it down to some amount, which I
6 do not know, but then you take a small
7 fraction of that concentrated sample, and in
8 the case of Norovirus, it was equivalent to
9 analyzing approximately a tenth of the
10 percent of the original sample, and you only
11 -- so the point is, you analyzed a very,
12 very small fraction of the original sample
13 in the form of a sub sample of the
14 concentrated sample and you analyzed a small
15 fraction of that and then extrapolate those
16 results to the entire sample. My point was
17 that small sample, that small fraction of
18 the concentrated sample that you analyzed
19 may or may not have been representative of
20 the entire sample.

21 MR. ANDES: Well, let me ask you, so
22 you are saying that there is a small
23 fraction of the concentrated sample?

24 DR. YATES: Correct, correct.

1 MR. ANDES: And can you show me
2 where in the Risk Assessment it causes that
3 process and what fraction is it of the
4 concentrated sample?

5 DR. YATES: If you look at the --
6 here I'm referring -- the point I was making
7 with the small fraction, specifically where
8 I have information as to the volume that was
9 analyzed is the Norovirus analysis. So I
10 believe this information would be in
11 Appendix D, the report, I believe from
12 Dr. Gerba's laboratory. I believe was
13 Appendix D, which they indicated that ten
14 milliliters of the concentrated sample was
15 sent to their laboratory. I don't know what
16 fraction of the entire concentrated sample
17 that entire sample represents, but ten
18 milliliters of the concentrated sample,
19 which is the sample that has been taken to
20 the membrane sample was sent to Dr. Gerba's
21 laboratory, and if I remember correctly 8.3
22 of that ten mils of concentrate was analyzed
23 in cell culture using the NPM method for
24 adenoviruses, and then a fraction of the

1 remainder of that ten milliliters of
2 concentrate was analyzed for Noroviruses,
3 and as you -- and then as you have reported
4 your results in The Risk Assessment for
5 Noroviruses -- and here I'm referring
6 specifically to Table 3.7, and this is in
7 The Risk Assessment, so that's Exhibit 71 --
8 there is a column in that table entitled
9 "Equivalent Volume Assay" -- so of the
10 200-ish, 300-ish, whatever, volume of sample
11 that was collected and then concentrated,
12 they analyzed an equivalent volume of
13 somewhere around .2, .18, .23 liters.

14 MR. ANDES: But initially you said
15 it was a small fraction of the concentrated
16 sample, but then I think you said you
17 weren't sure how much the total amount of
18 the concentrated samples were. If it was a
19 hundred milliliters and they took ten,
20 that's ten percent of the sample?

21 DR. YATES: Ten milliliters of
22 sample concentrate was sent to Dr. Gerba's
23 laboratory, and 8.3, if I remember
24 correctly, milliliters of that 10 was

1 analyzed for adenoviruses in cell culture.
2 And then -- I wrote it down somewhere -- a
3 small proportion of the remainder of that
4 ten milliliters was then processed and a
5 portion of that was analyzed for the
6 Norovirus. And I have the exact numbers
7 written down here if you want, but the point
8 is that the -- of the total sample that was
9 collected, and it's a very -- and if you
10 assume that -- you said it -- if 300 liters
11 were collected and they analyzed, say,
12 .2 liters, that's equivalent to less than
13 .1 percent of the total sample volume that
14 was collected.

15 MR. ANDES: Before concentration?

16 DR. YATES: No, sir. No, sir. No,
17 no, no.

18 MR. ANDES: You are talking as a
19 percent of the 300?

20 DR. YATES: Correct, correct.

21 MR. ANDES: But the 300 is the
22 sample before concentration.

23 DR. YATES: Correct. And they
24 reported it as an equivalent volume assay,

1 which refers back to that original
2 300 liters of 2.4 liters.

3 MR. ANDES: Isn't one of the
4 purposes of the filtration process to give
5 you a homogenous sample that then you could
6 take through the process and know that you
7 can, as is done here and is done generally,
8 split it off into pieces to conduct
9 different analytical exercises and know that
10 you are basically taking different portions
11 of that homogenous sample which had all the
12 stuff concentrated into it?

13 DR. YATES: Let's look at an
14 example. Let's say I take this large sample
15 and concentrate it. One of the reasons for
16 concentrating it is for ease of analysis.
17 It would be difficult, if I could only
18 analyze a couple liters at a time and take
19 300 and have enough to analyze the whole
20 thing. One of the purposes of the
21 concentration method is to get the sample
22 into a volume that is easily analyzed in the
23 laboratory. So let's say that I ended up,
24 after I concentrate that 300 liters, let's

1 say I ended up with 30 milliliters. Okay?
2 Let's say just for the purposes of argument,
3 let's say I ended up with 30 milliliters.
4 Let's say that there were two Noroviruses in
5 that 30 milliliters, and I send 10
6 milliliters of that 30 to the University of
7 Arizona where that sample is analyzed.
8 There is a probability that in that 10 ml
9 sample that I took, there were no
10 Noroviruses, even though the other 20
11 milliliters did have Norovirus. Okay? So
12 there's one place that you can miss
13 something that's present in a sample.

14 Let's assume that of those 30
15 milliliters where there were two
16 Noroviruses, the 10 ml subsample that I sent
17 to the University of Arizona did have a
18 Norovirus in it, for the sake of argument.
19 Okay? I took that 10 mls of concentrated
20 sample, and let's assume it had a Norovirus
21 in it, I then took 8.3 mls out of that 10 --
22 I need a chalkboard -- I'm a professor. I
23 use a chalkboard. I talk with chalk in my
24 hand. Let's envision this. I've got 10

1 mls. I have got one Noroviruses in that 10
2 mls. I take 8.3 milliliters out of it for
3 adenoviruses on cell culture. There is a
4 very high probability because 8.3 out of 10,
5 there is a very high probability that that
6 Norovirus ended up in the part of the sample
7 that I analyzed for adenoviruses --

8 MR. ANDES: And we are talking about
9 levels of one or two, aren't we,
10 concentrating the samples? So we are
11 talking about the chance of getting one or
12 two. We are talking about the fact of
13 significant amounts --

14 DR. YATES: I'm using this as an
15 illustration, how you can by analyzing a
16 portion of a sample, there is a probability
17 that you can miss an organism that's there.
18 And having one organism, one Norovirus,
19 especially, is extraordinarily significant
20 because as has been reported by Dr. Tounes
21 and Christine Moe, and a number of others,
22 in this article from the Journal of Medical
23 Virology --

24 MR. ANDES: I'm sorry, what article?

1 DR. YATES: We can and will have to
2 present it into evidence. Norovirus is
3 especially significant because as they --
4 but as they report in this article, we
5 estimate that the average probability of
6 infection for a single one Norovirus
7 particle is close to 0.56789. In other
8 words, the probability of infection from
9 exposure to one Norovirus particle is
10 50 percent, which is higher than that
11 reported for any virus study to date. So
12 finding even a single Norovirus particle has
13 huge public health consequences. And the
14 point is, the point is if I may finish, the
15 point is, by analyzing a very, very tiny
16 fraction of the sample that was collected,
17 .2 liters out of 300 liters, you could miss
18 large numbers of Norovirus particles, not
19 just one.

20 MR. ANDES: How could you miss large
21 numbers if you said if there were one or two
22 you might miss them in a sample? The
23 question is, if there are more large
24 samples, why isn't it you are going to have

1 them in the other part of the sample and not
2 in ours?

3 DR. YATES: As I mentioned, you
4 analyzed .2 liters out of 300. That's a
5 very, very small amount, a very small
6 amount, less than a tenth of a percent. So
7 even if there were hundreds of Noroviruses
8 in that entire 3 liters, by taking out such
9 a tiny, tiny amount, it was -- you could
10 easily miss viruses in the samples.

11 MR. ANDES: Doesn't The Risk
12 Assessment address those issues using
13 probabilistic methods?

14 DR. YATES: I don't believe that,
15 assuming that because the tiny fraction of
16 sample that you analyzed contained zero
17 Noroviruses, meaning that the entire sample
18 was devoid of Noroviruses, I don't believe
19 that was accounted for in the Risk
20 Assessment. Not according to anything I
21 could read. You assumed if the fraction you
22 analyzed didn't contain any, the whole
23 sample was negative.

24 MR. ANDES: If you do multiple

1 samples, you do the probabilistic sample,
2 based on that, you are not taking one data
3 point and making conclusions based on that.
4 You are taking a range of data points over a
5 period of time in wet and dry weather, and
6 125 samples, not one. You are saying that
7 that still, because the sample is small
8 relative to the 300 originally taken, 300
9 which is a large amount, that this renders
10 this invalid.

11 DR. YATES: What I'm saying is that
12 there is a very good chance that you have
13 underestimated the public health risk of the
14 presence of Noroviruses in the water. Eave
15 if you took 100 samples or 125, which I
16 don't believe is an extraordinarily high
17 number when making a decision of this
18 magnitude, but that's a different subject --
19 even if you took 125 samples, if you analyze
20 such a small fraction of each of those
21 samples and don't find anything in that tiny
22 fraction, and then you just discount that
23 entire sample as negative, that is going to
24 buy us the results.

1 MR. ANDES: If one compares, let's
2 take a look, at the moment, the 300 liters
3 used to concentrate down for purposes of
4 this sampling the kind of numbers we have
5 talked about, in terms of ingestion are
6 actually 30 milliliters for swimming,
7 correct?

8 DR. YATES: I believe that's what
9 you said, yes.

10 MR. ANDES: So the .02 milliliters
11 is actually not a miniscule percentage
12 amount one might ingest during swimming?

13 DR. YATES: I don't believe that the
14 two are related. The point is you assume
15 that that entire 300 liters contained
16 nothing. You only analyzed .2 liters of it.
17 I may have -- what if I ingested one of
18 those 299.8 liters, what if I ingested 30
19 mills out of that 299.8 liters that you
20 didn't analyze? Guess what? I could have
21 gotten the Norovirus.

22 MR. ANDES: So do we have to analyze
23 the 300 liters?

24 DR. YATES: You are making a

1 decision -- someone -- not you personally --
2 a decision is being made whether or not
3 there is a public health risk associated
4 with continuing the practice of putting
5 nondisinfected effluent into a water body
6 where you know that recreation occurs. It
7 certainly seems to me that the way that you
8 would want to approach this would be to do a
9 very, very thorough job of assessing the
10 potential health risks. You know that these
11 organisms are present in waste water. We
12 know that these organisms cause disease.
13 There's plenty of evidence. We've known for
14 years and years and years that these cause
15 disease. We know they are present in waste
16 water. We know we can reduce concentrations
17 by disinfecting the waste water. It's as
18 simple as that.

19 MR. ANDES: Let me ask a couple
20 questions. Is the method that was followed
21 consistent with the EPA methods?

22 DR. YATES: Which methods, I'm
23 sorry?

24 MR. ANDES: The way that the

1 sampling was done, is that consistent with
2 the EPA protocols?

3 DR. YATES: You've asked two
4 different questions. The way in which the
5 sample was collected and the way in which
6 the sample was concentrated, collected and
7 then desorbed from the membranes and then
8 concentrated. According to the Risk
9 Assessment, the U.S. EPA protocols were
10 followed, yes, sir.

11 CHAIRMAN TIPSORD: Excuse me.

12 DR. YATES: Now, the part about the
13 analysis of the sample is a whole different
14 question. There's not, to my knowledge, any
15 EPA protocol that says how, what fraction of
16 that sample do you need to analyze, and as
17 we've already discussed, there's no EPA
18 standard method for analyzing samples for
19 some of the pathogens that were done for
20 this study.

21 CHAIRMAN TIPSORD: Before we go any
22 further, we haven't entered this article in
23 as an exhibit. It's "Norovirus-How
24 Infectious Is It?" Journal of Medical

1 Virology from 2008. If there's no
2 objection, we will mark this as Exhibit 255.
3 Seeing none, it's Exhibit 255.

4 MR. ANDES: The report, the study
5 that you've provided on Noroviruses, you
6 indicated indicates that even one Norovirus
7 creates a 50 percent risk of infection.
8 Have you looked at the presence of
9 Noroviruses in the wet weather sources,
10 including combined sewer overflows, in the
11 CAWS?

12 DR. YATES: As I said, my focus was
13 on the dry weather because that was when the
14 effluent from the waste water treatment
15 plant was known to be the major source of
16 pathogens in the CAWS.

17 MR. ANDES: So if it rains every few
18 days and if the effects can last four days
19 or even weeks, would you agree that it would
20 be relevant to assessing the risk and the
21 total risk since people don't swim or people
22 don't canoe or kayak when there hasn't been
23 rain in a few days, would you agree that one
24 might also assess and put in context the

1 levels of Norovirus in combined with sewer
2 overflows which are untreated sewage as
3 compared to the secondary treatment treated
4 effluent from the treatment plants?

5 MS. ALEXANDER: Can we clarify that?
6 Is there any evidence in the record to
7 support any substantial numbers of pathogens
8 or indicators lingering a week or two weeks
9 after wet weather? I think the benchmark is
10 about two days. If you want to ask it as a
11 hypothetical --

12 MR. ANDES: I wouldn't agree with
13 your characterization.

14 MS. ALEXANDER: I wouldn't agree
15 with your characterization. If you want to
16 ask this as a hypothetical, you can go ahead
17 and do that.

18 DR. YATES: The point is, you know,
19 based on your own sampling that you are
20 putting human disease causing pathogens into
21 the water. You know that you can reduce the
22 concentrations of those disease causing
23 pathogens through disinfection. You can
24 reduce, therefore, the risk to public health

1 by implementing that disinfection treatment.
2 So it seems to me that it would be your
3 responsibility to do it. You know you can
4 have an impact.

5 MR. ANDES: If the conclusion of the
6 Risk Assessment were that in fact, A, the
7 risk is low even with the combined sewers
8 and secondary, that it would not be infected
9 by disinfection, would you still agree with
10 that?

11 DR. YATES: If you can have an
12 impact, a positive impact by reducing the
13 risk to public health through treatment,
14 then I believe personally that is the
15 responsible thing to do.

16 MR. ANDES: No matter how small the
17 risk reduction is?

18 DR. YATES: If I were in the
19 business of public health, I believe it's my
20 job to protect public health to the extent
21 that I can. It's that simple.

22 MR. ANDES: And if you were dealing
23 with a water body, whereas this one, where
24 combined sewers will continue, over 200

1 combined sewers will continue discharging
2 and are not effected by this rulemaking, and
3 therefore Noroviruses, to the extent they
4 are present, will be there, and other
5 pathogens, even with disinfection would be
6 in there, would this water body be safe to
7 recreate in?

8 DR. YATES: I do not believe I have
9 said that. I have said, if I have control
10 over something such as disinfecting the
11 effluent that will result in a decreased
12 risk to public health, I believe that that
13 step should be taken.

14 MR. ANDES: And if one were to
15 disinfect and, again, hypothetically, but
16 based on the results of this Risk
17 Assessment, one could conclude that the risk
18 reduction would be small, would you be
19 concerned that that would give a false sense
20 of security to recreators that now they can
21 go and recreate in a clean, safe water body,
22 even though the combined sewers are still
23 discharging?

24 DR. YATES: Again, I couldn't

1 speculate on what people would be thinking
2 necessarily. I don't know anybody who is
3 recreating there. But, again, I get in a
4 car, I don't put a seat belt on and believe
5 that I can drive recklessly because I know
6 the seat belt will protect me.

7 MR. ANDES: That's a different
8 question. Would you be promoting people
9 going into the water which still has
10 significant levels, by your terms, of
11 pathogens in it in terms of combined sewers
12 and other sources because they think it's
13 safe, would that be consistent with
14 protection of public health?

15 DR. YATES: I believe you are
16 mischaracterizing my point. My point is if
17 I have control of a source of public health
18 risk, and there's something that I can do to
19 reduce that public health risk by
20 disinfecting that source, I believe it's the
21 responsible thing to do.

22 MR. ANDES: No matter how small the
23 risk reduction is? No matter what the
24 economic cost to the community is?

1 DR. YATES: My job here has nothing
2 to do with determining costs. It's policy
3 and decision. It's someone else's decisions
4 what level of risk they are willing to
5 accept and what cost they are willing to pay
6 to achieve that level of risk.

7 MS. ALEXANDER: I have a couple
8 follow-ups.

9 Do you believe that the Risk
10 Assessment is in fact wrong about the flow
11 in the CAWS?

12 DR. YATES: As I believe I pointed
13 out fairly, specifically in my testimony, I
14 think there are a number of flaws with the
15 Risk Assessment, some of which we've already
16 talked about, and therefore, the conclusions
17 that are drawn with respect to the risk, the
18 risks that are present in "The Risk
19 Assessment," I would just say that there are
20 a lot of assumptions that went into that and
21 there are a lot of problems as we've talked
22 about with analyzing small fractions of
23 samples, with several of the other things
24 that I brought up in my testimony, and so my

1 confidence in some of the numbers that are
2 presented is certainly not where I would
3 want it to be if I were in the position of
4 having to make a decision about whether or
5 not I was going to require disinfection of
6 this effluent prior to discharge into the
7 CAWS.

8 MS. ALEXANDER: And one more
9 follow-up. Do you believe that the levels
10 of indicators illustrated on Figure 2 in
11 your testimony do indicate a likelihood of
12 risk to recreators in the CAWS?

13 DR. YATES: Again, as we've talked
14 about before, it's been shown time and time
15 again, and as we've already talked about
16 earlier this morning, in general, higher
17 levels of indicators are associated with
18 higher levels of pathogens, and some of the
19 levels of indicators that are present in the
20 CAWS are greater than 10,000 higher levels
21 of indicators, higher levels of pathogens.
22 So definitely if you have higher levels of
23 indicators and higher levels of pathogens,
24 you have higher levels of risk.

1 MR. ANDES: Let me move to another
2 follow-up question. I'm going to direct
3 your attention to Table 3 of in the report.
4 One of the issues, Dr. Yates, you raised
5 earlier was about, adenoviruses, and whether
6 the report was somehow ignoring certain
7 results. Now, as I understand it, in this
8 table, the total numbers, the samples for
9 viruses were then put through a PCR in
10 essence of DNA test, and if positive, which
11 would indicate the presence of adenovirus,
12 the conservative assumption was made that it
13 was called adenovirus even though it that
14 might not necessarily be true; is that
15 correct? So, for example, 7.52 for Calumet
16 outflow was assumed to be all adenoviruses
17 and treated as that 7.52, even though it's
18 entirely possible that not all of that
19 sample was adenovirus?

20 DR. YATES: That's my understanding
21 of how this was handled.

22 MR. ANDES: But not all of it would
23 be viable, but it was assumed it was all
24 adenovirus, and factored into The Risk

1 Assessment as viable?

2 DR. YATES: My understanding is that
3 the concentration, the MPN/100L was derived
4 from the cell culture assays, which means
5 that those were indeed ineffective viruses.

6 MR. ANDES: But not necessarily
7 adenovirus, right?

8 DR. YATES: That's correct. They
9 were infected viruses.

10 MR. ANDES: And then if the results
11 were negative, it was figured already
12 there's not adenovirus in here, and then
13 that sample would be -- but those
14 concentrations were addressed in the results
15 for enteric viruses. If they weren't adeno,
16 they were likely enteric. They were
17 accounted for there, and then it was just
18 that the sample viruses for enteric viruses
19 were dealt with in another parameter,
20 correct?

21 DR. YATES: I do not find anything
22 in this document that indicated that a cell
23 culture positive PCR negative sample was
24 then included as an enteral virus positive

1 sample.

2 MR. ANDES: But there were
3 measurements of culturable enteric viruses,
4 correct, using an EPA method?

5 DR. YATES: Yes, a portion of the
6 sample -- my understanding is that a portion
7 of the sample was sent to a laboratory, and
8 that portion of the sample, some fraction of
9 it, I don't know what, was analyzed for
10 enterovirus, yes.

11 MR. ANDES: So the enteroviruses are
12 not ignored?

13 DR. YATES: Let me try to explain
14 this.

15 MR. ANDES: Simply tested with
16 another fraction of the sample?

17 DR. YATES: One fraction of the
18 sample was tested for enteroviruses, and
19 those reports are shown in, I believe, in
20 Table 3.5. Okay? Another fraction of the
21 sample was sent to the University of Arizona
22 and analyzed for adenoviruses. If there
23 were cell culture positive results, the
24 conclusion was that there were infected

1 viruses there, either enteroviruses or
2 adenoviruses. There was a follow-up
3 determination done using a PCR process, that
4 if positive, would indicate that the sample
5 contained adenoviruses.

6 MR. ANDES: And the purpose of
7 testing that sample was for adenoviruses,
8 correct? For that fraction that was the
9 whole point?

10 DR. YATES: The fraction of the
11 sample that was analyzed at the University
12 of Arizona for adenoviruses, that
13 methodology that was used in cell culture,
14 detected as it states, enteroviruses and
15 adenoviruses, right. The purpose of the
16 analysis according to your table anyway says
17 adenoviruses. The purpose of analysis is to
18 determine whether there were adenoviruses
19 there. But regardless, that cell culture
20 test detected adeno. So if it came up
21 positive in that analysis, one would
22 conclude it contained enterovirus and/or
23 adenovirus. You further then analyze that
24 sample using PCR, and if it was positive,

1 you said, okay, we've got adenoviruses in
2 this sample. If it was negative, then one
3 would conclude that the cell culture results
4 resulted from infection by enteroviruses.

5 MR. ANDES: Right.

6 DR. YATES: Okay. My point is, that
7 those samples that were analyzed for
8 adenoviruses in Dr. Gerba's lab and yet were
9 shown by his own technique to contain
10 enteroviruses were not considered to be
11 enterovirus positive for the Risk
12 Assessment.

13 MR. ANDES: Because there was
14 another test on other fractions, which was
15 testing for enteroviruses, right?

16 DR. YATES: But if that sample that
17 was separate, the sample collected on that
18 date that you've already described, went
19 through this concentration to some small
20 volume, okay, when that sample was split, a
21 fraction of it was sent to -- I'm not sure
22 where the laboratory was -- HML -- is that
23 -- I don't know where that lab is -- that
24 fraction was analyzed for enterovirus. If

1 that fraction from that date was found to be
2 negative, was found to be negative by that
3 laboratory but Dr. Gerba's analysis of a
4 different portion of that same sample was
5 shown to be positive for enteroviruses, did
6 you not include that's a positive
7 enterovirus result? And did you compare the
8 two sets of data?

9 DR. YATES: I did, sir, yes. And
10 there were numerous occasions, and I had
11 them highlighted in blue. There were
12 numerous occasions on which Dr. Gerba's
13 analysis showed there were enteroviruses,
14 infected enteroviruses in a sample when the
15 other fraction of the sample that was
16 analyzed by the other laboratory was shown
17 to be negative. And this, again,
18 illustrates -- this again illustrates the
19 issues I was talking about earlier with the
20 Norovirus. That when we take a sample and
21 we analyze it, by splitting it up into
22 smaller fractions and analyzing only a
23 portion of that sample, you can miss things.

24 MR. ANDES: But you also don't know

1 one was -- you don't know which one was
2 right, right?

3 DR. YATES: So now you are telling
4 me that the analyses that Dr. Gerba did in
5 his laboratory using this SOP that you have
6 said was a marvelous method, using this
7 method that Dr. Gerba has in his laboratory,
8 which are with all the QAC's and giving all
9 the positive cell culture results, which he
10 has already says means it's adenoviruses or
11 enteroviruses, you are now telling me it's
12 wrong, that there were not viruses?

13 MR. ANDES: The question is the SOP,
14 was it designed to detect and to adequately
15 capture enteric risk, because if it wasn't
16 and the other one was specifically designed
17 for that and one was focused on adeno and
18 the other was not, the question is are you
19 dealing with apples and oranges? Can you
20 say that because one was specifically
21 designed to capture enteric risks, you are
22 saying one was illegitimate because of the
23 one design by Dr. Gerba, which wasn't
24 designed to look for that?

1 DR. YATES: By Dr. Gerba's own
2 testimony, and is published in his paper in
3 "Applied Environmental Microbiology" in
4 2008, this test, using this cell line that
5 he has in his laboratory, detects both types
6 of viruses, adenoviruses and enteroviruses.

7 MR. ANDES: Are the culture results
8 the same in the two tests?

9 DR. YATES: Which virus?

10 MR. ANDES: The two?

11 DR. YATES: One, the specifics of
12 each media. The point is that Dr. Gerba has
13 testified that they are detected using this
14 assay. The point is that you took a sample,
15 you split it up into different fractions and
16 analyzed it using two different methods,
17 both of which you have said will detect
18 entero viruses. If one said the viruses
19 were there and the other said they weren't,
20 if both of them will detect entero viruses,
21 then that sample should be counted as
22 positive for enteroviruses.

23 MR. ANDES: I believe the records
24 will show that the focus of Dr. Gerba's

1 testimony is using that specific test with
2 its media and that methodology to look at
3 adenovirus. And if you were doing a test to
4 design, to look at enteroviruses, that's
5 why -- if they thought -- let me ask you
6 this question. If they thought that this
7 test was going to be fine for detecting
8 both, why would one send off another
9 fraction to have a different test done
10 unless you were specifically focused on
11 getting on a more accurate type of pathogen.

12 DR. YATES: Probably because there
13 is a standard accepted EPA procedure
14 approved method for the detection of
15 enteroviruses.

16 MR. ANDES: That they used?

17 DR. YATES: That was used by the
18 other laboratory and not used by Dr. Gerba.

19 DR. YATES: Didn't Gerba testify,
20 and you asked me questions, that they are
21 detected, and yes, indeed they both are.
22 Furthermore, if you were being very careful
23 about the entire analysis, the prudent thing
24 to have done would have been to take those

1 samples, which were PCR negative for
2 adenoviruses, but cell culture positive, and
3 analyze them for PCR by PCR for the
4 enterovirus.

5 MR. ANDES: Unless one wanted to
6 follow the EPA method for enterovirus and
7 send them to a different lab to do that.

8 MR. ANDES: In fact that was done as
9 you've testified, correct? You are saying
10 they should have tested them twice?

11 DR. YATES: You are the one that
12 said that the cell culture process used by
13 Dr. Gerba, and Dr. Gerba has testified to
14 this himself, the cell culture method that
15 was used by Dr. Gerba detects enteroviruses
16 and adenovirus. You are now choosing to
17 ignore the entero virus results if they did
18 not agree with the results from the other
19 laboratory. And the point is they were not
20 analyzing the exact same water. They were
21 analyzing portions of samples.

22 MR. ANDES: But it's fairly
23 traditional to use split samples, and I will
24 contest whether Dr. Gerba's testimony was

1 specifically concerning adenoviruses and the
2 use of methodology for detecting that for
3 the whole purpose. Don't make it sound that
4 the he was trying to say that the
5 methodology would detect both.

6 MS. ALEXANDER: Is this a question?

7 CHAIRMAN TIPSORD: Listen, Dr.
8 Gerba's testimony is on the record and can
9 stand on what he had to say. I think we
10 need to move on. I think you've made your
11 point. I think that Dr. Yates has made her
12 point. And we could go on for hours arguing
13 over this point. Let's move on.

14 Excuse me. Dr. Lin has a
15 follow-up.

16 MEMBER LIN: Dr. Yates, do you have
17 any information to provide us of the
18 pathogen, for example the Cryptosporidium,
19 Giardia, die off or regrowth in the stream?

20 DR. YATES: The Giardia, the
21 Cryptosporidium and the viruses are not
22 capable of growing out in the stream. These
23 organisms must be inside of a living
24 particle cell. In the case of enteric

1 viruses, the Noroviruses and the others,
2 they can only grow and reproduce inside of a
3 human cell or in special laboratory cells or
4 in certain kinds of primates. So they are
5 incapable of reproduction or growth out in
6 the water. It's physically impossible for
7 them to do so.

8 MEMBER LIN: Yes, I know. How about
9 to die-off?

10 DR. YATES: The rate of die-off of
11 different microorganisms such as viruses and
12 parasites is dependent upon a number of
13 factors, including temperature, sunlight,
14 humidity, the amount of organic material
15 that's present in the water, the presence of
16 natural native bacteria in the water, and it
17 varies from organism to organism, and it
18 varies by those different environmental
19 conditions that I mentioned. So I can't
20 just give you one number. It's very
21 variable.

22 MR. ANDES: There are some pathogens
23 that do have regrowth and repair in the
24 water body, am I right?

1 DR. YATES: There are some
2 microorganisms that are able to grow in the
3 water, sure.

4 MR. ANDES: And if you reviewed
5 Dr. Blanchy's (phonetic) testimony, he
6 provides some reports that specifically
7 discuss situations where there was
8 disinfection and then repair and regrowth in
9 terms of levels coming back up, am I
10 correct?

11 DR. YATES: That's correct.
12 However, I would note that the
13 concentrations of the organisms after
14 disinfection, even with regrowth, were much
15 lower than the concentrations before
16 disinfection.

17 MR. ANDES: We can go back to
18 Dr. Blanchy's testimony in terms of how that
19 is characterized. I'll move on.

20 In terms of question eight --

21 DR. YATES: Just one minute. I'm
22 going to have to find it here.

23 MR. ANDES: I'll rephrase a little
24 bit because we've touched on some of these

1 issues. Correct me if I'm wrong, you don't
2 have any quantitative sense as to the extent
3 to which meeting this new technology based
4 limitation of 400 per hundred milliliter,
5 the extent to which that would reduce
6 overall pathogen levels in a water body?

7 DR. YATES: Again, the type of
8 disinfectant that's used is going to have an
9 impact on -- different impacts on different
10 kinds of microorganisms. So it would be
11 very difficult to make an overall sweeping
12 generalization as to how effectively every
13 single pathogen would be reduced by one type
14 of disinfectant. However, as we know,
15 disinfection reduces pathogens, and it
16 reduces indicators, it also reduces
17 pathogens. So that's why, because we have
18 this -- what's the word? Because there are
19 so many different kinds of pathogens and you
20 can test for all of them and you can't look
21 for the effects of disinfection on all of
22 them, that's why we use indicators to give
23 us some indications of levels of pathogens
24 in the water.

1 MR. ANDES: And you are aware of
2 data showing there are pathogens upstream of
3 the treatment plants, correct?

4 DR. YATES: I have seen the results
5 of the sampling that was done for this
6 study, yes.

7 MR. ANDES: And disinfection of the
8 effluent obviously won't do anything to
9 address those sources, am I right?

10 DR. YATES: Disinfection of the --

11 MR. ANDES: Treatment plant.

12 DR. YATES: Of the treatment plant
13 effluent is going to have a -- the majority
14 of that impact is obviously going to be on
15 the organisms in the effluent. If there
16 were residual disinfectants that were
17 present in the effluents, that were present,
18 that disinfectant could indeed have effect
19 on organisms in the water from other
20 sources. It would probably be minor, but
21 certainly.

22 MS. WILLIAMS: If the effluent in
23 impact upstream of the point of where it's
24 discharged, either through stagnation or

1 some type of hydrological effect where the
2 water is moving upstream, could disinfection
3 reduce those values of pathogens?

4 DR. YATES: Certainly. If there
5 were residual disinfectant in the water or
6 in the effluent as it was deposited in the
7 CAWS, certainly it could have an impact on
8 pathogens from other sources.

9 MR. ANDES: Let me follow up with
10 that. Because I'm pretty sure that under
11 the Clean Water Act, the District would not
12 be allowed to use residual disinfectant in
13 the upstream. Perhaps. Presuming at first
14 they would have to chlorinate and then they
15 would have to dechlorinate because they are
16 talking --

17 MS. ALEXANDER: Is that a question?

18 MR. ANDES: Is that your
19 understanding?

20 DR. YATES: I have to know -- I do
21 not know what the laws are in the State of
22 Illinois regarding that, but if you did have
23 to chlorinate, then certainly there would
24 not be residual disinfection left.

1 MR. ANDES: In fact, there would be
2 disinfectant byproducts, correct?

3 DR. YATES: That's going to depend
4 on a number of factors.

5 MR. ANDES: You haven't looked at
6 the risk of disinfecting byproducts?

7 DR. YATES: I'm not a toxicologist,
8 and I really cannot speak to those risks.

9 MR. ANDES: On page 8 of your
10 testimony you have a Figure 3 concerning
11 urban rivers.

12 MS. ALEXANDER: For the benefit of
13 all here, I will put this up on the easel.

14 MR. ANDES: Have you compared the
15 flow of the Mississippi River to the flow in
16 the CAWS?

17 DR. YATES: I have some general
18 information on the flow in the Mississippi
19 River.

20 MR. ANDES: Or the Delaware River?
21 Aren't they larger rivers in terms of flow?

22 DR. YATES: I truly have no idea
23 what the size of the Delaware River is.

24 MR. ANDES: We are talking about the

1 situation where 70 percent of the
2 effluent -- you have no reason to believe
3 that the Delaware River is seven percent --

4 DR. YATES: I have absolutely no
5 knowledge of the Delaware River. I wouldn't
6 and couldn't speculate.

7 MR. ANDES: And it's not clear where
8 there's significant delusion flow compared
9 to the CAWS, where there really is very
10 low --

11 DR. YATES: Let's look at, say, the
12 Fox River. The Fox River I do know a little
13 bit about. Not much, but I do know that the
14 flows in the Fox River are, depending on
15 where, et cetera, the flows in the Fox River
16 are somewhat comparable to the flows in the
17 CAWS. The amount of waste water or the
18 proportion of waste water in the Fox River,
19 at least in general, and my understanding,
20 is less than that in the CAWS. It's not
21 70 percent, at lease not to my
22 understanding. There may be places where it
23 is, but even correcting for the differences,
24 the concentrations in the CAWS are huge. We

1 are talking about, you know, almost 20,000
2 fecal coliforms per hundred mls. Whereas
3 here we are talking about way less than
4 5500. We are talking huge, huge
5 differences. More than an order of
6 magnitude.

7 MR. ANDES: Are those data at the
8 effluent?

9 DR. YATES: Which ones?

10 MR. ANDES: The ones on the left.

11 DR. YATES: The ones on the left,
12 these are at the waste water treatment
13 plant, and these are at water monitoring --
14 the patch mark blue ones are at monitoring
15 stations.

16 MR. ANDES: The other ones aren't at
17 treatment plants, right?

18 DR. YATES: No, this is -- the
19 darker blue are at the treatment plant, and
20 these are at the -- the other bar is at a
21 water quality monitoring station.

22 MR. ANDES: You are not saying that
23 the levels say significantly downstream of
24 the treatment plants in the CAWS are at

1 20,000?

2 DR. YATES: I'm sorry, repeat that.

3 MR. ANDES: Are you saying that the
4 levels downstream, say downstream in the Cal
5 Sag Channel or in the Chicago Sanitary &
6 Ship Canal are 20,000 or are you talking
7 mainly at the treatment plant? I'm trying
8 to figure out where that data comes from.

9 DR. YATES: At the treatment plant.
10 For example, North Shore, it was 19,538 to
11 be precise. At a downstream monitoring
12 station, and I believe that that indicates
13 that it was three miles downstream, the
14 concentration was in excess of 10,000 per
15 hundred ML.

16 MR. ANDES: And is that one data
17 point? Is that an average of data points
18 taken from --

19 DR. YATES: I believe this is just
20 a --

21 MR. ANDES: Certainly not an
22 average, right?

23 DR. YATES: These are -- you know,
24 off the top of my head, I'm sorry, at this

1 exact moment I can't recall.

2 MR. ANDES: If those are one data
3 point, do we know what the samples are in
4 terms of the other body, in terms of whether
5 those are averages or one data point taken?

6 DR. YATES: Again, I'm totally
7 blanking on this. I'm really sorry.

8 MR. ANDES: Okay, thank you.

9 DR. YATES: Actually, it does say
10 samples were taken from May to October. So
11 I do believe these are averages. As it
12 states here in the legend -- I'm sorry, you
13 guys can't see it -- but in the legend it
14 states that the samples were taken monthly
15 from May to October. So that would
16 certainly imply that those are average
17 values.

18 MR. ANDES: I'm not sure, is that
19 one sample or are you saying those were
20 average of the all the samples taken during
21 the recreational season?

22 DR. YATES: Again, I don't remember
23 the exact detail, but the fact that it
24 states here in the legend that the samples

1 were taken monthly from May to October, that
2 would imply that there are multiple samples
3 that contribute to these numbers and that
4 they are averages of some numbers of
5 samples.

6 MR. ANDES: These are EPA data, not
7 district data, correct?

8 DR. YATES: These are data from the
9 U.S. EPA, not Illinois EPA.

10 MR. ANDES: Can we get more
11 information about where those samples were
12 taken and what they represent?

13 MS. ALEXANDER: We can clear this up
14 on a break.

15 MR. ANDES: Okay. And I guess the
16 final question, on say the Fox River, I
17 notice that the levels are actually higher
18 downstream than at the treatment plant
19 indicating, I guess, that there are other
20 significant sources.

21 DR. YATES: I really don't know
22 whether there's other sources. It could
23 have to do with --

24 MR. ANDES: It could be repair and

1 regrowth, right?

2 DR. YATES: It could be sampling.
3 It could be regrowth. These are fecal
4 coliforms, it could be --

5 MR. ANDES: So I'm going to skip a
6 few questions. And I think we've addressed
7 this issue, but I want to get it clear, and
8 I believe J5 would be the issue. You
9 haven't looked, am I correct --

10 DR. YATES: I'm there. Go ahead.

11 MR. ANDES: You have not looked at
12 the contribution of other sources on the
13 bacteria, on the weather particularly during
14 wet conditions, am I right?

15 DR. YATES: What I know about other
16 sources is what I've read in the Risk
17 Assessment Report. But, again, I did not
18 focus on the wet weather conditions. I
19 focused on the dry weather conditions.

20 MR. ANDES: Since the treatment
21 plants discharge during dry and wet weather,
22 you haven't looked at the relative
23 information of the treatment plants during
24 certain other sources during wet weather

1 events and after, correct?

2 DR. YATES: Again, as I believe I've
3 stated several times now, the fact is there
4 are pathogens in the effluent. You are
5 putting that effluent in the CAWS. People
6 are recreating in that, and they are being
7 exposed to pathogens which has public health
8 risk associated with it.

9 MR. ANDES: And in terms of
10 disinfection, that would not eliminate
11 pathogens from the effluent, right? There
12 would still be pathogens in the effluents,
13 correct?

14 DR. YATES: If you are asking would
15 disinfection reduce the number of all
16 pathogens to zero -- is that the question
17 you had?

18 MR. ANDES: Sure.

19 DR. YATES: The answer is, I can't
20 remember the which way the question is --
21 disinfection of the effluent would not
22 reduce the concentration of all pathogens to
23 zero.

24 MR. ANDES: And do we know what

1 levels it would reduce to, given that you've
2 read Dr. Blanchy's testimony concerning this
3 issue and whether conventional disinfection
4 as required here, whether it would in fact
5 disinfect infection significant? Do you
6 have a conclusion that, not fecal coliforms,
7 but actual pathogens, would be reduced to a
8 400 standard?

9 DR. YATES: I cannot speak
10 specifically to the degree of pathogens
11 reduction that would result from
12 disinfection to a 400 fecal coliform per ML
13 standard. I can tell you that disinfection
14 will reduce the concentration of pathogens,
15 thereby decreasing public health risk.

16 MR. ANDES: But you are not saying,
17 correct me if I'm wrong, that the levels
18 that are remaining after disinfection --

19 MS. ALEXANDER: Levels of what?

20 MR. ANDES: The level of pathogens
21 remaining after disinfection in this water
22 body from all sources would be protective of
23 the health of recreational users? As would
24 the conditions after this disinfection be

1 safe for recreational users?

2 MS. ALEXANDER: What do you mean by
3 safe? That's a vague question. There are
4 levels of safety. We need clarity.

5 MR. ANDES: Speak to levels of
6 safety then. The claims are being made that
7 this would reduce public health risk. I'm
8 trying to define what you use the level of
9 safe to be.

10 DR. YATES: I have not stated what
11 would be safe. That, to me, is a regulatory
12 designation.

13 MR. ANDES: You are speaking to a
14 regulatory body.

15 DR. YATES: As I've already stated,
16 it's someone else's role to determine what
17 is an acceptable risk. All I'm saying is
18 one can disinfect the waste water to reduce
19 the concentrations and thereby reduce the
20 risk. What the acceptable level of risk is,
21 is someone else's role to determine.

22 MR. ANDES: I'm going to skip to
23 12 and go to other questions later.

24 MS. WILLIAMS: Can we go back? I

1 want to ask one of Fred's questions. Is
2 that okay? I'd like to hear the answer to
3 Question 9.

4 CHAIRMAN TIPSORD: Question 9?
5 There's J9 and then 9.

6 MS. WILLIAMS: No, just 9. It
7 doesn't have any subparts. The question
8 quotes you as saying, "I also note that
9 disinfection is a longstanding standard
10 practice in most major metropolitan areas in
11 the U.S. and is implemented in many smaller
12 communities, as well," et cetera, and the
13 question is, are you aware in other parts of
14 the world, such as Western Europe waste
15 water disinfection is the exception? I
16 would like to know if you agree with that
17 statement and that question in 9?

18 DR. YATES: I have to say that with
19 respect to Europe, I don't have a lot of
20 direct knowledge. It's my understanding
21 that there are -- that there does seem to be
22 an increase in certain areas of the use of
23 disinfection. However, I had occasion to
24 speak directly with a colleague in Canada

1 who informed me that it is required by law
2 in their province that all waste water be
3 disinfected prior to discharge. So it's not
4 just that waste water effluents are
5 disinfected prior to discharge in the United
6 States. It's practiced in other places in
7 the world.

8 MR. ANDES: But you are aware, I
9 gather, that there are cities in Western
10 Europe that do not practice disinfection,
11 correct? You said it was increasing.

12 DR. YATES: I have not done a survey
13 of waste water treatment plants in Western
14 Europe to determine which ones require
15 disinfection on and which ones do not.

16 MS. ALEXANDER: I have a quick
17 follow-up concerning the data on Figure 3
18 because I think I understand what the
19 problem was.

20 Dr. Yates, do you have an
21 understanding of what the source is of the
22 data only with respect to the Chicago area,
23 the Little Canal and the North Shore?

24 DR. YATES: The Chicago area

1 waterways data, my understanding is that
2 those come from the District's own sampling,
3 results of their own sampling. I believe
4 the other data comes from the United States
5 Environmental Protection Agency. I believe
6 Region 5. I believe that's here.

7 MR. ANDES: Can we find out exactly
8 which data points are presented there
9 because that's not clear to me?

10 MS. ALEXANDER: That's the part that
11 we can clear up on break.

12 MR. ANDES: Is there any further
13 follow-up?

14 MS. ALEXANDER: No.

15 MR. ANDES: I'm going to skip around
16 a little bit. On question 14, you stated
17 that the district sampling in the CAWS near
18 the outfalls indicates higher bacteria level
19 of higher than five times the primary
20 contact standard. Do you know of a
21 technical basis for that five times the
22 primary contact standard or was that just a
23 rule of thumb?

24 DR. YATES: I do not have -- sitting

1 here thinking, going through everything I've
2 read, I do not know that I have ever read
3 where the five times -- the factor of five
4 comes from. I do not know.

5 MR. ANDES: And right now, there
6 isn't any federally recommended secondary
7 contact criteria, correct?

8 MS. ALEXANDER: What do you mean by
9 federally recommended? I mean, because what
10 we are talking about here is a
11 recommendation? Are we talking about formal
12 regulatory? We need to clarify that.

13 MR. ANDES: Yes, we have primarily
14 contacted recommended criteria, but they
15 don't have a secondary contact criteria,
16 correct?

17 DR. YATES: That is my
18 understanding. However, as you know, even
19 if EPA does not have a, you know, formal
20 enforced standard for secondary contact
21 recreation, again, in the interest of
22 protecting public health, if you know that
23 you are doing something that is putting the
24 public at risk, and you know that you can do

1 something about it, to reduce that risk,
2 even if EPA doesn't regulate it, doesn't
3 mean you have to do it or doesn't mean that
4 you shouldn't do it.

5 MR. ANDES: I guess we'll get into
6 the policy call then whether you balance how
7 much risk you are reducing to how much it
8 costs, what the greenhouse case and picks
9 are and everything else.

10 DR. YATES: Again, that is something
11 that's not my role. It's somebody else's
12 role to take all these factors into
13 consideration and determine how much risk
14 they are willing to accept and how much they
15 are willing to pay to reduce that risk to
16 whatever level they've considered
17 acceptable.

18 MR. ANDES: I'm going to go back to
19 some that we've already -- that I'm skipping
20 over -- in question 18D.

21 DR. YATES: 18B or D, I'm sorry?

22 MR. ANDES: D as in David.

23 Are you familiar with the expert
24 work report of the expert scientific

1 workshop on critical needs for the
2 development of your revised recreational
3 water quality criteria?

4 DR. YATES: Yes, sir.

5 MR. ANDES: Isn't it true that this
6 report pointed out that fecal coliform are
7 detected sometimes where fecal contamination
8 is not present possibly resulting in an
9 inaccurate assessment of effected
10 recreational safety?

11 DR. YATES: Yes, it certainly is one
12 of the things that was pointed out in that
13 workshop report, that there are times when
14 coliforms can be present when there isn't
15 fecal contamination. However, the converse
16 is also very true and very well documented,
17 that we can find pathogens in water, water
18 that has actually caused disease outbreaks,
19 in the absence of coliform bacteria.

20 MR. ANDES: It goes both ways then?

21 DR. YATES: It does go both ways.

22 MR. ANDES: Okay. You've discussed
23 the importance of, not point sources in
24 making recreational waters unsafe, citing an

1 EPA statement that, "It's the main reason
2 that approximately 40 percent of our
3 surveyed rivers, lakes and astute rivers are
4 not clean enough to make basic uses, such as
5 fishing or swimming." And I'll provide the
6 document that includes that quote.

7 CHAIRMAN TIPSORD: I've been handed
8 the "Analysis of the United States
9 Protection Agency Noncompliance with Beaches
10 and Environmental" by Dr. Yates and Rachel
11 T. Noble, and I don't see a date on this.
12 But if there's no objection, we'll mark this
13 as Exhibit 256. Seeing none, it's
14 Exhibit 256.

15 MR. ANDES: And I believe that
16 statement was on pages 8 and 9 of this
17 report. In your opinion, would not point
18 sources make the CAWS unsafe at times even
19 if disinfection was provided at the
20 treatment plants?

21 DR. YATES: I assume you are
22 referring to wet weather conditions?

23 MR. ANDES: Probably, primarily,
24 yes.

1 DR. YATES: I just want to be clear.

2 MS. ALEXANDER: Can we break the
3 question down? Can you ask the question
4 referring to wet weather sources because I
5 think the answers may be completely
6 different.

7 DR. YATES: Certainly if there are
8 wet weather sources contributing pathogens
9 to the CAWS, then the effects of, as we've
10 already said, the effects of disinfecting
11 the effluent would not be as great in terms
12 of pathogens, reducing pathogen risks as
13 they would be during dry weather times when
14 the waste water treatment plant effluent was
15 the main source of pathogens to the CAWS.

16 MR. ANDES: I'm not sure that
17 answered the question, but I'll move on.

18 In your same report you stated,
19 on page 5, that "The EPA must justify the
20 level of risk upon which any criteria are
21 based." Do you believe that the same would
22 apply in this rulemaking proceeding?

23 DR. YATES: That the EPA should you
24 justify the level of risk?

1 MR. ANDES: Or in this proceeding
2 the Agency too should look at and base the
3 level of risk upon which to make
4 requirements.

5 DR. YATES: Maybe I'm referring to
6 which -- obviously, I was referring to the
7 U.S. EPA.

8 MR. ANDES: And obviously the same
9 would be true for the state?

10 DR. YATES: Do I believe that the
11 level of risk has to be justified?

12 MR. ANDES: Yes.

13 DR. YATES: I think that would be
14 reasonable.

15 MR. ANDES: But nothing in your
16 testimony speaks to what the precise levels
17 of risk are or would be with or without
18 disinfection, correct?

19 DR. YATES: That's correct.

20 MR. ANDES: Are you aware -- and I
21 assume you've reviewed a fair amount of the
22 record in this matter -- are you aware of
23 any justification that's been provided in
24 the record by the Illinois EPA concerning

1 levels of risk that would be resulting from
2 disinfection?

3 DR. YATES: Justification for?

4 MR. ANDES: In other words, is there
5 anything you've seen in the record how the
6 level of infection would be reduced by
7 disinfection?

8 MS. ALEXANDER: By the record, are
9 you referring to what IEPA specifically has
10 presented?

11 MR. ANDES: Yes.

12 DR. YATES: I don't know that. I
13 haven't seen exactly anything that IEPA has
14 presented.

15 MR. ANDES: Okay.

16 DR. YATES: I'm racking my brain,
17 but I don't --

18
19 MS. WILLIAMS: When you say that,
20 does that include the proposed rulemaking
21 language in this proceeding?

22 DR. YATES: I have not seen the
23 proposed rulemaking language.

24 MR. ANDES: Did you review the

1 statement of basis that was included with
2 the rule or any of the testimony by the
3 agency?

4 DR. YATES: I do not believe I have
5 seen the testimony by the Agency.

6 MR. ANDES: What have you reviewed
7 in the record regarding --

8 DR. YATES: I've reviewed the
9 testimony of a number of experts.

10 MR. ANDES: Including the Illinois
11 EPA's experts?

12 DR. YATES: I have reviewed the
13 testimony of Dr. Blanchy, of Dr. Gerba,
14 Dr. Pertropolis, Dr. Hass, Dr. Gerba,
15 Dr. Dorevich. So I'm not sure if that's
16 what you are referring to by the -- I'm not
17 sure.

18 MS. ALEXANDER: I'm sorry, you
19 referenced IPA's experts. Do you mean their
20 staff members?

21 MR. ANDES: Yes.

22 DR. YATES: I do not believe I have
23 reviewed the testimony of the staff members
24 of the IEPA.

1 MR. ANDES: Did you review the
2 statement of basis they included with when
3 they started this rulemaking?

4 MS. WILLIAMS: Are you referring to
5 the statement of reasons, Fred?

6 MR. ANDES: Yes, thank you.

7 DR. YATES: I am not sure that I
8 have read that.

9 MR. ANDES: I noticed also in this
10 report that there were statements made
11 toward the back -- I'm sorry, on page --
12 starting on page 25.

13 DR. YATES: Are you speaking of the
14 analysis?

15 MR. ANDES: Got it.

16 DR. YATES: I wanted to make sure I
17 had the right report.

18 MR. ANDES: Under No. 5, the
19 statement is made that the CPSP, the
20 Critical Path Science Plan proposes
21 epidemiology or quantitative risk assessment
22 management, QRAM studies, to establish
23 criteria is not the appropriate way to
24 deliberate studies to develop criteria. And

1 then it goes on to say in the second
2 paragraph that -- I'm sorry, in the first
3 paragraph, that the experts at the expert
4 workshop indicated that the preferred
5 approach for defining the quantifying human
6 health risks from exposure to pathogens in
7 water is to conduct epidemiological studies,
8 going on to say epidemiological studies is
9 the primary way to be proceeding the
10 quantifications should only occur as an
11 adjunct or precursor to epidemiological
12 studies. Do you stand by those studies?

13 DR. YATES: Yes, in the context of
14 this, the issue for which this document was
15 prepared, yes.

16 MR. ANDES: So in this particular
17 proceeding where evidence has been
18 introduced as to both a quantitative
19 microbial Risk Assessment and
20 epidemiological Risk Assessment that is
21 currently ongoing, you would agree that
22 those should be relevant in the Agency
23 making its decision as a matter of public
24 policy?

1 DR. YATES: I believe that those
2 should be considered as the decision is made
3 regarding whether or not effluent should be
4 disinfected prior to discharge or not. I
5 believe both of those, in addition to other
6 things, should be considered, yes.

7 MR. ANDES: Okay. I'm going to skip
8 again to question 25. This concerns
9 statements in your testimony. If I can find
10 that again here under the pile. In the Risk
11 Assessment, those response methods were
12 selected and considered for general
13 population. You provided those response
14 parameters for those populations?

15 DR. YATES: First of all, I would
16 point out that my statements were that
17 sensitive populations weren't taken into
18 account in the Risk Assessment, and there
19 are other places in the risk assessment
20 where you can take into account sensitive
21 subpopulations other than that in the dose
22 response portion of the Risk Assessment.
23 For example, it's documented that the
24 severity of illness, for example, can be

1 higher in the sensitive subpopulations or
2 the mortality rate can be higher in
3 sensitive subpopulations. So just because
4 you don't have dose response data for
5 sensitive subpopulations doesn't mean that
6 you just ignore them.

7 MR. ANDES: So the answer to the
8 question is, you are not aware of dose
9 response parameters that could be used to
10 deal with sensitive populations?

11 DR. YATES: That's not entirely true
12 because there are dose response data that
13 have been derived from studies of children,
14 for example, and those would be considered
15 as a sensitive population.

16 MR. ANDES: For primary contact
17 water?

18 DR. YATES: Doing a dose response
19 study is not dependent on the kind of water.

20 MR. ANDES: And what particular
21 studies are you speaking of?

22 DR. YATES: If I remember correctly,
23 there are some of the studies that have been
24 done on children include polio, polio virus

1 studies. That's the only one I'm sure of at
2 this moment. There may be others, but
3 that's the only one coming immediately to
4 mind.

5 MR. ANDES: As I understand it, the
6 largest issue in determining sensitivity to
7 effluxion is the immune status of the
8 individual. And people do develop
9 immunities through antibodies to particular
10 pathogens, am I right?

11 DR. YATES: I would not necessarily
12 agree that the largest factor in determining
13 sensitivity to infection is the presence of
14 antibodies, no.

15 MR. ANDES: But it's a factor?

16 DR. YATES: It is a factor.

17 MR. ANDES: Are there studies
18 indicating that routine exposure, for
19 example, by going out on the water
20 frequently could build up the antibody and
21 one would be less sensitive?

22 DR. YATES: There are situations
23 where exposure to an organism actually can
24 make you -- can make it more likely that you

1 would be reinfected.

2 MR. ANDES: Is that true as to
3 pathogens?

4 DR. YATES: Norovirus.

5 MR. ANDES: But do you have any
6 studies to that effect?

7 DR. YATES: Not here with me. But
8 in speaking with Dr. Christine Mode, who has
9 done the human challenge studies for
10 Norovirus, she, two weeks ago, verified
11 that.

12 MR. ANDES: There are others where
13 repeated unexposure would make one less
14 infectible?

15 DR. YATES: There are exceptions,
16 that if you develop antibodies as a result
17 of exposure to that pathogen, it would make
18 it less likely that you would be less likely
19 to become infected by that particular
20 pathogen, likely.

21 MR. ANDES: Say in terms of
22 immunocompromised people, as a matter of
23 public health, would it be your
24 recommendation that people who are

1 immunocompromised maybe not recreate on the
2 CAWS?

3 DR. YATES: Could you define
4 immunocompromised?

5 MR. ANDES: Let's say people taking
6 immunosuppressive medications.

7 MS. ALEXANDER: She's already
8 testified that she's not here to make
9 specific recommendations. If that's what
10 you are asking for on the record, that's not
11 what she's here to do.

12 MR. ANDES: I was not asking as a
13 regulation ought to be made. As a matter of
14 public health you have opined as to what
15 makes sense as to public health. Would one
16 tell people who are taking immunosuppressive
17 medications that perhaps they not go on this
18 water body disinfected or not, given the
19 infection sources?

20 DR. YATES: I really couldn't
21 speculate as to that or not. I'm not a
22 physician.

23 MR. ANDES: On question 26, this
24 concerns, on the confutation of wet and dry

1 weather conditions, do you believe
2 recreational activities are conducted more
3 frequently near the treatment plant outfalls
4 or in other areas?

5 MS. ALEXANDER: I'm going to object
6 to that. There is a little vagueness here.
7 Near the outfalls, do you mean within a mile
8 or two of them? Do you mean right where the
9 water is falling into the river or what do
10 you mean by that?

11 MR. ANDES: I would say near the
12 sampling stations.

13 MS. ALEXANDER: Any of the sampling
14 stations?

15 MR. ANDES: In close proximity to
16 the outfalls.

17 MS. ALEXANDER: We are back to the
18 vagueness. Is close proximity a mile or two
19 feet?

20 MR. ANDES: Let's say it's a mile.

21 MS. ALEXANDER: Okay.

22 DR. YATES: So the question is, if
23 you could remind me again.

24 MR. ANDES: We have three treatment

1 plants --

2 DR. YATES: Right.

3 MR. ANDES: -- on this set of
4 waters. Do you believe that recreational
5 activities are conducted more frequently in
6 close proximity to the treatment plants,
7 within say a mile downstream of them or in
8 other areas of the system, including
9 upstream?

10 DR. YATES: I don't have specific
11 knowledge of where the recreation occurs
12 upstream or downstream.

13 MR. ANDES: And since data used in
14 The Risk Assessment included data near the
15 outfalls, wouldn't that tend to over
16 estimate the risk for people who are
17 recreating in other areas, including
18 upstream of those outfalls, if we are
19 looking at an overall assessment of risk
20 recreating on this set of water body?

21 DR. YATES: Well, again, we've
22 already talked about what I feel are some of
23 the major shortcomings of the Risk
24 Assessment. So it sounds like what you are

1 saying is that in this one particular case
2 we may have assumed that there may be a
3 little bit higher risk for some individuals,
4 but in the context of the overall Risk
5 Assessment how important that whole thing
6 is, it's really rather difficult to say.
7 And furthermore, if I remember correctly in
8 The Risk Assessment that was done, you
9 assumed that there was equal use of upstream
10 and downstream locations when it's my
11 understanding that more miles of the CAWS
12 are below or downstream of the treatment
13 plants. So I don't understand how you could
14 justify assuming that there was equal
15 recreation both up and downstream.

16 MR. ANDES: I'm not sure what you
17 are referring to.

18 DR. YATES: In the, if I remember
19 correctly, in the Risk Assessment you
20 assumed equal recreation occurred upstream
21 and downstream. Whereas the total number of
22 miles of waterways downstream of the
23 treatment plants is much, much higher, and
24 so there was kind of an unequal. The two

1 just don't jibe.

2 MR. ANDES: If more samples are
3 taken, and we can go back to the risk
4 assessment during wet weather of CFO's, that
5 would tend to increase the risk of
6 assessment, would it not? Remember all
7 those risks were taken into account and
8 included.

9 DR. YATES: I think we're mixing
10 apples and oranges here. I think we are
11 talking about different things. One had to
12 do with where people were recreating, and my
13 point is that you were assuming that people
14 were recreating equally upstream and
15 downstream when it's my understanding that
16 the downstream portion of the CAWS
17 represents a much larger percentage of the
18 system, if you will.

19 MR. ANDES: Can you point me to
20 where it's equally upstream and downstream?
21 I believe samples taken within four widths
22 of the outfalls were used to represent the
23 whole downstream area, including miles
24 downstream of the outfalls, which wouldn't

1 that tend to overestimate the risk?

2 DR. YATES: I'm not really sure I
3 can say that at this point. I'm sorry, I
4 don't think I'm following.

5 MR. ANDES: Let me continue on the
6 issue of wet and dry. Assume you know
7 people may be exposed on rainy days or days
8 immediately after a rain event.

9 DR. YATES: I don't have specific
10 knowledge of when people are recreating
11 here.

12 MR. ANDES: Are you aware that The
13 Risk Assessment did not take into account
14 the fact that rain may decrease recreational
15 use?

16 DR. YATES: Say that again.

17 MR. ANDES: It didn't take into
18 account any decrease in recreational use
19 when it's raining?

20 DR. YATES: I'm not certain that I
21 was aware of that specific point.

22 MR. ANDES: If so, if it used the
23 same assumption for recreational use in wet
24 and dry weather, that would tend to

1 overestimate the risk somewhat because it's
2 likely that somewhat less people are
3 recreating in rain storms than during dry
4 weather, correct?

5 DR. YATES: I don't have any
6 information to enable me to agree to that
7 statement.

8 MR. ANDES: And would you disagree
9 with the notion that including sampling data
10 from both dry and wet weather is necessary
11 to look at the impacts of disinfection of
12 the overall risk associated with the water
13 body considering people recreate in all
14 sorts of weather conditions?

15 DR. YATES: Again, it depends what
16 you are talking about. If I am a person and
17 I am recreating in that water body on a dry
18 weather day, then I don't really care what
19 my risk is on a wet weather day. I care
20 about what my risks when I'm recreating when
21 I know that there are pathogens being put
22 into the water from the treatment plant.
23 So, again, I care about the risk when I'm
24 recreating.

1 MR. ANDES: So do you think we
2 should not to have look at the wet weather
3 risk, only the dry weather risk?

4 DR. YATES: I'm saying for the
5 individual recreator it may or may not have
6 an impact. What I'm saying is something
7 I've said several times already, I believe,
8 and that is you have control over the
9 concentration of pathogens that are input
10 into the water during the dry weather. You
11 can reduce those pathogens, thereby reducing
12 public health risk by disinfecting that
13 effluent.

14 MR. ANDES: And therefore? And
15 that's where you stop.

16 DR. YATES: I believe I said by
17 disinfecting the effluent you could reduce
18 the effect of pathogens, reduce the effect
19 of pathogens to the people recreating in the
20 water. I believe I said all that.

21 MR. ANDES: When do you want to
22 break? =

23 CHAIRMAN TIPSORD: We've got about
24 ten minutes. As long as we leave about five

1 to 3:00. The call is supposed to initiate
2 at 3:00.

3 MR. ANDES: I'm going to move to
4 question 29, concerning dose response
5 assumptions. Are the pathogens dose
6 response parameters that were employed in
7 the Risk Assessment typically used in
8 Agency's risk assessment?

9 DR. YATES: It depends on what
10 organisms are the risk assessments are being
11 done for. So the dose response values that
12 are reported in the Risk Assessment Document
13 are correct for the pathogens that you cite
14 them for, you know. So when you say this is
15 the dose response for, you know, a given --
16 for Salmonella or this is the dose response
17 for Cryptosporidium, the number that you
18 give as the dose response for the numbers or
19 the values that you give for the dose
20 response are correct. The issue is that
21 there are occasions when you say, well, we
22 don't have a value for the dose response for
23 this organism so we are going to use the
24 dose response for that organism. That's

1 where I would say that there are issues.

2 MR. ANDES: And one of the questions
3 you raised was concerning the adenovirus
4 dose response parameter. But the dose
5 response parameter cited is for respiratory
6 infection of adenovirus, do you believe it
7 accurately reflects dose response parameters
8 for gastrointestinal virus?

9 DR. YATES: I really couldn't
10 speculate on how the dose response
11 parameters for respiratory acquired
12 adenovirus infection relates to the dose
13 response parameters for gastrointestinal
14 adenoviruses. The point is that one can
15 acquire respiratory adenovirus infections
16 from adenoviruses that are present in fecal
17 material, and therefore in sewage, and there
18 was no attempt made to do a Risk Assessment
19 for the respiratory route of acquiring
20 adenovirus infection. And, again, I'm not
21 the only person who has pointed this out.
22 This is another one of the concerns that the
23 EPA has brought to your attention.

24 MR. ANDES: But I think there are

1 two separate issues there, and the EPA issue
2 was responded to in the comments and
3 responses. And the question was, in doing
4 the dose response on gastrointestinal
5 illnesses, the issue was as stated here, was
6 that in the risk assessment, they said
7 uninfectivity in respiratory infections are
8 very high, so using that high dose response
9 value would seem inappropriate for
10 gastrointestinal illnesses where the
11 infectivity is much lower, but you are
12 saying you should use it any way because
13 it's conservative.

14 DR. YATES: I don't believe that's
15 what I said, sir. I said one should look at
16 the potential for respiratory transmission
17 of adenoviruses since you have the
18 transmission of adenovirus. I do not know,
19 as I also stated, whether the dose response
20 parameters for respiratory transmitted
21 adenoviruses. I don't know how those relate
22 to the dose response parameters for the
23 gastrointestinal adenoviruses. I just don't
24 know.

1 MR. ANDES: If there is not a route,
2 if there is not a pathway in canoeing for
3 respiratory inhalation of significant levels
4 of adenoviruses, would that still be
5 something that you want to look at? I
6 believe The Risk Assessment looked at these
7 issues qualitatively. Do you believe there
8 is a significant risk of inhaling from
9 canoeing on the CAWS?

10 DR. YATES: Now, you are changing
11 the kinds of activities you are talking
12 about. But nonetheless I have not done a
13 study to look at the volume of water one
14 might be exposed through the respiratory
15 route during those kinds of activities, so I
16 could not speculate as to whether those
17 risks would be high or low. The point is I
18 don't know.

19 MR. ANDES: The EPA, in looking at
20 primary contact recreational criteria, are
21 they looking at that? Are they focusing a
22 lot of attention on inhalation?

23 DR. YATES: They are looking at
24 nongastrointestinal illnesses yes, sir.

1 MR. ANDES: My question is, are they
2 spending any significant amount of attention
3 on inhalation?

4 DR. YATES: They are looking at
5 other types of end points, in addition to
6 gastrointestinal illness, of which
7 respiratory effects are included. They are
8 also looking at other kinds of infections,
9 eye infections and ear infections. Things
10 like that. The other thing I would point
11 out is that even the respiratory
12 adenoviruses can be transmitted, especially
13 in children. They can be transmitted
14 through the fecal-oral route. So as far as
15 I know, your Risk Assessment did not take
16 that into consideration. Even the so-called
17 nonenteric adenoviruses can be transmitted
18 through exposure through ingestion.

19 MR. ANDES: Would you expect the
20 dose response parameters to be similar?

21 DR. YATES: I couldn't speculate to
22 that because I'm not aware of any studies on
23 that.

24 MR. ANDES: Are all adenoviral

1 pathogens equally capable of producing
2 gastrointestinal effects?

3 DR. YATES: Based on my knowledge of
4 adenoviruses, there are two of them that are
5 most frequently associated with
6 gastrointestinal effects. Those are
7 adenoviruses 40 and 41. There are other
8 adenoviruses that are most frequently
9 associated with respiratory effects. There
10 are some adenoviruses that may be most
11 frequently associated with causing
12 respiratory effects but may produce
13 gastrointestinal effects. The more
14 important thing is whether the cause is a
15 respiratory effect or gastrointestinal
16 effect. The adenoviruses replicate in the
17 gastrointestinal tract, and therefore are
18 shed in fecal material, and therefore they
19 are present in sewage. And as I've also
20 mentioned in even some of the respiratory
21 adenoviruses that produce respiratory
22 effects, some of them can be spread through
23 ingestion. And that's especially true in
24 children.

1 MR. ANDES: Have you looked at the
2 extent to which the biological treatment of
3 secondary sewage, the treatment and risk to
4 the respiratory from effluents of raw
5 sewage? So you are dealing with secondary
6 sewage, the extent to that would contain
7 those or the extent to which those would be
8 removed.

9 DR. YATES: I cannot specifically
10 tell you of any study that I can call to
11 mind right now that has looked at the
12 removal of, specifically adenoviruses, by
13 secondary treatment.

14 MR. ANDES: But you are aware of
15 studies indicating that there were
16 significant removal of pathogens in
17 secondary pathogens?

18 MS. ALEXANDER: Can I object?

19 MR. ANDES: Some?

20 DR. YATES: Certainly some is fine.

21 MR. ANDES: You are aware of removal
22 of pathogens by secondary treatment?

23 DR. YATES: Yes, there is some
24 removal of pathogens during secondary

1 treatment, yes. Significant, that's a
2 different matter.

3 MR. ANDES: Do you know how much?

4 DR. YATES: It varies based on the
5 specific type of secondary treatment
6 process. It varies even with the same type
7 of secondary treatment process. It varies
8 from plant to plant, different operating
9 conditions. But it could be, especially for
10 viruses, it could -- it's extremely
11 variable, and it could be as low as, I don't
12 know, 10, 20, 30 percent. Maybe up to 80 or
13 90 percent. Something like that.

14 MR. ANDES: Can you provide any
15 documentation for those numbers?

16 DR. YATES: Sure. If you look -- I
17 don't have them with me, but if you would
18 look at standard textbooks such as --

19 MR. ANDES: I'd like to get
20 specifics.

21 MS. ALEXANDER: She was about to
22 finish her sentence about which ones, I
23 believe.

24 DR. YATES: Standard textbook, which

1 was referenced in my testimony, "Waste Water
2 Microbiology," written by Gabriel Baton. I
3 believe published by Academic Press. It's
4 in my testimony.

5 MR. ANDES: So would you disagree
6 with the conclusions of Dr. -- I can't
7 remember if it's Dr. Orlis or Garlack -- in
8 their papers which discussed there was
9 significant removal of pathogens in
10 secondary treatment?

11 DR. YATES: I do recall it. I don't
12 remember the word "significant." To me
13 99 percent removal is not significant.

14 MR. ANDES: Oh, okay.

15 DR. YATES: I don't know. I didn't
16 define what percentage significant was.

17 MR. ANDES: Thank you. Can you
18 clarify why 99 percent is not significant?

19 DR. YATES: Certainly. If you have
20 a million pathogens in the water and you
21 remove 99 percent of them, you still have
22 10,000, and if you are dealing with
23 something like a Norovirus, where one
24 Norovirus particle can give you a 50 percent

1 probability of infection, you understand why
2 I say 99 percent removal is not significant.

3 CHAIRMAN TIPSORD: With that, we
4 need to take a break. We'll try to be back
5 here at 3:30.

6 (Whereupon, a break was taken
7 after which the following
8 proceedings were had.)

9 MS. ALEXANDER: Before we start, we
10 just wanted to put on the record the
11 clarification concerning the source of the
12 data that is in Figure 3 that is currently
13 displayed.

14 DR. YATES: Right. I did go back
15 and check my notes. And indeed these do
16 represent the geometric means of monthly
17 sampling, and those data were gathered by
18 the Region 5 EPA as I had thought. I did
19 verify that that was indeed the case.

20 MR. ANDES: And you are speaking to
21 the data on the board?

22 DR. YATES: The data on the right,
23 the nonChicago area waterways, the Fox
24 River, the Mississippi River and the

1 Delaware.

2 MR. ANDES: Are the District data
3 also geometric means?

4 DR. YATES: Yes, I believe they are.

5 MR. ANDES: And do we know what
6 particular months and years those were from?

7 DR. YATES: Yes, May through
8 October, in I believe, 2002.

9 MR. ANDES: I could not read that on
10 the --

11 CHAIRMAN TIPSORD: Go ahead. We are
12 ready.

13 MR. ANDES: We'll go back to
14 Question 10. This concerns the statement
15 concerning the likely presence of dangerous
16 pathogens. The District's treated waste
17 water has been shown to have relatively low
18 levels of pathogenic microorganisms during
19 dry weather conditions, therefore, please
20 provide scientific evidence to explain the
21 following, A, what evidence is there that
22 the pathogens listed in Table 1 exist in
23 high concentrations in the CAWS.

24 MS. ALEXANDER: I'm going to object

1 to the question because it assumes facts not
2 in evidence or I object to your
3 characterization that the District's treated
4 the waste water has been demonstrated to
5 have relatively low levels of
6 microorganisms. I think that's the topic
7 that's been hotly contested all of today,
8 and also on vagueness. I'm not sure what
9 you mean relatively low. Relative to what?

10 DR. YATES: So if you could --

11 MR. ANDES: So my statement was, if
12 you could go through the various pathogens
13 and pathogen categories listed in Table 1
14 and tell me what evidence there is that
15 these pathogens exist in high concentrations
16 in the CAWS.

17 DR. YATES: So as I believe I've
18 already stated, based on the sampling that's
19 been done by the District, a number of the
20 pathogens that are listed in Table 1 have
21 been found in the CAWS. Those include the
22 adenoviruses, as I believe I explained
23 earlier, the cocci A and B virus, and the
24 echo viruses, which are members of the

1 entero virus group. So you did do analysis
2 for entero viruses. And did you find
3 enteroviruses in there? I do not know
4 because you did not do further
5 characterizations of which of the
6 enteroviruses you did find. You also found
7 Norovirus in there. I believe you also
8 found salmonella, as well as Giardia and
9 Cryptosporidium.

10 MR. ANDES: And in terms of the
11 enteroviruses, weren't those all
12 characterized as coxsackie viruses which
13 would tend to over-estimate the risk?

14 DR. YATES: I have not seen any
15 information regarding the characterization
16 of the enteroviruses that were detected.

17 MR. ANDES: Part of my question was
18 whether these categories of pathogens exist
19 in -- what levels they exist in.

20 DR. YATES: Well, you have provided
21 for some of these pathogens at least
22 concentrations based on your analysis, and
23 I've already spent, I think, quite a bit of
24 time discussing how it's very difficult to

1 interpret the actual significance of those
2 numbers because of the fact that only a
3 fraction of each of the samples was analyzed
4 for each of those pathogens. So I could not
5 specifically comment on the numbers that you
6 reported.

7 MR. ANDES: Putting aside the issue
8 of sampling, if these are taken to be the
9 levels that were detected, the question is
10 are those levels high?

11 DR. YATES: I guess it would depend
12 on how you define high. If you define high
13 as above zero, yes.

14 MR. ANDES: And if you define high
15 by reference to some dose response
16 information or other information out there
17 indicating some threshold for likely health
18 effects.

19 DR. YATES: Well, again, as I've
20 mentioned for the Norovirus, ingestion of a
21 single Norovirus particle is sufficient to
22 give you a 50 percent probability of
23 infection. So detection of one Norovirus
24 particle, right there gives you what I would

1 consider to be a very significant public
2 health risk. 50 percent probability of
3 infection is very, very high.

4 MR. ANDES: And there are
5 Noroviruses all around us.

6 DR. YATES: Not that I know.

7 MR. ANDES: Do people sneeze?

8 DR. YATES: I'm sorry?

9 MR. ANDES: Where are Noroviruses
10 present?

11 DR. YATES: Well, the Noroviruses
12 are in the intestinal tract of individuals
13 that are infected, and anything that has
14 been contaminated by the fecal materials of
15 individuals who are infected.

16 MR. ANDES: I mean, they are present
17 in the environment more than just this water
18 body, correct? One could encounter them in
19 other environments?

20 DR. YATES: Noroviruses are present
21 in environments that are fecally
22 contaminated with human fecal material.

23 MR. ANDES: Are they found in
24 drinking water?

1 DR. YATES: If the drinking water
2 contains human fecal material and it has not
3 been disinfected to remove them, then, yes,
4 they could be present in drinking water.

5 MR. ANDES: Disinfection doesn't
6 remove them all, right?

7 DR. YATES: I believe I've said a
8 number of times, you cannot guarantee
9 100 percent removal of pathogens using
10 disinfection. You reduce the concentration.

11 MR. ANDES: So in your table when it
12 says the Noroviruses are known to cause 23
13 million cases of viruses in U.S., are those
14 from all sewage contaminated water bodies?
15 What are the causes of those viruses?

16 DR. YATES: Realize again these are
17 an estimate of the number. These are not
18 all documented, which again points to the
19 fact that we really don't have a good idea
20 of the actual number of all of these cases
21 of illnesses that occur. However, the
22 sources of, specifically Norovirus
23 infection, can be water. They can be
24 food -- those are probably the main two

1 sources of Norovirus infection, water and
2 food.

3 MR. ANDES: Drinking water you are
4 saying?

5 DR. YATES: I believe I said water.

6 MR. ANDES: I'm asking, are you
7 talking primarily about ingestion of water
8 in drinking?

9 DR. YATES: No, I wouldn't. I would
10 say ingestion of water period, whether it be
11 from drinking or whether it be from
12 recreation. Both of those have been shown
13 to be sources of exposure to Norovirus that
14 can result in illness.

15 MR. ANDES: So do you have -- of the
16 23 million cases of Norovirus in the U.S.,
17 do you have any numbers?

18 DR. YATES: I could not break out
19 the number that could be attributed to
20 recreation versus other sources.

21 MR. ANDES: There are other sources
22 that indicate that the predominant amount of
23 recreational water body illnesses are
24 attributed to treated water such as pools?

1 DR. YATES: If you look at the CDC,
2 reported outbreak of waterborne disease
3 outbreaks, it is generally the case that a
4 higher percentage of outbreaks are reported
5 to occur in treated water bodies. However,
6 as has been indicated by others, and I will
7 reiterate the point, that the reported
8 number of outbreaks versus the actual number
9 of outbreaks that occur, is well-known that
10 they are vastly under-reported. It's very,
11 very difficult to pinpoint the exact source
12 of illness, especially when the case is that
13 the symptoms are as nonspecific as vomiting
14 and/or diarrhea.

15 MS. ALEXANDER: Can I just
16 follow-up? It may be more likely to be
17 under-reported in treated water venues or
18 other recreational water venues?

19 DR. YATES: I don't really
20 necessarily have any specific documentation
21 I can point to for this, but it's certainly,
22 just using my own common sense and
23 professional judgment, I would believe that
24 it would be more likely that if there were

1 an outbreak, it would be more likely to
2 notice that it was an outbreak and report it
3 as such in a treated water venue than in a
4 nontreated venue, simply because of the
5 nature of the site itself. Because at a
6 pool or something like that, you have an
7 identified population. You know in general
8 who is coming and going. It's only open
9 certain hours, et cetera, et cetera. So I
10 believe it would be more likely that you
11 would recognize an outbreak in a treated
12 water venue. But as I said, I don't have
13 any documentation to support that.

14 MR. ANDES: As we go through these
15 pathogens on Table 1 as to adenovirus, you
16 point out that it's highly resistant to
17 disinfection using standard UV light,
18 correct?

19 DR. YATES: Yes.

20 MR. ANDES: So the UV disinfection
21 systems that we've had testimony about here,
22 in terms of cost and timing and practicality
23 and engineering aspects, would likely not do
24 much to remove adenoviruses?

1 DR. YATES: What I can say is using
2 the -- this is just based on my knowledge of
3 the studies that have been done on UV
4 disinfection for adenoviruses, there are
5 studies that show using the standard UV
6 wavelengths, they are not as effective
7 against adenoviruses as they are against
8 other viruses and other pathogens for that
9 matter. However, there are a number of
10 studies that are going on that are
11 specifically looking at other types of UV
12 disinfection and are showing that other
13 types of UV disinfection may be more
14 effective for inactivating adenoviruses. So
15 there's more and more data coming out.

16 MR. ANDES: So there's research
17 ongoing?

18 DR. YATES: Correct.

19 MR. ANDES: And what types of UV are
20 you speaking of?

21 DR. YATES: There's different kinds
22 of UV, there's low pressure UV and high
23 pressure UV. I'm not an engineer so.

24 DR. YATES: Are you speaking of

1 types that are being used in California with
2 reclaimed water?

3 DR. YATES: Not necessarily, no.
4 These are types of UV that are being
5 examined by drinking water utilities for use
6 in disinfecting drinking water. By waste
7 water utilities that are being looked at for
8 use in disinfecting waste water as well.

9 MR. ANDES: But there's nothing you
10 know of that's currently being used that
11 would do a good job of treating
12 adenoviruses?

13 DR. YATES: I do not have sufficient
14 knowledge at this point of all the different
15 types of UV that are currently in use to be
16 able to say that that is the case.

17 MR. ANDES: As to the next set of
18 viruses, the coxsackie viruses, including
19 meningitis, you estimate those to cause 10
20 to 15 million symptomatic infections here in
21 the U.S. I assume that asymptomatic would
22 be more in addition. Do you have a sense of
23 what the primary causes are of those?

24 DR. YATES: The primary causes of?

1 MR. ANDES: Of those infections.

2 DR. YATES: How they occur, you
3 mean, what the source is?

4 MR. ANDES: The path.

5 DR. YATES: The source of the virus
6 to the individuals?

7 MR. ANDES: Yes.

8 DR. YATES: Off the top of my head,
9 no, I do know. However, there have been
10 waterborne disease outbreaks that have been
11 caused by these viruses.

12 MR. ANDES: Where?

13 DR. YATES: In the United States. I
14 couldn't tell you exactly what states.

15 MR. ANDES: In treated water venues?

16 DR. YATES: I could not tell you,
17 recall off the top of my head if they
18 occurred in treated or only untreated or
19 both.

20 MR. ANDES: Not aware of any
21 nondisinfected water body that this would be
22 an issue?

23 DR. YATES: I do not know. I have
24 not memorized that literature to be able to

1 answer that question one way or the other.

2 MR. ANDES: How about as to echo
3 viruses?

4 DR. YATES: The same response would
5 be the case. But they have been associated
6 with waterborne disease, but as to whether
7 they occurred in treated or untreated or
8 both, I really could not recall that at this
9 exact moment.

10 MR. ANDES: I would ask as to
11 rotaviruses, what the likely cause is
12 usually for that? That causes more than
13 three million cases?

14 DR. YATES: Yes, it does. Rotavirus
15 is, again, an organism that can be
16 transmitted through water. It can also be
17 transmitted through person to person
18 contact. It's extraordinarily common,
19 especially in young children. It causes
20 quite a bit of lost time at school, lost
21 time at work.

22 MR. ANDES: As to rotaviruses, it
23 sounds like these are in terms of potency.
24 Are these more potent in terms of the facts

1 than, say, the Noroviruses?

2 DR. YATES: I'm not sure what you
3 mean by more potent.

4 MR. ANDES: You specify it's a major
5 cause of diarrhea in young children?

6 DR. YATES? Right.

7 MR. ANDES: Does it cause more
8 effects or long-term effects than simply
9 where there's a situation where one will
10 cause a problem, and here we are talking
11 about ten million?

12 MS. ALEXANDER: That's a compound
13 question. You are asking about more
14 effects, and in fact, activity rates. Can
15 we break those apart?

16 DR. YATES: With respect to its
17 infectious dose, my understanding is that a
18 single rotavirus particle is sufficient to
19 cause disease. I'd also note that Dr.
20 Charles has stated on numerous occasions
21 very publicly and he's already published to
22 this effect, that one should consider that
23 exposure to a single pathogen is sufficient
24 to initiate a negative -- to initiate harm,

1 harmful effects in the exposed individual.
2 So really there is, as you know, Dr. Has --
3 as Dr. Has would put it, there is a nonzero
4 probability in ensuing from exposure to a
5 single one of any of these pathogens. So,
6 yes, indeed one can have negative health
7 effects as a result of exposure to a single
8 rotavirus particle.

9 With respect to, if I can
10 remember back that far, kind of you are
11 talking about the severity, I believe, of
12 the illness. One of the issues with
13 rotavirus is that it is very, very common in
14 young children, and as with young children,
15 diarrhea can be especially severe because
16 it's very easy for young children to become
17 dehydrated very readily. So one of the
18 things that tends to happen is that you have
19 a young child, they have quite a bit -- a
20 large volume of diarrhea -- I hope that's
21 not too graphic for the reporter -- they
22 have a large volume of diarrhea, and one of
23 the concerns is that they can become
24 dehydrated. And if you become dehydrated

1 that can be severe and can lead to death.
2 And there is -- that's why there is death in
3 third world countries from gastroenteritis
4 because they don't have access to medical
5 care that we do, but if you look at
6 rotavirus, the Centers For Disease Control
7 has actually compiled statistics on the
8 number of doctor visits, hospitalizations,
9 emergency room visits, et cetera,
10 specifically as a result of exposure to
11 rotavirus, and I can't remember the numbers
12 exactly, but it's on the order of couple
13 hundred thousand I believe, doctor visits
14 and tens of thousands of hospitalizations
15 annually as a result of rotavirus,
16 gastrovirus.

17 MR. ANDES: And the major causes of
18 the infection?

19 DR. YATES: I believe I've already
20 answered that question.

21 MR. ANDES: One dirty diaper can
22 cause substantial effluence in the
23 environment and create a problem?

24 DR. YATES: Yes.

1 MR. ANDES: Salmonella is also
2 listed here, and you include Typhoid among
3 the diseases. And that causes two to four
4 million cases of illness per year?

5 DR. YATES: Salmonella in general.
6 There aren't two to four million cases of
7 typhoid a year. That's one of the success
8 stories as a result of disinfection in the
9 United States. We have dramatically reduced
10 the infection of cholera and typhoid because
11 these organisms are readily killed or
12 inactivated by typical disinfection. And
13 the implementation of the indicator standard
14 to tell us how well we've done with
15 disinfecting has really done a good job at
16 telling us that we've reduced level of
17 bacterial pathogens like Salmonella.

18 MR. ANDES: Are you aware that void
19 of typhoid was one of the reasons this
20 waterway system was constructed?

21 DR. YATES: No, I was not.

22 MR. ANDES: And in fact, has been
23 fairly successful. You are not aware of any
24 outbreaks in this area since then?

1 DR. YATES: I have no specific
2 outbreaks of any outbreaks that have
3 occurred on the CAWS ever.

4 MR. ANDES: In terms of shigella,
5 which is about 300,000 cases of illnesses
6 per year and causes --

7 DR. YATES: Many of the shigella
8 outbreaks are specifically associated with
9 recreational water exposures.

10 MR. ANDES: From?

11 DR. YATES: Nontreated waters.

12 MR. ANDES: Nontreated waters?

13 DR. YATES: Correct.

14 MR. ANDES: Specifically?

15 DR. YATES: Lakes.

16 MR. ANDES: With swimming?

17 DR. YATES: I do not know that
18 swimming necessarily was the manner in which
19 the people were exposed. It is ingestion
20 however.

21 MR. ANDES: Drinking or --

22 DR. YATES: Ingestion.

23 MR. ANDES: -- ingestion during
24 swimming and/or ingestion from drinking the

1 water?

2 DR. YATES: Ingestion through water
3 getting into your mouth through whatever
4 means, intentional or non.

5 DR. YATES: Did that include people
6 who didn't recreate in the water, simply
7 that was their drinking can water supply?

8 DR. YATES: Now I'm a little bit
9 confused. What we are talking about or what
10 I have stated is there have been outbreaks
11 of shigella associated with recreational
12 exposures. I didn't say anything about
13 drinking water exposures. I'm not talking
14 about drinking water exposures. So I didn't
15 say anything about drinking water outbreaks
16 of shigella.

17 MR. ANDES: Has any specific
18 instance of that come to mind?

19 DR. YATES: I would have to go back
20 and read the CBC reports that come out
21 biannually and morbidity mortality reports.
22 I couldn't bring any one specific outbreak
23 to mind. Suffice it to say they occur in
24 the United States.

1 MR. ANDES: I assume that would
2 include water bodies where disinfection is
3 practiced since you said most systems
4 practice disinfection?

5 DR. YATES: I have no information
6 about whether or not those water bodies are
7 receiving treated or untreated sewage
8 effluent.

9 MR. ANDES: Okay. Thank you. And
10 by the way, in looking at these various
11 parameters, the various categories of
12 viruses, et cetera, that are laid out here,
13 are generally included in the analyses that
14 have been done here, am I correct? For
15 example, Noroviruses are included in what's
16 been assessed in this Risk Assessment?

17 DR. YATES: Several of the -- as
18 I've indicated earlier, several of the
19 organisms which is listed in this table
20 which is just examples of some of the
21 organisms that can be present in fecal
22 material and therefore in sewage, several of
23 the organisms in this table have been
24 included in this study, yes.

1 MR. ANDES: Well, are there any
2 here? In fact, most of these have been
3 included one way or another in the study, am
4 I correct?

5 DR. YATES: If most is -- I haven't
6 counted them. If most is more than half, I
7 would say yes. I didn't count them.

8 MS. ALEXANDER: But they have not
9 all, is that correct?

10 DR. YATES: They have not all. And,
11 again, I do not know when enteroviruses were
12 detected whether they were coxsackie's or
13 echos or what they were or if they were
14 polio's. Probably not polio's anymore
15 but --

16 MR. ANDES: And cholera we didn't
17 look at, but I think we've discussed that
18 already?

19 DR. YATES: Right.

20 MR. ANDES: And Giardia and crypto
21 were looked at, correct?

22 DR. YATES: Correct.

23 MR. ANDES: And Giardia, domestic
24 and wild animals are significant

1 contributors, correct?

2 DR. YATES: They are contributors to
3 the -- I can't speak specifically to the
4 CAWS. I have no idea whether animals
5 contribute any Giardia or Cryptosporidium to
6 the CAWS. In general, if you go out into
7 the environment into water up in the
8 mountains if there's never been a person
9 there may be Giardia there because they came
10 there from an animal though.

11 MR. ANDES: And as to
12 Cryptosporidium, you mentioned here
13 relatively resistant removal by traditional
14 processes, you are speaking of chlorination
15 for example.

16 DR. YATES: Yes, Cryptosporidium is
17 actually relatively resistant to traditional
18 chlorination, which is why the Environmental
19 Protection Agency promulgated the surface
20 water -- well, that is not true, which is
21 why the Environmental Protection Agency has
22 promulgated the long-term to enhance water
23 service treatment rule which requires
24 specific treatment processes to remove

1 Cryptosporidium, which include things like
2 filtration, not disinfection. Disinfection
3 is also there, but the primary removal is
4 not disinfection in the cases.

5 MR. ANDES: So one might have to add
6 additional treatment systems to take care of
7 that too?

8 DR. YATES: Again, what EPA or what
9 people have found for Cryptosporidium is one
10 of the best ways to remove it is through, in
11 a traditional drinking water treatment plant
12 that practices chlorination, a filtration
13 step does a good job of reducing the level
14 of Cryptosporidium. It also has been found,
15 however, that ultraviolet light is a very
16 effective way of reducing concentrations of
17 cryptosporidium.

18 MR. ANDES: Which doesn't work so
19 well for some of the viruses.

20 DR. YATES: As I've already said,
21 there's a variant -- for different
22 disinfectants that are more or less
23 effective against different pathogens.

24 MR. ANDES: Let's go back to

1 question 10, and I think you've answered
2 some of these but let's just make sure. You
3 don't have, correct me if I'm wrong, an
4 estimate of the current health risk to the
5 recreating population due to bacterial
6 levels in the CAWS without disinfection?

7 MS. ALEXANDER: I'm sorry, we've got
8 to clarify that. What do you mean the
9 current health risk? Do you mean is there
10 any risk, yes or no? Do you mean something
11 like a level? How would that be measured?
12 I'm not clear what you are asking.

13 MR. ANDES: Well, the EPA has ways
14 of assessing and quantifying levels of risk.
15 So I'm asking what is, based on standard
16 methods, including this risk assessment of
17 quantifying risk, is there a quantitative
18 estimate of the current health risk due to
19 bacteria levels without disinfection in the
20 CAWS?

21 DR. YATES: Is there a health risk
22 due to bacteria? Are you referring to
23 pathogenic bacteria? I'm not sure what you
24 are referring to.

1 MR. ANDES: I would assume
2 pathogenic bacteria. And what level you
3 think it exists as far as a health risk to
4 people recreating in the CAWS now?

5 DR. YATES: The only information
6 that I would have that would enable me to at
7 least start to be able to get any sense of
8 that risk would be the information that's
9 provided in the Risk Assessment that was
10 presented. So other than that, I am not
11 aware of any specific information regarding
12 specific pathogenic bacteria in the CAWS.
13 On the other hand, as we've discussed a
14 number of times, the presence of high levels
15 of indicators in the CAWS gives one reason
16 to believe that there are pathogenic
17 microorganisms that are present in the CAWS,
18 including pathogenic bacteria, and those in
19 and of themselves carry a health risk to the
20 recreators.

21 MR. ANDES: The next question, and
22 again, I think I know where our discussion
23 has gone, but do you have any information as
24 to the rate of illness among sensitive

1 populations for those who engage in limited
2 contact recreation on the CAWS under current
3 conditions?

4 DR. YATES: Well, if you are asking
5 specifically about sensitive populations, I
6 really don't have specific information
7 regarding the risk to sensitive populations.
8 I could say, however, that based on
9 publication by Charles Gerba, John Rose and
10 Dr. John Has, that in at least in a
11 publication that they have in the
12 International Journal of Food Microbiology
13 from 1996 that I guess, and can introduce,
14 they indicated that about 20 percent of the
15 United States population is in that
16 sensitive population. I believe in
17 Dr. Gerba's testimony he stated that 25 to
18 30 percent of the population could be
19 considered to be sensitive. So we know that
20 a high percentage of the -- we know that 20
21 to 30 percent of the U.S. population is
22 considered sensitive. You can categorize
23 that as high or low, whatever you want, and
24 they do cite in that 1996 article that there

1 are a number of situations in which the
2 severity of illness from exposure to a
3 particular microorganism is higher in those
4 sensitive subpopulations. They also
5 indicate that for certain of the
6 microorganisms there is a higher case
7 fatality ratio, a higher level of death
8 among the sensitive subpopulations than the
9 members of -- than the nonsensitive
10 subpopulations. And another situation,
11 another article that was written by
12 Dr. Charles Gerba, along with Dr. Nina
13 Wachuku from the United States Environmental
14 Protection Agency, this is an opinion from
15 Current Microbiology, 2004, Dr. Gerba states
16 that there's a growing body of evidence that
17 children under age 19 may suffer
18 disproportionately from some environmental
19 risk, and these risks may arise because
20 children's neurological and digestive
21 systems are still in developmental stages.
22 Kids are more likely to be exposed to
23 pathogens because of being kids. They put
24 things in their mouth. They put their hands

1 in their mouths. They engage in other
2 activity that make them more likely to be
3 exposed, and they also cite specifically
4 that there are two studies that provide
5 quantitative epidemiological evidence that
6 kids are at risk of entero virus illnesses
7 as a result of exposure to water volume
8 contact with recreation.

9 MS. ALEXANDER: Let me introduce
10 into evidence the two studies that were just
11 references?

12 MR. ANDES: I don't recall the exact
13 numbers Dr. Gerba used when he came here?

14 CHAIRMAN TIPSORD: Mr. Andes, let's
15 get these marked first.

16 CHAIRMAN TIPSORD: The first is
17 sensitive population who is at the greatest
18 risk. The International Journal of Food
19 Microbiology 1996, authors are Charles
20 Gerba, Joan Rose and Charles Has. I'll mark
21 this as Exhibit 257 if there's no objection.
22 Seeing none, it's Exhibit 257. And then
23 Microbial Risk Assessment, Don't Forget The
24 Children, by Nina Wachuku, W-A-C-H-U-K-U,

1 and Charles P. Gerba from Science Direct
2 from 2004. I will mark that as Exhibit 258
3 if there's no objection. Seeing none, it's
4 Exhibit 258.

5 DR. YATES: It's actually, if I
6 could correct it, the name of the journal is
7 current opinion in microbiology. Science
8 Direct is just the source from which I got
9 that journal.

10 CHAIRMAN TIPSORD: Thank you.

11 MR. ANDES: So is it, I gather, in
12 looking at one, the Wachuku report, I
13 noticed that it notes in the conclusion that
14 children may have the greatest environmental
15 exposure for enteric pathogens, especially
16 swimming. There's nothing about these
17 particular reports that talks about
18 secondary contact recreation, canoeing,
19 kayaking, things like that. It's a general
20 discussion of sensitivity of particular
21 populations?

22 DR. YATES: That's correct. It's
23 saying that children especially are more
24 sensitive than other populations, and that

1 they are at increased risk to a number of
2 infections that are transmitted through the
3 environment and that they specifically cited
4 as I mentioned two studies that showed that
5 they are at, children are at increased risk
6 of enterovirus illnesses as a result of
7 contact with recreational waters. Again,
8 whether they were exposed through swimming
9 in water that contained the pathogens or
10 whether they were exposed through those
11 pathogens in recreating, engaging in
12 nonswimming activities is not the important
13 part. The point is children are at
14 increased risk from enteroviruses that they
15 are exposed to through recreating in water.

16 MR. ANDES: With all due respect,
17 that is the critical point here in terms of
18 assessing risk, and it seems that these
19 studies talk about lake beach users,
20 insufficiently chlorinated outdoor pool,
21 marine and fresh water bathers, swimming
22 associated outbreak of Norovirus, swimming
23 associated adenovirus infections.

24 DR. YATES: Again, the point is,

1 children are at increased risk from exposure
2 to enteroviruses in recreating in water. It
3 can be through swimming. It doesn't matter
4 if there are enteroviruses in the water
5 whether they are exposed to them through
6 ingestion of water as a result of swimming
7 or whether they are exposed to them as a
8 result of ingesting water as a result of
9 other recreational activity on the water.
10 The point is children are at increased risk.

11 MR. ANDES: In fact, on page 2 of
12 that study, it indicates that infants and
13 children have a greater environmental, even
14 though you develop proper sanitary
15 standards, it has been suggested that they
16 have greater exposure during swimming than
17 adults during swimming.

18 MS. ALEXANDER: And why would that
19 preclude that, being exposed to less water
20 during nonswimming activity in the water?

21 DR. YATES: It's already been shown
22 it's not just greater exposure to the water
23 itself and greater volumes of water, but it
24 also has to do with their immune status as

1 anyone else.

2 MR. ANDES: And if you don't have
3 the separate dose response occur for them,
4 how would you treat them differently in
5 doing a quantitative Risk Assessment?

6 DR. YATES: Through other parts of
7 quantitative Risk Assessment, which includes
8 the exposure assessment, the propensity to
9 develop illness as a result of that
10 exposure, et cetera, et cetera. So not just
11 have -- a dose response is just one part of
12 doing a quantitative risk assessment.

13 MR. ANDES: Different entries
14 including inhalation and ingestion were
15 looked at?

16 DR. YATES: But I do not believe
17 that children or any other sensitive
18 subpopulations were treated differently,
19 assuming that potentially for children and
20 other sensitive subpopulations they might,
21 or for children especially, they might have
22 been exposed to higher volumes of water or
23 that the outcomes of the exposure might have
24 been more severe in those sensitive

1 subpopulations.

2 MR. ANDES: One of issues, and
3 without Dr. Gerba here, I can only recollect
4 is, one of the issues he was asked to do was
5 look at risks for bacteria from recreating
6 in the CAWS relative to risks from public
7 bathrooms. I believe he stated pretty
8 strongly that the risks from public
9 bathrooms were more significant. Do you
10 have any reason to doubt that?

11 DR. YATES: I would say it would be
12 highly dependent on what public bathrooms
13 you were in. You might find public
14 bathrooms where the risks might be high and
15 the risks might be extremely low.

16 MR. ANDES: I'll go back to question
17 10 and subparagraph D, and I'll rephrase it
18 based on our discussions. If we're talking
19 about a proposed standard of 400 per hundred
20 milliliters, which could be met through
21 chlorination or UV, so if you postulate for
22 a moment that that limitation could be met
23 either of those ways, based on what you are
24 saying that could lead to control of some

1 viruses, for example, but not protozoa, so
2 you could end up dealing with viruses but
3 not crypto, if you do it one way. You could
4 end up with crypto, not viruses, if you do
5 it another way. So what assurance is there
6 that this requirement of doing 400 per
7 hundred milliliters of infection so going to
8 lead to control of the pathogens in the
9 treatment plant effluents putting aside all
10 the other sources?

11 DR. YATES: Again, as I've already
12 said, and you just acknowledged, different
13 disinfection on technologies have different
14 capabilities of reducing levels of different
15 pathogens to different degrees. However,
16 that does not mean that you get no reduction
17 in pathogens as a result of a particular
18 disinfectant, applying a particular
19 disinfectant. So while you may get more
20 removal from a particular pathogen using a
21 different disinfectant, doesn't mean you get
22 no removal of that particular pathogen. So
23 the point is by implying disinfection, you
24 will get presumably some level of removal of

1 a variety of pathogens, and as you decrease
2 the level of pathogens through that
3 disinfection on process, you are going to
4 decrease the risk to individuals who are
5 recreating and being exposed to that
6 effluent after it's been discharged into the
7 CAWS.

8 MR. ANDES: On adenoviruses though,
9 where you stated in the table are highly
10 resistant to UV disinfection, and it sounds
11 from your testimony like we would need to
12 reduce these to very low levels, if UV is
13 not going to reduce them to very low levels,
14 what effect is it having on the risk?

15 DR. YATES: First of all, I believe
16 that the specific language in the table was
17 using standard UV technology, and as I've
18 already mentioned, there are studies that
19 are going on looking at alternative UV
20 technologies. So I believe that there are
21 going to be, and maybe already are. As I've
22 said, I'm not a waste water treatment
23 engineer, but I believe that there are going
24 to be more effective ways to reduce

1 adenovirus concentrations using UV. Having
2 said that, even though the concentration of
3 adenoviruses might not be reduced as much as
4 the concentration of other organisms, if you
5 applied standard UV as the treatment, you
6 would get reduction of a number of
7 adenoviruses. As you reduce the number of
8 adenoviruses, you reduce the risk from those
9 adenoviruses.

10 MR. ANDES: If you are spending the
11 money to put in the UV, but then you are
12 finding that it only deals with some of your
13 pathogens and not others, would you then say
14 that they need to do something else to
15 address the remaining risk?

16 DR. YATES: Well, again, I'm not the
17 person who is determining what the
18 acceptable level of risk is, but if you
19 disinfect, you know that you are reducing
20 risk because you are reducing pathogens.
21 And, again, it would be up to someone else
22 to determine what level of risk you are
23 going to accept, which would then determine
24 what level of disinfection or other types of

1 treatments one would have to employ to
2 achieve that level of risk. The point is if
3 you employ disinfection, you are decreasing
4 the level of pathogens, you are decreasing
5 the level of risk.

6 MR. ANDES: You can say if we say
7 using UV and reducing crypto and one can
8 question if you are not seeing significant
9 level of crypto anyway. But say you are
10 addressing crypto and Giardia through UV.
11 So maybe you are reducing that risk to the
12 extent there is one, but you are not
13 addressing adenoviruses. Can you give the
14 public any sense how much safer are we
15 making it if we are reducing some and we're
16 not doing much to reduce others?

17 MS. ALEXANDER: I'm going to object
18 to the characterization. She didn't testify
19 that you are not reducing adenoids. I think
20 the testimony was that you are not reducing
21 them less by other methods.

22 MR. ANDES: But the comment is using
23 highly resistant to infection using UV.

24 DR. YATES: Highly resistant to

1 other pathogens studied at that time, yes.

2 MR. ANDES: Do we have a sense what
3 that means quantitatively. Is that 20
4 percent, 30 percent?

5 DR. YATES: Again, it really varies
6 depending on the study. There have been
7 several different studies, and I couldn't
8 quote to you a specific difference in
9 percentages. All I can say is that when the
10 EPA promulgated the Long-term II Enhance
11 Surface Water Treatment Rule, and they used
12 adenovirus as the worst case scenario which
13 they did only with respect to UV treatment
14 processes. It did result in increase in the
15 amount of UV that one would have to apply in
16 order to achieve the, what EPA considered to
17 be an acceptable level of for drinking water,
18 but I couldn't tell you the exact difference
19 in percentages.

20 MR. ANDES: And the waste water
21 effluent matrix is significantly different
22 than a fairly delude drinking water stream.

23 DR. YATES: They are very different,
24 however, UV is employed more frequently to

1 treat waste water than it is to treat
2 drinking water. UV is at least the latest
3 data that I've seen on drinking water
4 treatment disinfection processes. UV is
5 still fairly uncommon, and much of the U.S.
6 that's used to treat drinking water
7 specifically for ground water systems. But
8 there is a greater use of UV in the waste
9 water industry and it's actually been used
10 longer to my knowledge in the waste water
11 industry.

12 MR. ANDES: So if we have a lot of
13 cities around the country that are using UV,
14 that means they are not doing much to reduce
15 adenovirus; they are getting low levels of
16 adenovirus in their system?

17 DR. YATES: I couldn't say unless I
18 look at all the studies that had been done,
19 look at removals of adenoviruses by those
20 treatment plants and those studies. I
21 really couldn't speak to that. I haven't
22 seen those studies.

23 MR. ANDES: Are you familiar with
24 any cities that are doing chlorination and

1 UV?

2 DR. YATES: Again, I'm not a waste
3 water treatment engineer, so I couldn't say
4 specifically whether anyone is doing that.
5 There may be, but I really wouldn't know.

6 MR. ANDES: As to those doing
7 chlorination, it sounds like those systems
8 have an issue in terms of removal of crypto
9 and Giardia, am I correct, in terms of those
10 being resistant to removal by chlorination?

11 DR. YATES: Again, it would depend
12 on what other treatment processes were being
13 employed in the treatment plant, so I really
14 couldn't generalize.

15 MR. ANDES: Okay. I'll move to
16 question 11. And it relates to what I think
17 we've just spoken about. You state on
18 page 11 that while the concentrations of
19 pathogens may be reduced incidentally during
20 primary and secondary treatment processes,
21 disinfection is specifically designed to
22 decrease the concentration of pathogens and
23 microorganisms. Do you agree that reduction
24 of the concentration of pathogens is, of

1 specific pathogens, is assumed based on a
2 specific level of indicator activation by a
3 particular disinfection system?

4 DR. YATES: I'm a little bit
5 confused when you are talking about primary
6 and secondary treatment in one place and
7 then you are bringing in disinfection.

8 MR. ANDES: Let's put aside primary
9 and secondary issues. Dr. Orlis and Gorland
10 spoke about that at great length. The
11 question is, when you say you'll be reducing
12 the concentrations of pathogens, you are
13 really assuming that based upon indicators
14 and activation by particularly this
15 disinfection system, which you believe that
16 the levels of pathogens would be reduced as
17 well, specific pathogens.

18 DR. YATES: Specifically I can't
19 take credit for that statement. I do have
20 to attribute it's source, and did in my
21 testimony, and it's in my references I
22 believe, its attributable, which I am not
23 sure how you say his name, 2003, it's
24 chapter in the book called "The Handbook Of

1 Water and Wastewater Microbiology." Those
2 are not my words. I actually quoted him.

3 MR. ANDES: I'm sorry, I didn't see
4 a footnote.

5 DR. YATES: It's there. Back to
6 your specific question. When they
7 determine -- when they look at the waste
8 water disinfection process or drinking water
9 disinfection process for that matter, what
10 they do is they do studies where they spike
11 that water with known concentrations of
12 pathogens and determine how much removal
13 occurs as a result of the disinfection
14 process, and so there is a linkage that's
15 made between the removal of the indicator
16 organisms and the removal of pathogens,
17 which is why then you can use indicator
18 concentrations to give you some information
19 about the level of pathogen reduction that's
20 occurred. Because you do spiked studies
21 where you add known numbers of pathogens and
22 known numbers of indicator organisms, apply
23 your disinfection process and then follow
24 the disinfection or reduction in those

1 levels that occur, and that's one of the
2 bases for establishing indicator levels,
3 because we know we can't monitor levels for
4 all the different pathogens. We know what
5 it takes to do that. That's why we use
6 indicators. We have a backup based on
7 studies that have been done on pathogenic
8 organisms as well.

9 MR. ANDES: So when -- this in
10 Dr. Blanchy's testimony -- you spoke at
11 length, some of those studies look at
12 whether removing, addressing the indicators
13 through, say, a 400 effluent standard would
14 in fact reduce pathogens, and in fact
15 concluded that it wouldn't do very much to
16 reduce the pathogen levels, particularly as
17 compared to the more extreme forms of
18 treatment for reclaimed water. So you say
19 that the risk levels would not be accurate,
20 and that was based on these various
21 treatment studies. Do you have any reason
22 to question the studies that he referred to?

23 DR. YATES: Well, again, I think
24 that there is a recognition that some of the

1 pathogens that we now know about are not as
2 easily inactivated by some of the treatment
3 processes -- the disinfection processes as
4 are the indicator bacteria, which is why,
5 especially in the case of drinking water,
6 EPA has stopped relying exclusively on the
7 total coliform standard which had been in
8 place for many, many, decades and is
9 imposing other types of treatment
10 requirements, because they know that there
11 are many times when the coliforms are absent
12 and yet the pathogens are indeed present.
13 So the coliforms are actually
14 under-predicting risks.

15 MR. ANDES: And I believe we talked
16 about other situations where there was
17 studies indicating that coliforms were
18 present and that the pathogens were not.

19 DR. YATES: There have been
20 environments where that has been the case.

21 MR. ANDES: Let me go back to
22 page 11 because I want to be clear on
23 sourcing the specific sentence you mentioned
24 here. I don't see a reference. So I'm not

1 sure which reference we're --

2 DR. YATES: I'm sorry, I believe if
3 you look at page 8 of my testimony. The
4 first paragraph under subsection B, it says,
5 "Conventional waste water treatment plants
6 that don't disinfect their effluent." That
7 sentence I reference Oragui 2003 for that
8 point. It's not a direct quote, but I have
9 a reference.

10 MR. ANDES: So the statement in 11
11 also references Oragui, which for the
12 foundation --

13 DR. YATES: It is, correct. The
14 fact is that you may get some reduction, and
15 I would characterize is as rather minimal
16 reduction in primary and secondary treatment
17 processes, the disinfection step is there
18 specifically, designed specifically to
19 reduce the levels of pathogens. The other
20 steps are taking care of things like oxygen
21 demand, organic compounds, nitrogen,
22 phosphorous, those types of things. That's
23 what it's intended to do. It's the
24 disinfection step that is specifically

1 designed to reduce the level of human
2 pathogens.

3 MR. ANDES: As to the -- and we can
4 obviously take a look back at the Oragui
5 study or report. I know that the removal
6 through secondary seemed to be characterized
7 differently by Dr. Zorus and Dorevich.

8 DR. YATES: It's a matter of degree.

9 MR. ANDES: We can talk about that
10 the further we get. It seemed like they
11 were talking about more than minimal.

12 DR. YATES: Again, it's a matter of
13 definition. I don't think they defined X
14 percent removal. They may define 99 percent
15 as high, the example I gave as not high.

16 MR. ANDES: The second part of that
17 question, 11A was, do you agree that the
18 degree to which the assumption holds true,
19 and that's obviously the assumption of the
20 relation between inactivating indicators and
21 reducing levels of pathogens depends to some
22 extent on the microorganism in question and
23 the specific disinfection applied, the
24 disinfection technique applied.

1 DR. YATES: Certainly, yes.

2 MR. ANDES: Let's me move on to
3 question 12.

4 MS. ALEXANDER: I'm sorry, I'd like
5 to ask 11B as a follow-up, if you are not
6 going to. Which is your statement, those
7 whose age or physical condition make them
8 more vulnerable to infection and implies
9 that it causes a lower dose to infect,
10 please provide evidence that the outcome of
11 infection is more severe but still requires
12 the same number of organisms to infect the
13 sensitive populations?

14 DR. YATES: So basically I believe
15 you were questioning my use of the term
16 infection and certain individuals being more
17 susceptible to infection. And what I would
18 say to that is that indeed there are
19 individuals who are more susceptible to
20 infection than others. For example, for the
21 Norwalk virus in the human challenge studies
22 done by Dr. Christine Moe, it has been found
23 that in order to be infected by those
24 Noroviruses you have to have a specific

1 genetic marker. And so you might be able to
2 give one individual a single Norovirus and
3 that would cause them to become infected,
4 whereas another individual you could give
5 them a larger number, and they wouldn't
6 become infected because they don't have the
7 marker. I would also cite a comment that
8 was made in the 2004 paper by Dr. Gerba and
9 Nina Wachuku that we just introduced into
10 evidence a few moments ago. The 2004
11 current opinion in microbiology article,
12 where they reference a paper that indicates
13 that children actually could have a higher
14 probability of becoming infected from the
15 same dose as adults. So you could give
16 children the same number of viruses or other
17 pathogens as you do adults and because of
18 differences in the physiological development
19 of the child, they actually might have a
20 higher probability of becoming infected from
21 that same dose. The other thing I would
22 point out is that --

23 MR. ANDES: Could I stop you there?

24 DR. YATES: Yes, certainly.

1 MR. ANDES: Where is that statement?

2 DR. YATES: I don't have a hard copy
3 of the paper right in front of me.

4 MR. ANDES: Because I read the
5 statement, no studies have been conducted to
6 determine the impact --

7 DR. YATES: Go to the end of that
8 paragraph, if I remember.

9 MR. ANDES: While the severity of
10 illness is greater in children than adults,
11 it's currently not known if the severity is
12 related to dose in enteric viruses.

13 DR. YATES: That's not what I'm
14 referring to.

15 MR. ANDES: That's what I'm
16 interested in. There is a statement that a
17 reduction in stomach acid taken from
18 secretions are estimated to be different in
19 children infected from a given dose than
20 adults?

21 DR. YATES: Yes, and they do cite a
22 study.

23 The other point that I would
24 make is that when you do human challenge

1 studies, the way you do those studies is you
2 divide your subjects up into groups and you
3 give all the members of each group the same
4 dose of the organism. It's very well
5 documented in these studies that, let's say
6 you have five individuals in one group and
7 they all receive a hundred of a particular
8 organism, some of those individuals will
9 become infected and some of them won't. And
10 that's actually the basis for developing
11 what we call the ID50, the Infectious Dose
12 50. So different individuals do have
13 different susceptibilities to becoming
14 infected based on the dose.

15 MR. ANDES: But the specific --

16 DR. YATES: I just found the
17 sentence that I read from that Gerba paper.
18 It's in the section entitled, "Infectivity"
19 -- on the last page -- it's the second to
20 the last sentence there that says, "reduced
21 stomach acid in Pepcid secretions
22 predisposes children to having a greater
23 probability in a given dose."

24 MR. ANDES: The sentence before is?

1 DR. YATES: It says, "No studies
2 have been done." Agree.

3 MR. ANDES: So that's really just
4 speculation.

5 DR. YATES: My point is that there
6 are people who have evidence that suggest
7 that individuals may indeed be predisposed
8 to becoming infected at a lower dose, and we
9 have absolute data from human challenge
10 studies, of which you have a group of
11 individuals, all of whom are given a same
12 dose of the same organism, and some of them
13 become infected and some of them don't.
14 Now, they may or may not have identified
15 exactly what the reason for that is, but it
16 is indeed the case that some individuals
17 will become infected from a given dose and
18 some will not.

19 MR. ANDES: And that's always the
20 case, but we are talking specifically here
21 about children versus adults. And I'll read
22 the earlier statement here concerning dose
23 response. "Models have been developed from
24 studies in the oral exposure of polio virus

1 types I and III in which infants and
2 premature babies were used as subjects. The
3 dose response of those viruses is similar to
4 that observed of echo virus 12 and rotavirus
5 in adults. However, infection is directly
6 culpable because this is likely to be
7 dependent upon the type --

8 DR. YATES: Right.

9 MR. ANDES: How does that --

10 DR. YATES: All I'm saying is there
11 are individuals who have published in the
12 literature and they have referenced a paper
13 here.

14 MR. ANDES: Which reference?

15 DR. YATES: Number 24 is referenced
16 in this article, and those individuals have
17 referenced that based on the physiology of
18 children, specifically their stomach and
19 their gastrointestinal tract could
20 predispose them to becoming infected from a
21 lower dose than adults. That's all.

22 MR. ANDES: Okay. We will -- since
23 we've just seen these reports -- reserve the
24 right when we continue, whenever we do

1 continue, to ask some further questions
2 about those reports and the ones that are
3 cited. I don't know if there's any, if
4 those are going to be introduced into
5 evidence or not.

6 DR. YATES: No, I wasn't planning
7 to.

8 MR. ANDES: Okay. Go to number 12
9 then. Based on what we've spoken about, I
10 gather you don't know how much actual water
11 is swallowed and inhaled and directly
12 exposed by rowers, paddlers, boaters and
13 fishers in the CAWS?

14 DR. YATES: I have not done those
15 studies to determine that. However, as you
16 know, in order to do a Risk Assessment, you
17 have to make some assumption and the people
18 who did the Risk Assessment study did make
19 assumptions because they had to come up with
20 numbers. So I don't know how much actual
21 water is swallowed or inhaled, et cetera,
22 but I don't believe the people who did the
23 Risk Assessment did either. That's why they
24 had to come up with some assumption.

1 MR. ANDES: The epidemiological
2 study, the CHEERS study that's going on now
3 will give us a better idea of that answer?

4 DR. YATES: That's my understanding,
5 yes.

6 MR. ANDES: So that would also be
7 information that the Board would want to
8 consider in making a decision here?

9 DR. YATES: I would imagine that the
10 Board would consider that information, yes.

11 MR. ANDES: The next question was
12 what is the actual micro exposure dose
13 exposed by paddlers, boaters and fishers in
14 the CAWS?

15 DR. YATES: Well, I guess the actual
16 number of microorganisms they would consume
17 would depend on the amount of water they
18 ingest, as well as the concentration of
19 microorganisms that were present in that
20 water.

21 MR. ANDES: So one would look at the
22 Risk Assessment and the epidemiological
23 study together to get some perspective on
24 that since you can't measure directly the

1 actual microbial exposure dose but you can
2 make some assumptions.

3 MS. ALEXANDER: What's your
4 question? Is that the only thing someone
5 would look at or is that one thing you could
6 look at?

7 MR. ANDES: Right. You could you
8 look at those two things combined, and I
9 think that goes back to your analysis report
10 in terms of the use of Risk Assessment and
11 EPI studies together, assume that the actual
12 data collector from the EPI study, along
13 with some of the projections developed
14 through The Risk Assessment would combine to
15 give you some perspective on those?

16 DR. YATES: Well, I wouldn't want to
17 guess exactly how these studies might be
18 used by people making the decision about
19 whether other not to disinfect this
20 effluent, but I would assume that they would
21 consider that a single epidemiological study
22 and a single Risk Assessment wouldn't
23 necessarily provide adequate information to
24 enable them to make those decisions.

1 MR. ANDES: Certainly it could end
2 up validating, or not, some of the
3 assumption and findings made in the Risk
4 Assessment, correct?

5 DR. YATES: You are referring to the
6 epidemiological study?

7 MR. ANDES: Yes.

8 DR. YATES: Not having seen the
9 results of it, it's possible. I don't know.

10 MR. ANDES: And none of us have seen
11 the results. Again, you are not aware of
12 any outbreaks of disease associated with
13 recreational use with outbreaks on the CAWS?

14 DR. YATES: As I said, just because
15 there haven't been any reported outbreaks
16 doesn't mean that there haven't been any
17 illnesses associated with recreating on the
18 CAWS. I've mentioned before that it's very
19 well-known that outbreaks are vastly
20 under-recognized and under-reported and
21 especially when you are dealing with the
22 situation where the kinds of illnesses that
23 result from exposure to these pathogens are
24 the result of things like gastroenteritis or

1 respiratory infections or eye infections or
2 something like that. Those are not
3 reportable diseases. So if somebody has
4 gastroenteritis, they are not running to
5 their doctors. Unless it becomes very
6 severe, they are not running to the doctor.
7 So there is at this point in time no way to
8 know how much illness or infection is
9 resulting. Again, as has been mentioned by
10 others, you could have infection that
11 results from exposure to pathogens in the
12 CAWS, and that infected person may, the
13 person who actually recreated in the CAWS
14 may never develop any outward signs of that
15 infection, yet they can act as a source of
16 infection for others who may become ill and
17 you would never know that original source of
18 infection was recreating in the CAWS. So
19 it's very, very difficult to document these
20 kinds of health effects.

21 MR. ANDES: And The Risk Assessment,
22 that was done, looked at the risk of
23 infection, correct? I mean, obviously EPI
24 studies are more focused on symptoms, but

1 risk assessment, like this one, looked at
2 risk of infection?

3 DR. YATES: I believe that The Risk
4 Assessment cites risks of illness.

5 MR. ANDES: And if we can go back to
6 the report, I think it talks about risk of
7 infection.

8 DR. YATES: I would direct you to --
9 let's see if I can find it. Tables, let's
10 look at 59, total expected illnesses.
11 Pathogen concentration with no effluent
12 disinfection, table 511, proportion of
13 recreational user types contributing to
14 gastrointestinal illnesses with no effluent
15 disinfection on Table 511.

16 MR. ANDES: I believe that those
17 tables were derived based on Dr. Gerba's
18 assessment or assumption based on his
19 expertise that conservative assumption was
20 made that 50 percent of those infected would
21 become ill.

22 DR. YATES: I have absolutely no
23 idea. I do not recall reading anything to
24 that effect anywhere in this document.

1 MR. ANDES: We can find it later.
2 And are you also aware that secondary risks
3 were looked at in this report?

4 DR. YATES: Yes, I am.

5 MR. ANDES: Do you know of any
6 studies published in the peer review
7 literature that estimated how much water
8 people swallowed with recreating, and I
9 guess we can ask that as to swimming and as
10 to nonprimary contact uses.

11 DR. YATES: So I just want to make
12 sure, I'm sorry, I was still distracted by
13 the other -- the question was do I know of
14 any studies that estimated how much water
15 people swallow when recreating, was that the
16 question?

17 MR. ANDES: Yes.

18 DR. YATES: Yes, I do. Dr. Al
19 DuFour, and I'm sorry I don't have -- I
20 don't believe I brought a copy of this, but
21 there is a publication by Dr. Al DuFour who
22 is with the Environmental Protection Agency,
23 he has a publication from 2006. And again,
24 I apologize, in which they did studies of

1 individuals and used -- they actually did
2 studies in swimming pools because what they
3 looked at was the amount of cyanic acid, I
4 believe I'm pronouncing that correctly, that
5 was excreted by the individuals after
6 swimming. And this particular chemical is
7 conserved so they could estimate based on
8 those studies what volume of water was
9 ingested, and I know someone else has
10 testified about those studies. I can't
11 remember exactly who that was. If it was --
12 I just don't remember exactly.

13 MR. ANDES: Any other studies?

14 DR. YATES: Yes, there have been
15 other studies. I believe in my testimony I
16 reference some studies of divers, who one
17 would not expect, especially if they are
18 wearing full diving gear, head gear, one
19 would not necessarily expect they would
20 ingest water, but there was a study done by
21 Dr. Jack Zivan and others in the Netherlands
22 looking at the number of water ingested by
23 divers. I don't remember what volume that
24 was, but it was actually measurable volumes

1 of water ingested during that course of
2 activity.

3 MR. ANDES: Any others?

4 DR. YATES: Most of the -- I'll stop
5 there. To my knowledge, those are the only
6 studies that I know of where they
7 specifically measured the volume of water
8 that was ingested. There is another
9 citation that I found on the Web. It's an
10 EPA study in which they look at over 500
11 individuals, and again, used that same
12 analysis for the cyanic acid and came up
13 with volumes of water that people were
14 ingesting during the course of swimming.

15 MR. ANDES: From swimming pools?

16 DR. YATES: It was because they,
17 with the cyanic acid, that is what's
18 present in chlorine used in swimming pools,
19 yes.

20 MR. ANDES: And I'd like to get a
21 citation of that study at some point.

22 DR. YATES: I will do that.

23 MR. ANDES: And the Netherlands
24 study as well.

1 DR. YATES: The citation to the
2 Netherlands study I believe is in my
3 testimony. Shivan, it's the first one on
4 page 30. Shivan and Anna Marie Deroto,
5 Cushman published in 2006 in Environmental
6 Health Perspectives.

7 MR. ANDES: I take it you are not
8 aware any studies of quantities of water
9 that would be swallowed by boaters, rowers,
10 fishermen?

11 DR. YATES: No. All I know is as I
12 mentioned quite a bit earlier this morning,
13 is that when we did our Risk Assessment for
14 those noncontact type recreational
15 activities, we used a volume of 30
16 milliliters, and that volume was approved by
17 both Dr. Gerba and Dr. Hass, among more than
18 a dozen other individuals, but that was
19 again an assumption not based on actual
20 studies.

21 MR. ANDES: And that was for
22 swimming?

23 DR. YATES: No, that was for nonbody
24 contact, what we called nonbody contact

1 recreational activities which were
2 nonswimming activities, kayaking, canoeing
3 those kinds of activities.

4 MR. ANDES: The report, and again we
5 haven't read that report yet, but it talks
6 about body contact recreational activities
7 in the title.

8 DR. YATES: I shouldn't -- there's
9 -- I should not call it nonbody contact. I
10 should call it nonswimming recreational
11 activities. Those are considered to be body
12 contact recreational activities. Kayaking,
13 canoeing, all of those were defined for
14 those purposes as body contact recreational
15 activities. I misspoke when I said nonbody.
16 I meant nonswimming.

17 MR. ANDES: The purpose was to look
18 at the risk from the drinking water, from
19 the drinking water pathway, is that correct?

20 DR. YATES: Correct. This was a
21 reservoir that was going to be used as a
22 site to store water that would then be used
23 as a source of drinking water, and the
24 question was whether recreational activities

1 should be allowed on that.

2 MEMBER JOHNSON: Doctor, have you
3 ever spent a hot, humid August day in the
4 City of Chicago?

5 DR. YATES: I was born in Chicago.

6 MEMBER JOHNSON: Well, you blew my
7 line. It looks like you are gonna.

8 CHAIRMAN TIPSORD: Actually,
9 Mr. Andes, if you are done with that
10 immediate line of questioning, it is almost
11 5:00 o'clock, and unfortunately Dr. Yates,
12 it looks like you are going to be coming
13 back to Chicago.

14 DR. YATES: Like I said, I was born
15 here, and the pizza is pretty much unrivaled
16 if I could say.

17 MR. ANDES: We'll have that on the
18 record.

19 CHAIRMAN TIPSORD: And we will speak
20 to Ms. Alexander in more detail about the
21 availability.

22 MS. ALEXANDER: I may not be able to
23 be here, but I'll make sure what the
24 available dates are.

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

CHAIRMAN TIPSORD: I want to thank
you all, and again we'll start tomorrow
morning and we'll begin with Ms. Frisbie.
Thank you very much.

-
-
-

1 STATE OF ILLINOIS)
) SS.
2 COUNTY OF C O O K)
3

4 I, DENISE A. ANDRAS, being a Certified
5 Shorthand Reporter doing business in the City of
6 Des Plaines, Illinois, County of Cook, certify
7 that I reported in shorthand the proceedings had
8 at the foregoing hearing of the above-entitled
9 cause. And I certify that the foregoing is a true
10 and correct transcript of all my shorthand notes
11 so taken as aforesaid and contains all the
12 proceedings had at the said meeting of the
13 above-entitled cause.

14
15
16
17
18
19
20
21
22
23
24

Denise Andras
DENISE A. ANDRAS, CSR
CSR NO. 084-0003437

-
-
-

A	access 5:1 104:4	131:21	137:15,17	77:6 129:23
able 40:2 99:16	according 16:20	addition 67:5	138:10,20	135:17 140:2
100:24 113:7	20:8 31:16	83:5 99:22	140:21 141:5	ahead 4:12
137:1 153:22	account 67:18	additional 111:6	141:21	22:16 50:10
about 6:5,19	67:20 75:7	address 5:24	aforsaid 155:11	89:11
14:8,11,12	76:13,18	16:12 42:9	after 12:24 22:9	AI 148:18,21
18:5 20:12	accounted 16:19	125:15	40:13 51:1	ALBERT 2:17
22:10 26:10,16	29:17	addressed 29:14	52:18,21,24	Alexander 4:5
26:22 27:4,14	accurate 36:11	50:6	76:8 88:7	4:23 22:5,14
27:15 28:5	132:19	addressing	124:6 149:5	26:7 27:8 38:6
33:19 36:23	accurately 80:7	126:10,13	afternoon 4:1	43:17 44:12
39:8 44:24	achieve 26:6	132:12	again 6:12 24:15	49:13 52:19
45:13 46:1,3	126:2 127:16	adeno 29:15	24:24 25:3	53:2 55:16
49:11 50:15	acid 138:17	31:20 34:17	27:13,15 33:17	56:10,14 57:8
57:10,11 58:1	139:21 149:3	adenoids 126:19	33:18 41:7	61:2 63:8
73:22 75:11	150:12,17	adenoviral	48:6,22 50:17	64:18 71:7
77:16,20,23	acknowledged	83:24	51:2 57:21	72:5,13,17,21
78:23,24 82:12	123:12	adenovirus	58:10 67:8,10	85:18 86:21
86:21,22 95:7	acquire 80:15	28:11,13,19,24	72:23 73:21	88:9 89:24
97:21 101:2	acquired 80:11	29:7,12 31:23	76:16 77:15,23	96:15 102:12
102:11,13	acquiring 80:19	36:3 37:16	80:20 92:19	109:8 112:7
103:11 106:5	act 43:11 146:15	80:3,6,12,15	94:16,18	116:9 119:18
107:9,12,14,15	activation 130:2	80:20 81:18	101:15 109:11	126:17 136:4
108:6 114:5,14	130:14	97:15 118:23	111:8 113:22	144:3 153:20
117:16,17	activities 72:2	125:1 127:12	118:7,24	153:22
118:19 120:18	73:5 82:11,15	128:15,16	123:11 125:16	ALISA 2:8
122:19 129:17	118:12 151:15	adenoviruses	125:21 127:5	allowed 43:12
130:5,10	152:1,2,3,6,11	9:24 11:1 14:3	129:2,11	153:1
131:19 133:1	152:12,15,24	14:7 28:5,16	132:23 135:12	alluded 7:8
133:16 135:9	activity 102:14	30:22 31:2,5,7	145:11 146:9	almost 46:1
135:11 140:21	116:2 119:9,20	31:12,15,17,18	148:23 150:11	153:10
142:2,9 144:18	150:2	32:1,8 34:10	151:19 152:4	along 115:12
147:6 149:10	actual 52:7 92:1	35:6 37:2 38:1	154:2	144:12
152:6 153:20	94:20 96:8	80:14,16 81:17	against 98:7,7	already 20:17
above 92:13	142:10,20	81:21,23 82:4	111:23	26:15 27:15
above-entitled	143:12,15	83:12,17 84:4	age 115:17	29:11 32:18
155:8,13	144:1,11	84:7,8,10,16	136:7	34:10 53:15
absence 59:19	151:19	84:21 85:12	agency 2:9 56:5	58:19 61:10
absent 133:11	actually 7:14	90:22 97:24	60:9 62:2 64:3	71:7 73:22
absolute 140:9	18:6,11 48:9	98:4,7,14	64:5 66:22	78:7 90:18
absolutely 45:4	49:17 59:18	99:12 124:8	110:19,21	91:23 102:21
147:22	69:23 104:7	125:3,7,8,9	115:14 148:22	104:19 109:18
Academic 87:3	110:17 117:5	126:13 128:19	Agency's 79:8	111:20 119:21
accept 26:5	128:9 131:2	adequate 144:23	ago 5:8 70:10	123:11 124:18
58:14 125:23	133:13 137:13	adequately	137:10	124:21
acceptable	137:19 139:10	34:14	agree 21:19,23	alternative
53:17,20 58:17	146:13 149:1	adjunct 66:11	22:12,14 23:9	124:19
125:18 127:17	149:24 153:8	Adm 1:11	37:18 54:16	always 140:19
accepted 36:13	add 4:23 111:5	adults 119:17	66:21 69:12	AMENDMEN...

1:10	18:1,10,22	85:19,21 86:3	148:5,17	Appeared 2:18
among 105:2	19:19,24 21:4	86:14,19 87:5	149:13 150:3	3:7
113:24 115:8	21:17 22:12	87:14,17 88:20	150:15,20,23	Appendix 9:11
151:17	23:5,16,22	89:2,5,9,13	151:7,21 152:4	9:13
amount 8:5	24:14 25:7,22	90:11 91:10,17	152:17 153:9	apples 34:19
10:17 16:5,6,9	28:1,22 29:6	92:7,14 93:4,7	153:17	75:10
17:9 18:12	29:10 30:2,11	93:9,16,23	ANDRAS 155:4	applied 35:3
39:14 45:17	30:15 31:6	94:5,11 95:3,6	155:17	125:5 135:23
62:21 83:2	32:5,13 33:24	95:15,21 97:14	and/or 31:22	135:24
95:22 127:15	34:13 35:7,10	97:20 98:16,19	96:14 106:24	apply 61:22
143:17 149:3	35:23 36:16	99:9,17 100:1	animal 110:10	127:15 131:22
amounts 14:13	37:5,8,22	100:4,7,12,15	animals 109:24	applying 123:18
ANAD 2:6	39:22 40:4,17	100:20 101:2	110:4	approach 19:8
analyses 34:4	40:23 42:1,7	101:10,22	Anna 151:4	66:5
108:13	42:11 43:9,18	102:4,7 104:17	annually 104:15	appropriate
analysis 9:9	44:1,5,9,14,20	104:21 105:1	another 7:22	65:23
12:16 20:13	44:24 45:7	105:18,22	28:1 29:19	approved 7:22
31:16,17,21	46:7,10,16,22	106:4,10,12,14	30:16,20 32:14	36:14 151:16
33:3,13 36:23	47:3,16,21	106:16,21,23	36:8 80:22	approximately
60:8 65:14	48:2,8,18 49:6	107:17 108:1,9	109:3 115:10	8:9 60:2
91:1,22 144:9	49:10,15,24	109:1,16,20,23	115:11 123:5	area 1:7 55:22
150:12	50:5,11,20	110:11 111:5	137:4 150:8	55:24 75:23
analytical 12:9	51:9,18,24	111:18,24	answer 51:19	88:23 105:24
analyze 12:18	52:16,20 53:5	112:13 113:1	54:2 68:7	areas 54:10,22
12:19 17:19	53:13,22 55:8	113:21 116:12	101:1 143:3	72:4 73:8,17
18:20,22 20:16	56:7,12,15	116:14 117:11	answered 61:17	arguing 38:12
31:23 33:21	57:5,13 58:5	118:16 119:11	104:20 112:1	argument 13:2
37:3	58:18,22 59:5	120:13,20	answers 61:5	13:18
analyzed 6:21	59:20,22 60:15	121:2,13 122:2	antibodies 69:9	arise 115:19
7:15 8:11,14	60:23 61:16	122:16 124:8	69:14 70:16	Arizona 13:7,17
8:18 9:9,22	62:1,8,12,15	125:10 126:6	antibody 69:20	30:21 31:12
10:2,12 11:1,5	62:20 63:4,11	126:22 127:2	anybody 25:2	around 10:13
11:11 12:22	63:15,24 64:6	127:20 128:12	anymore 109:14	56:15 93:5
13:7 14:7 16:4	64:10,21 65:1	128:23 129:6	anyone 121:1	128:13
16:16,22 18:16	65:6,9,15,18	129:15 130:8	129:4	article 14:22,24
30:9,22 31:11	66:16 67:7	131:3 132:9	anything 16:20	15:4 20:22
32:7,24 33:16	68:7,16,20	133:15,21	17:21 29:21	114:24 115:11
35:16 92:3	69:5,15,17	134:10 135:3,9	42:8 63:5,13	137:11 141:16
analyzing 8:9	70:2,5,12,21	135:16 136:2	93:13 107:12	aside 92:7 123:9
14:15 15:15	71:5,12,23	137:23 138:1,4	107:15 147:23	130:8
20:18 26:22	72:11,15,20,24	138:9,15	anyway 31:16	asked 20:3
33:22 37:20,21	73:3,13 74:16	139:15,24	126:9	36:20 122:4
Andes 3:6 4:3	75:2,19 76:5	140:3,19 141:9	anywhere	asking 51:14
5:7,15,22 6:3	76:12,17,22	141:14,22	147:24	71:10,12 95:6
6:18 7:18 8:21	77:8 78:1,14	142:8 143:1,6	apart 102:15	102:13 112:12
9:1 10:14	78:21 79:3	143:11,21	apologize	112:15 114:4
11:15,18,21	80:2,24 82:1	144:7 145:1,7	148:24	aspects 97:23
12:3 14:8,24	82:19 83:1,19	145:10 146:21	APPEARANCE	assay 10:9 11:24
15:20 16:11,24	83:24 85:1,14	147:5,16 148:1	3:1	35:14

assess 21:24	assumes 90:1	back 12:1 40:9	103:16,23,24	103:11 104:13
assessed 108:16	assuming 16:15	40:17 53:24	137:3,6 139:9	104:19 113:16
assessing 19:9	74:14 75:13	58:18 65:11	140:13,17	114:16 121:16
21:20 112:14	121:19 130:13	72:17 75:3	146:16 147:21	122:7 124:15
118:18	assumption	88:4,14 89:13	becomes 146:5	124:20,23
assessment 6:9	28:12 76:23	103:10 107:19	becoming	130:15,22
6:10,14,17,21	135:18,19	111:24 122:16	137:14,20	133:15 134:2
7:1 9:2 10:4,7	142:17,24	131:5 133:21	139:13 140:8	136:14 142:22
16:12,20 20:9	145:3 147:18	135:4 144:9	141:20	147:3,16
23:6 24:17	147:19 151:19	147:5 153:13	before 1:1,14	148:20 149:4
26:10,15,19	assumptions	backup 132:6	4:5 6:3,6 11:15	149:15 151:2
29:1 32:12	26:20 79:5	bacteria 39:16	11:22 20:21	below 74:12
50:17 59:9	142:19 144:2	50:13 56:18	27:14 40:15	belt 25:4,6
65:21 66:19,20	assurance 123:5	59:19 112:19	88:9 139:24	benchmark 22:9
67:11,18,19,22	astute 60:3	112:22,23	145:18	benefit 44:12
73:14,19,24	asymptomatic	113:2,12,18	begin 154:3	best 111:10
74:5,8,19 75:4	99:21	122:5 133:4	behalf 2:18 3:7	better 143:3
75:6 76:13	attempt 80:18	bacterial 105:17	being 19:2 36:22	between 131:15
79:7,8,12	attention 28:3	112:5	51:6 53:6	135:20
80:18 81:6	80:23 82:22	balance 58:6	77:21 79:10	biannually
82:6 83:15	83:2	bar 46:20	99:1,4,7,10	107:21
108:16 112:16	attributable	BARNES 3:2	115:23 119:19	biological 85:2
113:9 116:23	130:22	base 62:2	120:16,23	bit 40:24 45:13
120:14,19,24	attribute 130:20	based 17:2,3	124:5 129:10	56:16 74:3
121:5,7,8,12	attributed 95:19	22:19 24:16	129:12 136:16	91:23 101:20
142:16,18,23	95:24	41:3 61:21	155:4	103:19 107:8
143:22 144:10	August 153:3	84:3 86:4	believe 4:3 7:1	130:4 151:12
144:14,22	authors 116:19	90:18 91:22	7:19 9:10,11	Blanchy 64:13
145:4 146:21	availability	98:2 112:15	9:12 16:14,18	Blanchy's 40:5
147:1,4,18	153:21	114:8 122:18	17:16 18:8,13	40:18 52:2
151:13	available 153:24	122:23 130:1	23:14,19 24:8	132:10
assessments	average 15:5	130:13 132:6	24:12 25:4,15	blanking 48:7
79:10	47:17,22 48:16	132:20 139:14	25:20 26:9,12	blew 153:6
associated 19:3	48:20	141:17 142:9	27:9 30:19	blue 33:11 46:14
27:17 51:8	averages 48:5	147:17,18	35:23 45:2	46:19
77:12 84:5,9	48:11 49:4	149:7 151:19	47:12,19 48:11	board 1:1,15 2:3
84:11 101:5	aware 42:1	bases 132:2	50:8 51:2 56:3	88:21 143:7,10
106:8 107:11	54:13 55:8	basic 60:4	56:5,6 60:15	boaters 142:12
118:22,23	62:20,22 68:8	basically 12:10	61:21 62:10	143:13 151:9
145:12,17	76:12,21 83:22	136:14	64:4,22 67:1,5	bodies 94:14
assume 11:10	85:14,21	basis 56:21 64:1	72:1 73:4	96:5 108:2,6
13:14,20 18:14	100:20 105:18	65:2 139:10	75:21 78:7,16	120:8
60:21 62:21	105:23 113:11	bathers 118:21	78:20 80:6	body 19:5 23:23
76:6 99:21	120:21,23	bathrooms	81:14 82:6,7	24:6,21 39:24
108:1 113:1	145:11 148:2	122:7,9,12,14	86:23 87:3	41:6 48:4
144:11,20	151:8	Baton 87:2	89:4,8 90:17	52:22 53:14
assumed 16:21		beach 118:19	90:22 91:7	71:18 73:20
28:16,23 74:2	B	Beaches 60:9	94:7 95:5	77:13,17 93:18
74:9,20 130:1	B 90:23 134:4	become 70:19	96:23 97:10	95:23 100:21
	babies 141:2			

115:16 152:6 152:11,14 book 130:24 born 153:5,14 both 35:5,17,20 36:8,21 38:5 59:20,21 66:18 67:5 74:15 77:10 95:12 100:19 101:8 151:17 brain 63:16 break 4:2,7 5:14 49:14 56:11 61:2 78:22 88:4,6 95:18 102:15 bring 107:22 bringing 130:7 brought 26:24 80:23 148:20 build 69:20 business 23:19 155:5 buy 17:24 byproducts 44:2 44:6	capable 38:22 84:1 120:8 capture 34:15 34:21 car 25:4 care 77:18,19,23 104:5 111:6 134:20 careful 36:22 carry 113:19 case 8:8 38:24 58:8 74:1 88:19 96:3,12 99:16 101:5 115:6 127:12 133:5,20 140:16,20 cases 94:13,20 95:16 101:13 105:4,6 106:5 111:4 categories 90:13 91:18 108:11 categorize 114:22 cause 19:12,14 84:14 94:12 99:19 101:11 102:5,7,10,19 104:22 137:3 155:9,13 caused 4:21 59:18 100:11 causes 9:2 94:15 99:23,24 101:12,19 104:17 105:3 106:6 136:9 causing 22:20 22:22 84:11 CAWS 5:19,21 6:1 21:11,16 26:11 27:7,12 27:20 43:7 44:16 45:9,17 45:20,24 46:24 51:5 56:17 60:18 61:9,15 71:2 74:11	75:16 82:9 89:23 90:16,21 106:3 110:4,6 112:6,20 113:4 113:12,15,17 114:2 122:6 124:7 142:13 143:14 145:13 145:18 146:12 146:13,18 CBC 107:20 CDC 96:1 cell 9:23 11:1 14:3 29:4,22 30:23 31:13,19 32:3 34:9 35:4 37:2,12,14 38:24 39:3 cells 39:3 Center 1:16 2:13 Centers 4:14 104:6 certain 28:6 39:4 50:24 54:22 76:20 97:9 115:5 136:16 certainly 19:7 27:2 42:21 43:4,7,23 47:21 48:16 59:11 61:7 85:20 87:19 96:21 136:1 137:24 145:1 Certified 155:4 certify 155:6,9 cetera 45:15 54:12 97:9,9 104:9 108:12 120:11,12 121:10,10 142:21 CFO's 75:4 CHAIRMAN 4:1,11 5:5 6:12 20:11,21 38:7 54:4 60:7	78:23 88:3 89:11 116:14 116:16 117:10 153:8,19 154:1 chalk 13:23 chalkboard 13:22,23 challenge 70:9 136:21 138:24 140:9 chance 14:11 17:12 changing 82:10 Channel 47:5 chapter 130:24 characterizati... 22:13,15 90:3 91:15 126:18 characterizati... 91:5 characterize 134:15 characterized 40:19 91:12 135:6 Charles 102:20 114:9 115:12 116:19,20 117:1 chart 7:4 check 88:15 CHEERS 143:2 chemical 149:6 Chicago 1:7,17 2:15 3:4 47:5 55:22,24 153:4 153:5,13 child 103:19 137:19 children 68:13 68:24 83:13 84:24 101:19 102:5 103:14 103:14,16 115:17 116:24 117:14,23 118:5,13 119:1 119:10,13 120:16,22,23	121:17,19,21 137:13,16 138:10,19 139:22 140:21 141:18 children's 115:20 chlorinate 43:14 43:23 chlorinated 118:20 chlorination 110:14,18 111:12 122:21 128:24 129:7 129:10 chlorine 150:18 cholera 105:10 109:16 choosing 37:16 Christine 14:21 70:8 136:22 citation 150:9 150:21 151:1 cite 79:13 114:24 116:3 137:7 138:21 cited 80:5 118:3 142:3 cites 147:4 cities 55:9 128:13,24 citing 59:24 City 153:4 155:5 claims 53:6 clarification 88:11 clarify 22:5 57:12 87:18 112:8 clarity 53:4 clean 24:21 43:11 60:4 clear 45:7 49:13 50:7 56:9,11 61:1 112:12 133:22 close 4:2 15:7 72:15,18 73:6
<hr/> C <hr/>				
C 2:1 155:2 Cal 47:4 California 99:1 call 58:6 79:1 85:10 139:11 152:9,10 called 28:13 130:24 151:24 Calumet 28:15 came 4:8 31:20 110:9 116:13 150:12 Canada 54:24 Canal 47:6 55:23 canoe 21:22 canoeing 82:2,9 117:18 152:2 152:13 capabilities 123:14				

Club 2:19	102:12	30:24 52:6	101:18 114:2	correct 8:24,24
cocci 90:23	compounds	117:13	116:8 117:18	11:20,20,23
Code 1:11	134:21	conclusions 17:3	118:7 148:10	18:7 28:15
coliform 52:12	computer 5:1	26:16 87:6	151:24,24	29:8,20 30:4
59:6,19 133:7	concentrate 7:9	condition 136:7	152:6,9,12,14	31:8 37:9
coliforms 46:2	8:5 9:22 10:2	conditions 39:19	contacted 57:14	40:10,11 41:1
50:4 52:6	10:22 12:15,24	50:14,18,19	contain 16:22	42:3 44:2 49:7
59:14 133:11	18:3	52:24 60:22	32:9 85:6	50:9 51:1,13
133:13,17	concentrated	72:1 77:14	contained 16:16	52:17 55:11
colleague 54:24	7:19,21 8:7,14	86:9 89:19	18:15 31:5,22	57:7,16 62:18
collected 10:11	8:18,23 9:4,14	114:3	118:9	62:19 77:4
11:9,11,14	9:16,18 10:11	conduct 12:8	contains 94:2	79:13,20 93:18
15:16 20:5,6	10:15,18 12:12	66:7	155:11	97:18 98:18
32:17	13:19 20:6,8	conducted 72:2	contaminated	106:13 108:14
collector 144:12	concentrating	73:5 138:5	93:14,22 94:14	109:4,9,21,22
column 10:8	7:12 12:16	confidence 27:1	contamination	110:1 112:3
combine 144:14	14:10	confused 107:9	59:7,15	117:6,22 129:9
combined 21:10	concentration	130:5	contest 37:24	134:13 145:4
22:1 23:7,24	11:15,22 12:21	confusion 6:8	contested 90:7	146:23 152:19
24:1,22 25:11	29:3 32:19	confutation	context 21:24	152:20 155:10
144:8	47:14 51:22	71:24	66:13 74:4	correcting 45:23
come 56:2	52:14 78:9	consequences	continue 23:24	correctly 9:21
107:18,20	94:10 125:2,4	15:13	24:1 76:5	10:24 68:22
142:19,24	129:22,24	conservative	141:24 142:1	74:7,19 149:4
comes 47:8 56:4	143:18 147:11	28:12 81:13	CONTINUED	cost 25:24 26:5
57:4	concentrations	147:19	3:1	97:22
coming 40:9	19:16 22:22	conserved 149:7	continuing 19:4	costs 26:2 58:8
69:3 97:8	29:14 40:13,15	consider 93:1	contract 4:21	count 109:7
98:15 153:12	45:24 53:19	102:22 143:8	contribute 49:3	counted 35:21
comment 5:3	89:23 90:15	143:10 144:21	110:5	109:6
92:5 126:22	91:22 111:16	consideration	contributing	countries 104:3
137:7	125:1 129:18	58:13 83:16	61:8 147:13	country 128:13
comments 81:2	130:12 131:11	considered	contribution	County 155:2,6
common 96:22	131:18	32:10 58:16	50:12	couple 6:5 8:2,4
101:18 103:13	concerned 24:19	67:2,6,12	contributors	12:18 19:19
communities	concerning 4:8	68:14 114:19	110:1,2	26:7 104:12
54:12	6:8 38:1 44:10	114:22 127:16	control 1:1,15	course 150:1,14
community	52:2 55:17	152:11	2:3 4:14 24:9	coxsackie 91:12
25:24	62:24 79:4	considering	25:17 78:8	99:18
comparable	80:3 88:11	77:13	104:6 122:24	coxsackie's
45:16	89:15 140:22	consistent 6:24	123:8	109:12
compare 33:7	concerns 67:8	7:15 19:21	convenient 5:3	CPSP 65:19
compared 22:3	71:24 80:22	20:1 25:13	conventional	create 104:23
44:14 45:8	89:14 103:23	constructed	52:3 134:5	creates 21:7
132:17	conclude 24:17	105:20	converse 59:15	credit 130:19
compares 18:1	31:22 32:3	consume 143:16	Cook 155:6	criteria 57:7,14
compiled 104:7	concluded	contact 56:20,22	copied 6:22	57:15 59:3
completely 61:5	132:15	57:7,15,20	copy 138:2	61:20 65:23,24
compound	conclusion 23:5	68:16 82:20	148:20	82:20

144:19	49:7 56:17	81:8,19,22	42:12 43:4,20	100:16,23
disinfectant	89:2 90:19	83:20 92:15	44:3,7,17,22	101:4,14 102:2
41:8,14 42:18	District's 56:2	102:17 121:3	45:4,11 46:9	102:6,16,19
43:5,12 44:2	89:16 90:3	121:11 136:9	46:11,18 47:2	103:2,3 104:19
123:18,19,21	divers 149:16,23	137:15,21	47:9,19,23	104:24 105:5
disinfectants	divide 139:2	138:12,19	48:6,9,22 49:8	105:21 106:1,7
42:16 111:22	diving 149:18	139:4,11,14,23	49:21 50:2,10	106:11,13,15
disinfected 55:3	DNA 28:10	140:8,12,17,22	50:15 51:2,14	106:17,22
55:5 67:4	doctor 104:8,13	141:3,21	51:19 52:2,9	107:2,5,8,19
71:18 94:3	146:6 153:2	143:12 144:1	53:10,15 54:18	108:5,17 109:5
disinfecting	doctors 146:5	doubt 122:10	55:12,20,24	109:10,19,22
19:17 24:10	document 6:11	down 7:10 8:5	56:24 57:17	110:2,16 111:8
25:20 44:6	7:2 29:22 60:6	11:2,7 18:3	58:10,21 59:4	111:20 112:21
61:10 78:12,17	66:14 79:12	61:3	59:11,21 60:10	113:5 114:4,10
99:6,8 105:15	146:19 147:24	downstream	60:21 61:1,7	114:17 115:12
disinfection	documentation	46:23 47:4,4	61:23 62:5,10	115:12,15
22:23 23:1,9	86:15 96:20	47:11,13 49:18	62:13,19 63:3	116:13 117:5
24:5 27:5 40:8	97:13	73:7,12 74:10	63:12,16,22	117:22 118:24
40:14,16 41:15	documented	74:12,15,21,22	64:4,8,12,13	119:21 120:18
41:21 42:7,10	59:16 67:23	75:15,16,20,23	64:13,14,14,14	120:21 121:6
43:2,24 51:10	94:18 139:5	75:24	64:15,22 65:7	121:16 122:3
51:15,21 52:3	doing 36:3 57:23	dozen 151:18	65:13,16 66:13	122:11 123:11
52:12,13,18,21	68:18 81:3	Dr 4:13 5:11,20	67:1,15 68:11	124:15 125:16
52:24 54:9,15	121:5,12 123:6	6:2,19 7:17,24	68:18,22 69:11	126:24 127:5
54:23 55:10,15	126:16 128:14	8:24 9:5,12,20	69:16,22 70:4	127:23 128:17
60:19 62:18	128:24 129:4,6	10:21,22 11:16	70:7,8,15 71:3	129:2,11 130:4
63:2,7 77:11	155:5	11:20,23 12:13	71:20 72:22	130:9,18 131:5
94:5,10 97:17	domestic 109:23	14:14,20 15:1	73:2,10,21	132:10,23
97:20 98:4,12	done 7:9 12:7,7	16:3,14 17:11	74:18 75:9	133:19 134:2
98:13 105:8,12	20:1,19 31:3	18:8,13,24	76:2,9,16,20	134:13 135:7,8
108:2,4 111:2	36:9,24 37:8	19:22 20:3,12	77:5,15 78:4	135:12 136:1
111:2,4 112:6	42:5 55:12	21:12 22:18	78:16 79:9	136:14,22
112:19 123:13	68:24 70:9	23:11,18 24:8	80:9 81:14	137:8,24 138:2
123:23 124:3	74:8 79:11	24:24 25:15	82:10,23 83:4	138:7,13,21
124:10 125:24	82:12 90:19	26:1,12 27:13	83:21 84:3	139:16 140:1,5
126:3 128:4	98:3 105:14,15	28:4,20 29:2,8	85:9,20,23	141:8,10,15
129:21 130:3,7	108:14 128:18	29:21 30:5,13	86:4,16,24	142:6,14 143:4
130:15 131:8,9	132:7 136:22	30:17 31:10	87:6,7,11,15	143:9,15
131:13,23,24	140:2 142:14	32:6,8,16 33:3	87:19 88:14,22	144:16 145:5,8
133:3 134:17	146:22 149:20	33:9,12 34:3,4	89:4,7 90:10	145:14 147:3,8
134:24 135:23	153:9	34:7,23 35:1,1	90:17 91:14,20	147:17,22
135:24 147:12	Dorevich 64:15	35:9,11,12,24	92:11,19 93:6	148:4,11,18,18
147:15	135:7	36:12,17,18,19	93:8,11,20	148:21 149:14
displayed 88:13	dose 67:21 68:4	37:11,13,13,15	94:1,7,16 95:5	149:21 150:4
disproportion...	68:8,12,18	37:24 38:7,11	95:9,18 96:1	150:16,22
115:18	79:4,5,11,15	38:14,16,20	96:19 97:19	151:1,11,17,17
distracted	79:16,18,19,22	39:10 40:1,5	98:1,18,21,24	151:23 152:8
148:12	79:24 80:4,4,7	40:11,18,21	99:3,13,24	152:20 153:5
district 43:11	80:10,12 81:4	41:7 42:4,10	100:2,5,8,13	153:11,14

dramatically 105:9	Eave 17:14	emergency 104:9	9:16,17 16:8 16:17 17:23 18:15 36:23	10:9,12 11:12 11:24
drawn 26:17	echo 90:24 101:2 141:4	employ 126:1,3	entirely 28:18 68:11	especially 14:19 15:3 83:12 84:23 86:9 96:12 101:19 103:15 117:15 117:23 121:21 133:5 145:21 149:17
drinking 93:24 94:1,4 95:3,8 95:11 99:5,6 106:21,24 107:7,13,14,15 111:11 127:22 128:2,3,6 131:8 133:5 152:18,19,23	echos 109:13	employed 79:6 127:24 129:13	entitled 4:16 10:8 139:18	essence 7:9 28:10
drive 2:14 3:3 25:5	effect 42:18 43:1 70:6 78:18,18 84:15,16 102:22 124:14 147:24	enable 77:6 113:6 144:24	entries 121:13	establish 65:22
dry 17:5 21:13 50:19,21 61:13 71:24 76:6,24 77:3,10,17 78:3,10 89:19	effectuated 24:2 59:9	encounter 93:18	environment 93:17 104:23 110:7 118:3	establishing 132:2
due 112:5,18,22 118:16	effective 98:6,14 111:16,23 124:24	end 83:5 123:2,4 138:7 145:1	environmental 2:6,9,13 35:3 39:18 56:5 60:10 110:18 110:21 115:13 115:18 117:14 119:13 148:22 151:5	estimate 15:5 73:16 94:17 99:19 112:4,18 149:7
DuFour 148:19 148:21	effectively 41:12	ended 12:23 13:1,3 14:6	environments 93:19,21 133:20	estimated 138:18 148:7 148:14
during 4:7 5:14 18:12 48:20 50:13,21,23,24 61:13 75:4 77:3 78:10 82:15 85:24 89:18 106:23 119:16,17,20 129:19 150:1 150:14	effects 21:18 41:21 61:9,10 83:7 84:2,6,9 84:12,13,22 92:18 102:8,8 102:14 103:1,7 146:20	enhanced 57:20	envision 13:24	et 45:15 54:12 97:9,9 104:9 108:12 120:11 120:11 121:10 121:10 142:21
<hr/> E <hr/>	effluent 1:6 19:5 21:14 22:4 24:11 27:6 42:8,13,15,22 43:6 45:2 46:8 51:4,5,11,21 61:11,14 67:3 78:13,17 108:8 124:6 127:21 132:13 134:6 144:20 147:11 147:14	enough 12:19 60:4	EPA 7:22,24 19:21 20:2,9 20:15,17 30:4 36:13 37:6 49:6,9,9 57:19 58:2 60:1 61:19,23 62:7 62:24 80:23 81:1 82:19 88:18 111:8 112:13 127:10 127:16 133:6 150:10	ETTINGER 2:17
E 2:1,1,5	effluence 104:22	ensuing 103:4	enter 29:24	Europe 54:14,19 55:10,14
each 17:20 35:12 92:3,4 139:3	effluent 1:6 19:5 21:14 22:4 24:11 27:6 42:8,13,15,22 43:6 45:2 46:8 51:4,5,11,21 61:11,14 67:3 78:13,17 108:8 124:6 127:21 132:13 134:6 144:20 147:11 147:14	entered 20:22	enteric 29:15,16 29:18 30:3 34:15,21 38:24 117:15 138:12	even 13:10 15:12 16:7 17:19 21:6,19 23:7 24:5,22 28:13,17 40:14 45:23 57:18 58:2 60:18 83:11,16 84:20 86:6 119:13 125:2
ear 83:9	effluxion 69:7	entero 35:18,20 37:17 91:1,2 116:6	enterovirus 30:10 31:22 32:11,24 33:7 37:4,6 118:6	event 76:8
earlier 4:9 27:16 28:5 33:19 90:23 108:18 140:22 151:12	eight 4:4 6:4 40:20	enteroviruses 30:11,18 31:1 31:14 32:4,10 32:15 33:5,13 33:14 34:11 35:6,22 36:4 36:15 37:15 91:3,6,11,16 109:11 118:14 119:2,4	entero 35:18,20 37:17 91:1,2 116:6	events 51:1
ease 12:16	either 31:1 42:24 122:23 142:23	entire 8:16,20	entero 35:18,20 37:17 91:1,2 116:6	ever 57:2 106:3 153:3
easel 44:13	eliminate 51:10		EPA's 64:11	every 21:17 41:12
easily 12:22 16:10 133:2	ELPC 2:18		EPI 144:11,12 146:23	everything 57:1 58:9
East 2:14	else's 26:3 53:16 53:21 58:11		epidemiological 66:7,8,11,20 116:5 143:1,22 144:21 145:6	
easy 103:16			epidemiology 65:21	
			equal 74:9,14,20 equally 75:14,20 84:1	
			equivalent 8:8	

evidence 15:2 19:13 22:6 66:17 89:20,21 90:2,14 115:16 116:5,10 136:10 137:10 140:6 142:5	64:19 66:3 explain 30:13 89:20 explained 90:22 exposed 51:7 76:7 82:14 103:1 106:19 115:22 116:3 118:8,10,15 119:5,7,19 120:5,16 121:22 124:5 142:12 143:13	119:11 120:7 132:14,14 134:14 factor 57:3 69:12,15,16 factored 28:24 factors 39:13 44:4 58:12 facts 90:1 101:24 fair 62:21 fairly 26:13 37:22 105:23 127:22 128:5	125:12 findings 145:3 fine 36:7 85:20 finish 15:14 86:22 first 43:13 66:2 67:15 116:15 116:16 124:15 134:4 151:3 fishermen 151:10 fishers 142:13 143:13 fishing 60:5 five 56:19,21 57:3,3 78:24 139:6 flaws 26:14 flow 26:10 44:15 44:15,18,21 45:8 flows 45:14,15 45:16 focus 21:12 35:24 50:18 focused 34:17 36:10 50:19 146:24 focusing 82:21 follow 37:6 43:9 131:23 followed 19:20 20:10 following 76:4 88:7 89:21 follow-up 6:4 27:9 28:2 31:2 38:15 55:17 56:13 96:16 136:5 follow-ups 26:8 food 94:24 95:2 114:12 116:18 footnote 131:4 foregoing 155:8 155:9 Forget 116:23 form 8:13 formal 57:11,19	forms 132:17 found 33:1,2 90:21 91:6,8 93:23 111:9,14 136:22 139:16 150:9 foundation 134:12 four 21:18 75:21 105:3,6 Fox 45:12,12,14 45:15,18 49:16 88:23 fraction 8:7,12 8:15,17,23 9:3 9:7,16,24 10:15 15:16 16:15,21 17:20 17:22 20:15 30:8,16,17,20 31:8,10 32:21 32:24 33:1,15 36:9 92:3 fractions 26:22 32:14 33:22 35:15 Fred 65:5 FREDERIC 3:6 Fred's 54:1 frequently 69:20 72:3 73:5 84:5 84:8,11 127:24 fresh 118:21 Frisbie 154:3 from 6:10 7:8,21 9:11 14:22 15:8 20:7 21:1 21:14 22:4 29:4 32:4 33:1 37:18 39:17 42:19 43:8 47:8,18 48:10 48:15 49:1,8 51:11 52:11,22 56:2,4 57:4 63:1 66:6 68:13 77:10,22 80:16 82:8 85:4 86:8 89:6
exact 11:6 37:20 48:1,23 96:11 101:9 116:12 127:18 exactly 56:7 63:13 100:14 104:12 140:15 144:17 149:11 149:12 examined 99:5 example 12:14 28:15 38:18 47:10 67:23,24 68:14 69:19 108:15 110:15 123:1 135:15 136:20 examples 108:20 exception 54:15 exceptions 70:15 excess 47:14 exclusively 133:6 excreted 149:5 Excuse 20:11 38:14 exercises 12:9 exhibit 6:14,16 10:7 20:23 21:2,3 60:13 60:14 116:21 116:22 117:2,4 exist 89:22 90:15 91:18,19 exists 113:3 expect 83:19 149:17,19 expected 147:10 expert 58:23,24 66:3 expertise 147:19 experts 64:9,11	exposure 15:9 66:6 69:18,23 70:17 83:18 95:13 102:23 103:4,7 104:10 115:2 116:7 117:15 119:1 119:16,22 120:15 121:8 121:10,23 140:24 143:12 144:1 145:23 146:11 exposures 106:9 107:12,13,14 120:10 extent 5:23 23:20 24:3 41:2,5 85:2,6,7 126:12 135:22 extraordinarily 14:19 17:16 101:18 extrapolate 8:15 extreme 132:17 extremely 86:10 122:15 eye 83:9 146:1	falling 72:9 false 24:19 familiar 58:23 128:23 far 83:14 103:10 113:3 fatality 115:7 fecal 46:2 50:3 52:6,12 59:6,7 59:15 80:16 84:18 93:14,22 94:2 108:21 fecally 93:21 fecal-oral 83:14 federally 57:6,9 feel 73:22 feet 72:19 few 21:17,23 50:6 137:10 figure 6:10 27:10 44:10 47:8 55:17 88:12 figured 29:11 filter 7:4,6 filtration 12:4 111:2,12 final 49:16 find 4:7 17:21 29:21 40:22 56:7 59:17 67:9 91:2,6 122:13 147:9 148:1 finding 15:12		
	F			
	fact 14:12 23:6 26:10 37:8 44:1 48:23 51:3 52:4 76:14 92:2 94:19 102:14 105:22 109:2			

94:14 95:11,11 103:4 104:3 106:10,24 110:10 114:13 115:2,13,14,18 117:1,2,8 118:14 119:1 122:5,6,8 123:20 124:11 125:8 137:14 137:20 138:17 138:19 139:17 140:9,17,23 141:20 144:12 145:23 146:11 148:23 150:15 152:18,18 front 138:3 full 149:18 further 20:22 31:23 56:12 91:4 135:10 142:1 furthermore 36:22 74:7	generalization 41:12 generalize 129:14 generally 12:7 96:3 108:13 genetic 137:1 geometric 88:16 89:3 GeoSyntec 120:19 Gerba 34:4,7,23 35:12 36:18,19 37:13,13,15 64:13,14 114:9 115:12,15 116:13,20 117:1 122:3 137:8 139:17 151:17 Gerba's 9:12,20 10:22 32:8 33:3,12 35:1 35:24 37:24 38:8 114:17 147:17 getting 14:11 36:11 107:3 128:15 Giardia 38:19 38:20 91:8 109:20,23 110:5,9 126:10 129:9 give 12:4 24:19 39:20 41:22 79:18,19 87:24 92:22 126:13 131:18 137:2,4 137:15 139:3 143:3 144:15 given 52:1 71:18 79:15 138:19 139:23 140:11 140:17 gives 92:24 113:15 giving 34:8 go 4:11 6:22	20:21 22:16 24:21 38:12 40:17 50:10 53:23,24 58:18 59:21 71:17 75:3 88:14 89:11,13 90:12 97:14 107:19 110:6 111:24 122:16 133:21 138:7 142:8 147:5 goes 59:20 66:1 144:9 going 15:24 17:23 25:9 27:5 28:2 36:7 40:22 41:8 42:13,14 44:3 50:5 53:22 56:15 57:1 58:18 66:8 67:7 69:19 72:5 79:3,23 89:24 97:8 98:10 123:7 124:3,13,19,21 124:23 125:23 126:17 136:6 142:4 143:2 152:21 153:12 gone 113:23 gonna 153:7 good 4:1 5:6 17:12 94:19 99:11 105:15 111:13 Gorland 130:9 gotten 18:21 graphic 103:21 great 61:11 130:10 greater 27:20 119:13,16,22 119:23 128:8 138:10 139:22 greatest 116:17 117:14 greenhouse 58:8	ground 128:7 group 91:1 139:3,6 140:10 groups 139:2 grow 39:2 40:2 growing 38:22 115:16 growth 39:5 guarantee 94:8 guess 18:20 49:15,19 58:5 92:11 114:13 143:15 144:17 148:9 guys 48:13	112:18,21 113:3,19 146:20 151:6 hear 54:2 hearing 2:4 155:8 held 1:15 her 38:11 86:22 high 14:4,5 17:16 81:8,8 82:17 89:23 90:15 92:10,12 92:12,14 93:3 98:22 113:14 114:20,23 122:14 135:15 135:15 higher 15:10 27:16,18,20,21 27:22,23,24 49:17 56:18,19 68:1,2 74:3,23 96:4 115:3,6,7 121:22 137:13 137:20 highlighted 33:11 highly 97:16 122:12 124:9 126:23,24 him 131:2 himself 37:14 HML 32:22 holds 135:18 homogenous 12:5,11 hope 103:20 hospitalizations 104:8,14 hot 153:3 hotly 90:7 hour 4:2 hours 38:12 97:9 huge 15:13 45:24 46:4,4 human 22:20 39:3 66:5 70:9 93:22 94:2
<hr/> G <hr/> Gabriel 87:2 Garlack 87:7 gastroenteritis 104:3 145:24 146:4 gastrointestinal 80:8,13 81:4 81:10,23 83:6 84:2,6,13,15 84:17 141:19 147:14 gastrovirus 104:16 gather 55:9 117:11 142:10 gathered 88:17 gave 135:15 gear 149:18,18 general 27:16 44:17 45:19 67:12 97:7 105:5 110:6 117:19			<hr/> H <hr/> half 4:2 109:6 hand 13:24 113:13 Handbook 130:24 handed 60:7 handled 28:21 handling 120:9 hands 115:24 happen 103:18 hard 138:2 harm 102:24 harmful 103:1 Hass 64:14 151:17 having 14:18 27:4 124:14 125:1 139:22 145:8 head 47:24 100:8,17 149:18 health 15:13 17:13 19:3,10 22:24 23:13,19 23:20 24:12 25:14,17,19 51:7 52:15,23 53:7 57:22 66:6 70:23 71:14,15 78:12 92:17 93:2 103:6 112:4,9	

135:1 136:21 138:24 140:9 humid 153:3 humidity 39:14 hundred 8:2,4 10:19 41:4 46:2 47:15 104:13 122:19 123:7 139:7 hundreds 16:7 hydrological 43:1 hypothetical 22:11,16 hypothetically 24:15	95:23 106:5 116:6 118:6 145:17,22 147:10,14 illustrated 27:10 illustrates 33:18 33:18 illustration 14:15 imagine 143:9 immediate 153:10 immediately 69:3 76:8 immune 69:7 119:24 immunities 69:9 immunity 120:11 immunocomp... 70:22 71:1,4 immunological 120:2 immunosuppr... 71:6,16 impact 23:4,12 23:12 41:9 42:14,23 43:7 78:6 138:6 impacts 41:9 77:11 implementation 105:13 implemented 54:11 implementing 23:1 implies 136:8 imply 48:16 49:2 implying 123:23 importance 59:23 important 74:5 84:14 118:12 imposing 133:9 impossible 39:6 inaccurate 59:9 inactivated	105:12 133:2 inactivating 98:14 135:20 inappropriate 81:9 incapable 39:5 incidentally 129:19 include 33:6 63:20 68:24 90:21 105:2 107:5 108:2 111:1 included 29:24 64:1 65:2 73:14 75:8 83:7 108:13,15 108:24 109:3 120:22 includes 60:6 121:7 including 21:10 39:13 64:10 73:8,17 75:23 77:9 99:18 112:16 113:18 120:15 121:14 increase 54:22 75:5 127:14 increased 118:1 118:5,14 119:1 119:10 120:4 increasing 55:11 indeed 29:5 36:21 42:18 88:15,19 103:6 133:12 136:18 140:7,16 indicate 27:11 28:11 31:4 95:22 115:5 indicated 9:13 21:6 29:22 66:4 96:6 108:18 114:14 indicates 21:6 47:12 56:18 119:12 137:12 indicating 5:9	5:17 49:19 69:18 85:15 92:17 133:17 indications 41:23 indicator 105:13 130:2 131:15 131:17,22 132:2 133:4 indicators 22:8 27:10,17,19,21 27:23 41:16,22 113:15 130:13 132:6,12 135:20 individual 69:8 78:5 103:1 137:2,4 individuals 4:20 74:3 93:12,15 100:6 124:4 136:16,19 139:6,8,12 140:7,11,16 141:11,16 149:1,5 150:11 151:18 industry 128:9 128:11 ineffective 29:5 infants 119:12 141:1 infect 136:9,12 infected 23:8 29:9 30:24 33:14 70:19 93:13,15 136:23 137:3,6 137:14,20 138:19 139:9 139:14 140:8 140:13,17 141:20 146:12 147:20 infectible 70:14 infection 4:21 5:23 15:6,8 21:7 32:4 52:5 63:6 69:13	71:19 80:6,12 80:20 88:1 92:23 93:3 94:23 95:1 104:18 105:10 123:7 126:23 136:8,11,16,17 136:20 141:5 146:8,10,15,16 146:18,23 147:2,7 infections 80:15 81:7 83:8,9,9 99:20 100:1 118:2,23 120:9 146:1,1 infectious 20:24 102:17 139:11 infectivity 81:11 139:18 information 4:7 5:8,17,23 9:8 9:10 38:17 44:18 49:11 50:23 77:6 91:15 92:16,16 108:5 113:5,8 113:11,23 114:6 131:18 143:7,10 144:23 informed 55:1 ingest 18:12 143:18 149:20 ingested 18:17 18:18 149:9,22 150:1,8 ingesting 119:8 150:14 ingestion 18:5 83:18 84:23 92:20 95:7,10 106:19,22,23 106:24 107:2 119:6 121:14 inhalation 82:3 82:22 83:3 121:14 inhaled 142:11
I				
idea 44:22 94:19 110:4 143:3 147:23 identified 97:7 140:14 ID50 139:11 IEPA 63:9,13 64:24 ignore 37:17 68:6 ignored 30:12 ignoring 28:6 II 127:10 III 141:1 ill 1:11 146:16 147:21 illegitimate 34:22 Illinois 1:1,15 1:17 2:3,9,15 3:4 5:18 43:22 49:9 62:24 64:10 155:1,6 illness 67:24 83:6 95:14 96:12 103:12 105:4 113:24 115:2 121:9 138:10 146:8 147:4 illnesses 81:5,10 82:24 94:21				

142:21 inhaling 82:8 initially 10:14 initiate 79:1 102:24,24 input 78:9 inside 38:23 39:2 instance 107:18 insufficiently 118:20 intended 134:23 intentional 107:4 interest 57:21 interested 138:16 International 114:12 116:18 interpret 92:1 intestinal 93:12 introduce 114:13 116:9 introduced 66:18 137:9 142:4 invalid 17:10 involved 5:16 IPA's 64:19 issue 50:7,8 52:3 66:14 69:6 76:6 79:20 81:1,5 92:7 100:22 129:8 issues 16:12 28:4 33:19 41:1 80:1 81:1 82:7 103:12 122:2,4 130:9	153:2,6 journal 14:22 20:24 114:12 116:18 117:6,9 judgment 96:23 July 4:19 just 4:6,8 5:13 6:15 7:11 13:2 15:19 17:22 26:19 29:17 39:20 40:21 47:19 54:6 55:4 56:22 61:1 68:3,6 75:1 81:23 88:10 93:17 96:15,22 98:2 108:20 112:2 116:10 117:8 119:22 120:4 121:10,11 123:12 129:17 137:9 139:16 140:3 141:23 145:14 148:11 149:12 justification 62:23 63:3 justified 62:11 justify 61:19,24 74:14 J5 50:8 J9 54:5	know 8:6 9:15 12:6,9 19:6,10 19:12,15,16 22:18,21 23:3 25:2,5 30:9 32:23 33:24 34:1 39:8 41:14 43:20,21 45:12,13 46:1 47:23 48:3 49:21 50:15 51:24 54:16 56:20 57:2,4 57:18,19,22,24 63:12 76:6 77:21 79:14,15 81:18,21,24 82:18 83:15 86:3,12 87:15 89:5 91:3 93:6 97:7 99:10 100:9,23 103:2 106:17 109:11 113:22 114:19 114:20 125:19 129:5 132:3,4 133:1,10 135:5 142:3,10,16,20 145:9 146:8,17 148:5,13 149:9 150:6 151:11 knowledge 20:14 45:5 54:20 73:11 76:10 84:3 98:2 99:14 128:10 150:5 known 19:13 21:15 94:12 131:11,21,22 138:11	39:3 laid 108:12 lake 4:21 118:19 lakes 60:3 106:15 language 63:21 63:23 124:16 large 8:2 12:14 15:18,20,23 17:9 103:20,22 larger 7:20 44:21 75:17 137:5 largest 69:6,12 last 21:18 139:19,20 later 53:23 148:1 latest 128:2 law 2:13 55:1 laws 43:21 lead 104:1 122:24 123:8 lease 45:21 least 45:19 91:21 113:7 114:10 128:2 leave 78:24 left 43:24 46:10 46:11 legend 48:12,13 48:24 length 130:10 132:11 less 11:12 16:6 45:20 46:3 69:21 70:13,18 70:18 77:2 111:22 119:19 126:21 let 7:21 8:21 19:19 28:1 30:13 36:5 43:9 76:5 116:9 133:21 let's 12:13,14,23 12:24 13:2,3,4 13:14,20,24 18:1 38:13	45:11 71:5 72:20 111:24 112:2 116:14 130:8 136:2 139:5 147:9,9 level 26:4,6 52:20 53:8,20 56:18 58:16 61:20,24 62:3 62:11 63:6 105:16 111:13 112:11 113:2 115:7 123:24 124:2 125:18 125:22,24 126:2,4,5,9 127:17 130:2 131:19 135:1 levels 14:9 22:1 25:10 27:9,17 27:18,19,20,21 27:22,23,24 40:9 41:6,23 46:23 47:4 49:17 52:1,17 52:19 53:4,5 62:16 63:1 82:3 89:18 90:5 91:19 92:9,10 112:6 112:14,19 113:14 123:14 124:12,13 128:15 130:16 132:1,2,3,16 132:19 134:19 135:21 light 97:17 111:15 like 54:2,16 73:24 83:10 86:13,19 87:23 97:6 101:23 105:17 111:1 112:11 117:19 124:11 129:7 134:20 135:10 136:4 145:24 146:2 147:1
J Jack 149:21 JESSICA 2:17 jibe 75:1 Joan 116:20 job 19:9 23:20 26:1 99:11 105:15 111:13 John 114:9,10 JOHNSON 2:5	K K 155:2 kayak 21:22 kayaking 117:19 152:2 152:12 kids 115:22,23 116:6 killed 105:11 kind 18:4 68:19 74:24 103:10 kinds 39:4 41:10 41:19 82:11,15 83:8 98:21 145:22 146:20 152:3	L lab 32:8,23 37:7 laboratory 9:12 9:15,21 10:23 12:23 30:7 32:22 33:3,16 34:5,7 35:5 36:18 37:19		

114:12 115:15 116:19 117:7 131:1 137:11 microorganism 115:3 135:22 microorganisms 39:11 40:2 41:10 89:18 90:6 113:17 115:6 129:23 143:16,19 might 6:18 15:22 18:12 21:24 28:14 82:14 111:5 121:20,21,23 122:13,14,15 125:3 137:1,19 144:17 mile 72:7,18,20 73:7 miles 47:13 74:11,22 75:23 milliliter 41:4 milliliters 9:14 9:18 10:1,19 10:21,24 11:4 13:1,3,5,6,11 13:15 14:2 18:6,10 122:20 123:7 151:16 million 87:20 94:13 95:16 99:20 101:13 102:11 105:4,6 mills 18:19 mils 9:22 mind 69:4 85:11 107:18,23 minimal 134:15 135:11 miniscule 18:11 minor 42:20 minute 40:21 minutes 78:24 mischaracteri... 25:16 miss 13:12 14:17 15:17,20,22	16:10 33:23 Mississippi 44:15,18 88:24 misspoke 152:15 mixing 75:9 ml 13:8,16 47:15 52:12 mls 13:19,21 14:1,2 46:2 Mode 70:8 Models 140:23 Moe 14:21 136:22 moment 18:2 48:1 69:2 101:9 122:22 moments 137:10 money 125:11 monitor 132:3 monitoring 46:13,14,21 47:11 monthly 48:14 49:1 88:16 months 89:6 morbidity 4:14 107:21 more 15:23 27:8 36:11 46:5 49:10 69:24 72:2 73:5 74:11 75:2 84:13 93:17 96:16,24 97:1 97:10 98:13,15 98:15 99:22 101:12,24 102:3,7,13 109:6 111:22 115:22 116:2 117:23 121:24 122:9 123:19 124:24 127:24 132:17 135:11 136:8,11,16,19 146:24 151:17 153:20 morning 27:16 151:12 154:3	mortality 68:2 107:21 most 5:3 54:10 84:5,8,10 108:3 109:2,5 109:6 150:4 mountains 110:8 mouth 107:3 115:24 mouths 116:1 120:7 move 28:1 38:10 38:13 40:19 61:17 79:3 129:15 136:2 moving 6:3 43:2 MPN/100L 29:3 much 10:17 40:14 45:13 58:7,7,13,14 74:23,23 75:17 81:11 86:3 97:24 125:3 126:14,16 128:5,14 131:12 132:15 142:10,20 146:8 148:7,14 153:15 154:4 multiple 16:24 49:2 must 38:23 61:19 MWRDGC 3:7	149:19 necessary 77:10 need 6:15 13:22 20:16 38:10 53:4 57:12 88:4 124:11 125:14 needs 59:1 negative 16:23 17:23 29:11,23 32:2 33:2,2,17 37:1 102:24 103:6 Netherlands 149:21 150:23 151:2 Network 2:19 neurological 115:20 120:1 never 110:8 146:14,17 new 6:13 41:3 next 99:17 113:21 143:11 Nina 115:12 116:24 137:9 nitrogen 134:21 Noble 60:11 non 107:4 nonbody 151:23 151:24 152:9 152:15 nonChicago 88:23 Noncompliance 60:9 noncontact 151:14 nondisinfected 19:5 100:21 none 21:3 60:13 116:22 117:3 145:10 nonenteric 83:17 nonetheless 82:12 nongastrointe... 82:24	nonprimary 148:10 nonsensitive 115:9 nonspecific 96:13 nonswimming 118:12 119:20 152:2,10,16 nontreated 97:4 106:11,12 nonzero 103:3 Norovirus 8:8 9:9 11:6 13:11 13:18,20 14:6 14:18 15:2,6,9 15:12,18 18:21 21:6 22:1 33:20 70:4,10 87:23,24 91:7 92:20,21,23 94:22 95:1,13 95:16 118:22 137:2 Noroviruses 10:2,5 13:4,10 13:16 14:1 16:7,17,18 17:14 21:5,9 24:3 39:1 93:5 93:9,11,20 94:12 102:1 108:15 136:24 Norovirus-How 20:23 North 3:3 47:10 55:23 Norwalk 136:21 note 40:12 54:8 102:19 noted 7:1 notes 88:15 117:13 155:10 nothing 18:16 26:1 62:15 99:9 117:16 notice 49:17 97:2 noticed 65:9
<hr/> N <hr/>				
N 2:1				
name 117:6 130:23 native 39:16 natural 39:16 nature 97:5 near 56:17 72:3 72:7,11 73:14 necessarily 25:2 28:14 29:6 69:11 96:20 99:3 106:18 120:8 144:23				

117:13	occurred 74:20	104:21 105:7	69:23 79:23,24	125:13 126:16
notion 77:9	100:18 101:7	105:19 107:22	101:15 139:4,8	136:20 146:10
NPM 9:23	106:3 131:20	109:3 111:5,9	140:12	146:16 149:21
number 4:4,16	occurs 19:6	113:15 117:12	organisms 19:11	150:3
14:21 17:17	73:11 131:13	121:11 122:2,4	19:12 38:23	ought 71:13
26:14 39:12,20	October 48:10	123:3 126:1,7	40:13 42:15,19	out 13:21 14:2,4
44:4 51:15	48:15 49:1	126:12 127:15	79:10 105:11	15:17 16:4,8
64:9 74:21	89:8	130:6 132:1	108:19,21,23	18:19 26:13
79:17 90:19	off 7:14 12:8	137:2 139:6	125:4 131:16	38:22 39:5
94:8,17,20	36:8 38:19	143:21 144:5	131:22 132:8	47:8 56:7 59:6
95:19 96:8,8	47:24 100:8,17	147:1 149:16	136:12	59:12 67:16
98:9 104:8	Officer 2:4	149:18 151:3	original 8:10,12	69:19 80:21
113:14 115:1	Oh 87:14	ones 46:9,10,11	12:1 146:17	83:11 92:16
118:1 125:6,7	okay 6:3 13:1,11	46:14,16 55:14	originally 17:8	95:18 97:16
136:12 137:5	13:19 30:20	55:15 86:22	Orlis 87:7 130:9	98:15 107:20
137:16 141:15	32:1,6,20 48:8	142:2	other 5:7 13:10	108:12 110:6
142:8 143:16	49:15 54:2	ongoing 66:21	15:7 16:1 24:4	137:22
149:22	59:22 63:15	98:17	25:12 26:23	outbreak 4:19
numbers 11:6	67:7 72:21	only 8:10 12:17	32:14 33:15,16	96:2 97:1,2,11
15:18,21 18:4	87:14 108:9	18:16 33:22	34:16,18 35:19	107:22 118:22
22:7 27:1 28:8	129:15 141:22	39:2 55:22	36:18 37:18	outbreaks 4:8
49:3,4 79:18	142:8	66:10 69:1,3	42:19 43:8	5:9,13,21
86:15 92:2,5	one 3:3 6:7,15	78:3 80:21	46:16,20 48:4	59:18 96:3,4,8
95:17 104:11	12:3,15,20	92:2 97:8	49:19,22 50:12	96:9 100:10
116:13 131:21	13:12 14:1,9	100:18 113:5	50:15,24 53:23	105:24 106:2,2
131:22 142:20	14:11,18,18	122:3 125:12	54:13 55:6	106:8 107:10
numerous 33:10	15:6,9,19,21	127:13 144:4	56:4 63:4 67:5	107:15 145:12
33:12 102:20	17:2,6 18:1,12	150:5	67:19,21 72:4	145:13,15,19
	18:17 21:6,23	open 97:8	73:8,17 83:5,8	Outbreaks-U...
	23:23 24:14,17	operating 86:8	83:10 84:7	4:18
O	27:8 28:4	operated 71:14	92:16 93:19	outcome 136:10
O 155:2,2	30:17 31:21	opinion 60:17	95:20,21 96:18	outcomes
object 72:5	32:2 34:1,1,16	115:14 117:7	98:8,8,11,12	121:23
85:18 89:24	34:17,20,22,23	137:11	101:1 113:10	outdoor 118:20
90:2 126:17	35:11,18 36:8	opportunity 4:6	113:13 116:1	outfalls 56:18
objection 21:2	37:5,11 39:20	5:12	117:24 119:9	72:3,7,16
60:12 116:21	40:21 41:13	Oragui 134:7,11	121:6,17,20	73:15,18 75:22
117:3	47:16 48:2,5	135:4	123:10 125:4	75:24
observed 141:4	48:19 53:18	oral 140:24	125:24 126:21	outflow 28:16
obviously 42:8	54:1 59:11	oranges 34:19	127:1 129:12	outward 146:14
42:14 62:6,8	69:1,3,21	75:10	133:9,16	over 17:4 23:24
135:4,19	70:13 71:15	order 46:5	134:19 137:16	24:10 38:13
146:23	74:1 75:11	104:12 127:16	137:21 138:23	58:20 73:15
occasion 54:23	80:2,14,22	136:23 142:16	144:19 148:13	78:8 150:10
occasions 33:10	81:15 82:13	Oregon 4:20	149:13,15	overall 41:6,11
33:12 79:21	87:23 92:23	organic 39:14	151:18	73:19 74:4
102:20	93:18 101:1	134:21	others 14:21	77:12
occur 66:10	102:9,22 103:5	organism 14:17	39:1 69:2	overestimate
94:21 96:5,9	103:6,12,17,22	14:18 39:17,17	70:12 96:6	76:1 77:1
100:2 107:23				
121:3 132:1				

overflows 21:10 22:2	117:17,20 123:17,18,20	123:15,17 124:1,2 125:13	135:14 147:20	42:11,12 46:13
over-estimate 91:13	123:22 130:3 139:7 149:6	125:20 126:4 127:1 129:19	percentage 18:11 75:17 87:16 96:4 114:20	46:19 47:7,9 49:18 61:14 72:3 77:22 86:8,8 111:11 123:9 129:13
own 22:19 32:9 35:1 56:2,3 96:22	particularly 5:19 50:13 130:14 132:16	129:22,24 130:1,12,16,17 131:12,16,21 132:4,14 133:1 133:12,18 134:19 135:2 135:21 137:17 145:23 146:11	percentages 127:9,19	plants 22:4 42:3 46:17,24 50:21 50:23 55:13 60:20 73:1,6 74:13,23 128:20 134:5
oxygen 134:20	parts 1:11 54:13 121:6	pathway 82:2 152:19	perhaps 43:13 71:17	please 89:19 136:10
o'clock 1:16 153:11	patch 46:14 path 65:20 100:4	pay 26:5 58:15 PCR 28:9 29:23 31:3,24 37:1,3 37:3	period 17:5 95:10	plenty 19:13 point 8:1,11,16 9:6 11:7 15:14 15:14,15 17:3 18:14 22:18 25:16,16 31:9 32:6 35:12,14 37:19 38:11,12 38:13 42:23 47:17 48:3,5 59:23 60:17 67:16 75:13,19 76:3,21 80:14 82:17 83:10 96:7,21 97:16 99:14 118:13 118:17,24 119:10 123:23 126:2 134:8 137:22 138:23 140:5 146:7 150:21
P	pathogen 36:11 38:18 41:6,13 61:12 70:17,20 90:13 102:23 123:20,22 131:19 132:16 147:11	PDF 4:24 peer 148:6 people 4:10 21:21,21 25:1 25:8 51:5 69:8 70:22,24 71:5 71:16 73:16 75:12,13 76:7 76:10 77:2,13 78:19 93:7 106:19 107:5 111:9 113:4 140:6 142:17 142:22 144:18 148:8,15 150:13	person 77:16 80:21 101:17 101:17 110:8 125:17 146:12 146:13	pointed 26:12 59:6,12 80:21
P 2:1,1 3:6 117:1	pathogenic 89:18 112:23 113:2,12,16,18 132:7	Pepcid 139:21 per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	personally 19:1 23:14	points 17:4 47:17 56:8 83:5 94:18
paddlers 142:12 143:13	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	percent 8:10 10:20 11:13,19 15:10 16:6 21:7 45:1,3,21 60:2 86:12,13 87:13,18,21,24 88:2 92:22 93:2 94:9 114:14,18,21 127:4,4 135:14	perspective 143:23 144:15	polio 68:24,24 140:24 =
page 44:9 61:19 65:11,12 119:11 129:18 133:22 134:3 139:19 151:4	pathogenic 89:18 112:23 113:2,12,16,18 132:7	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	Perspectives 151:6	polio's 109:14 109:14
pages 60:16	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	percent 8:10 10:20 11:13,19 15:10 16:6 21:7 45:1,3,21 60:2 86:12,13 87:13,18,21,24 88:2 92:22 93:2 94:9 114:14,18,21 127:4,4 135:14	Pertropolis 64:14	POLLUTION 1:1,15 2:3
paper 35:2 137:8,12 138:3 139:17 141:12	pathogenic 89:18 112:23 113:2,12,16,18 132:7	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	phonetic 40:5	
papers 87:8	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	phosphorous 134:22	
paragraph 66:2 66:3 134:4 138:8	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	physical 136:7 physically 39:6 physician 71:22	
parameter 29:19 80:4,5	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	physiological 137:18	
parameters 67:14 68:9 79:6 80:7,11 80:13 81:20,22 83:20 108:11	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	physiology 141:17	
parasites 39:12	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	picks 58:8	
part 7:2 14:6 16:1 20:12 56:10 91:17 118:13 121:11 135:16	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	piece 7:11	
particle 15:7,9 15:12 38:24 87:24 92:21,24 102:18 103:8	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	pieces 12:8	
particles 15:18	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	pile 67:10	
particular 66:16 68:20 69:9 70:19 74:1 89:6 115:3	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	pinpoint 96:11	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	pizza 153:15	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	place 13:12 130:6 133:8	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	places 45:22 55:6 67:19	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	Plaines 1:9 155:6	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	Plan 65:20	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	planning 142:6	
	pathogens 20:19 21:16 22:7,20 22:23 24:5 25:11 27:18,21 27:23 39:22 41:15,17,19,23 42:2 43:3,8 51:4,7,11,12 51:16,22 52:7 52:10,14,20 59:17 61:8,12 61:15 66:6 69:10 70:3 77:21 78:9,11 78:18,19 79:5 79:13 84:1 85:16,17,22,24 87:9,20 89:16 89:22 90:12,15 90:20 91:18,21 92:4 94:9 97:15 98:8 103:5 105:17 111:23 115:23 117:15 118:9 118:11 123:8	per 41:4 46:2 47:14 52:12 105:4 106:6 122:19 123:6	plant 21:15	

pool 97:6 118:20	62:16	99:23,24 111:3	110:19,22	publication
pools 95:24	preclude 119:19	129:20 130:5,8	127:10	114:9,11
149:2 150:15	precursor 66:11	134:16	pronouncing	148:21,23
150:18	predispose	primates 39:4	149:4	publicly 102:21
population	141:20	prior 27:6 55:3	propensity	published 35:2
67:13 68:15	predisposed	55:5 67:4	121:8	87:3 102:21
97:7 112:5	140:7	probabilistic	proper 119:14	141:11 148:6
114:15,16,18	predisposes	16:13 17:1	proportion 11:3	151:5
114:21 116:17	139:22	probability 13:8	45:18 147:12	purpose 31:6,15
populations	predominant	14:4,5,16 15:5	proposed 1:10	31:17 38:3
67:14,17 68:10	95:22	15:8 88:1	63:20,23	152:17
114:1,5,7	prefer 4:10	92:22 93:2	122:19	purposes 6:21
117:21,24	preferred 66:4	103:4 137:14	proposes 65:20	12:4,20 13:2
136:13	premature	137:20 139:23	protect 23:20	18:3 152:14
portion 11:5	141:2	probably 36:12	25:6	put 7:3 21:24
14:16 30:5,6,8	prepared 66:15	42:20 60:23	protecting 57:22	25:4 28:9
33:4,23 67:22	presence 17:14	94:24 109:14	protection 2:9	44:13 77:21
75:16	21:8 28:11	problem 55:19	25:14 56:5	88:10 103:3
portions 12:10	39:15 69:13	102:10 104:23	60:9 110:19,21	115:23,24
37:21	89:15 113:14	problems 26:21	115:14 148:22	125:11 130:8
position 27:3	present 4:9 5:2	procedure 36:13	protective 52:22	puts 120:3
positive 23:12	6:1 13:13 15:2	proceeding	protocol 20:15	putting 19:4
28:10 29:23,24	19:11,15 24:4	61:22 62:1	protocols 20:2,9	22:20 51:5
30:23 31:4,21	26:18 27:19	63:21 66:9,17	protozoa 123:1	57:23 92:7
31:24 32:11	39:15 42:17,17	proceedings	provide 38:17	120:6 123:9
33:5,6 34:9	59:8,14 80:16	1:14 88:8	60:5 86:14	p.m 1:16
35:22 37:2	84:19 93:10,16	155:7,12	89:20 116:4	
possible 5:24	93:20 94:4	process 6:23 9:3	136:10 144:23	Q
28:18 145:9	108:21 113:17	12:4,6 31:3	provided 21:5	QAC's 34:8
possibly 59:8	133:12,18	37:12 86:6,7	60:19 62:23	QRAM 65:22
120:16	143:19 150:18	124:3 131:8,9	67:13 91:20	qualitatively
postulate 122:21	presented 27:2	131:14,23	113:9	82:7
potency 101:23	56:8 63:10,14	processed 11:4	provides 40:6	quality 1:5
potent 101:24	113:10	processes	province 55:2	46:21 59:3
102:3	Press 87:3	110:14,24	proximity 72:15	quantifications
potential 19:10	pressure 98:22	127:14 128:4	72:18 73:6	66:10
81:16	98:23	129:12,20	prudent 36:23	quantifying
potentially	presumably	133:3,3 134:17	public 5:3 15:13	66:5 112:14,17
121:19	123:24	produce 84:12	17:13 19:3	quantitative
practicality	Presuming	84:21	22:24 23:13,19	41:2 65:21
97:22	43:13	produced 7:8	23:20 24:12	66:18 112:17
practice 19:4	pretty 43:10	producing 84:1	25:14,17,19	116:5 121:5,7
54:10 55:10	122:7 153:15	professional	51:7 52:15	121:12
108:4	previous 120:10	96:23	53:7 57:22,24	quantitatively
practiced 55:6	primarily 57:13	professor 13:22	66:23 70:23	127:3
108:3	60:23 95:7	projections	71:14,15 78:12	quantities 151:8
practices 111:12	primary 56:19	144:13	93:1 122:6,8	question 4:4 6:4
Prairie 2:18	56:22 66:9	promoting 25:8	122:12,13	15:23 20:14
precise 47:11	68:16 82:20	promulgated	126:14	25:8 28:2
				34:13,18 36:6

38:6 40:20	113:24	57:11 70:24	reduce 19:16	63:9 64:16
43:17 49:16	rates 102:14	recommendati...	22:21,24 25:19	65:4 74:17
51:16,20 53:3	rather 74:6	71:9	41:5 43:3	112:22,24
54:3,4,7,13,17	134:15	recommended	51:15,22 52:1	138:14 145:5
56:16 58:20	ratio 115:7	57:6,9,14	52:14 53:7,18	refers 12:1
61:3,3,17 67:8	raw 85:4	record 22:6 38:8	53:19 58:1,15	reflects 80:7
68:8 71:23	read 16:21	62:22,24 63:5	78:11,17,18	regarding 43:22
72:22 79:4	50:16 52:2	63:8 64:7	94:10 124:12	64:7 67:3
81:3 83:1	57:2,2 65:8	71:10 88:10	124:13,24	91:15 113:11
89:14 90:1	89:9 107:20	153:18	125:7,8 126:16	114:7
91:17 92:9	138:4 139:17	records 35:23	128:14 132:14	regardless 31:19
101:1 102:13	140:21 152:5	recreate 24:7,21	132:16 134:19	Region 56:6
104:20 112:1	readily 103:17	71:1 77:13	135:1	88:18
113:21 122:16	105:11	107:6	reduced 41:13	regrowth 38:19
126:8 129:16	reading 147:23	recreated	52:7 63:6	39:23 40:8,14
130:11 131:6	ready 89:12	146:13	105:9,16 125:3	50:1,3
132:22 135:17	Realize 94:16	recreating 4:20	129:19 130:16	regulate 58:2
135:22 136:3	really 44:8 45:9	25:3 51:6	139:20	regulation 71:13
143:11 144:4	48:7 49:21	73:17,20 75:12	reduces 41:15	regulatory
148:13,16	71:20 74:6	75:14 76:10	41:16,16	53:11,14 57:12
152:24	76:2 77:18	77:3,17,20,24	reducing 23:12	reinfected 70:1
questioning	80:9 94:19	78:19 112:5	58:7 61:12	reiterate 96:7
136:15 153:10	96:19 101:8	113:4 118:11	78:11 111:13	relate 81:21
questions 6:5	103:2 105:15	118:15 119:2	111:16 123:14	related 18:14
19:20 20:4	114:6 127:5	120:17 122:5	125:19,20	138:12
36:20 50:6	128:21 129:5	124:5 145:17	126:7,11,15,19	relates 80:12
53:23 54:1	129:13 130:13	146:18 148:8	126:20 130:11	129:16
80:2 142:1	140:3	148:15	135:21	relation 135:20
quick 55:16	reason 7:18 45:2	recreation 19:6	reduction 23:17	relative 17:8
quite 91:23	60:1 113:15	57:21 73:11	24:18 25:23	50:22 90:9
101:20 103:19	122:10 132:21	74:15,20 95:12	52:11 123:16	122:6
151:12	140:15	95:20 114:2	125:6 129:23	relatively 89:17
quote 60:6 127:8	reasonable	116:8 117:18	131:19,24	90:5,9 110:13
134:8	62:14	recreational	134:14,16	110:17
quoted 131:2	reasons 12:15	48:21 52:23	138:17	relevant 21:20
quotes 54:8	65:5 105:19	53:1 59:2,10	reference 92:15	66:22
	recall 48:1 87:11	59:24 72:2	133:24 134:1,7	relying 133:6
	100:17 101:8	73:4 76:14,18	134:9 137:12	remainder 10:1
R	116:12 147:23	76:23 82:20	141:14 149:16	11:3
R 2:1	receive 139:7	95:23 96:18	referenced	remaining 52:18
Rachel 60:10	receiving 108:7	106:9 107:11	64:19 87:1	52:21 125:15
racking 63:16	recklessly 25:5	118:7 119:9	141:12,15,17	remains 7:5
rain 21:23 76:8	reclaimed 99:2	145:13 147:13	references	remember 9:21
76:14 77:3	132:18	151:14 152:1,6	116:11 130:21	10:23 48:22
raining 76:19	recognition	152:10,12,14	134:11	51:20 68:22
rains 21:17	132:24	152:24	referred 132:22	74:7,18 75:6
rainy 76:7	recognize 97:11	recreator 78:5	referring 9:6	87:7,12 103:10
raised 28:4 80:3	recollect 122:3	recreators 24:20	10:5 60:22	104:11 138:8
range 17:4	recommendati...	27:12 113:20	61:4 62:5,6	149:11,12,23
RAO 2:6				
rate 39:10 68:2				

remind 72:23	represent 49:12 75:22 88:16	101:4 121:3,11 140:23 141:3	10:4,7 16:11 16:19 17:13	152:18		
removal 85:12 85:16,21,24 87:9,13 88:2 94:9 110:13 111:3 123:20 123:22,24 129:8,10 131:12,15,16 135:5,14	representative 8:19	responses 81:3	19:3 20:8 21:7 21:20,21 22:24 23:6,7,13,17 24:12,16,17 25:18,19,23 26:4,6,9,15,17 26:18 27:12,24 28:24 32:11 34:15 44:6 50:16 51:8 52:15 53:7,17 53:20,20 57:24 58:1,7,13,15 61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	responsibility 23:3	21:20,21 22:24 23:6,7,13,17 24:12,16,17 25:18,19,23 26:4,6,9,15,17 26:18 27:12,24 28:24 32:11 34:15 44:6 50:16 51:8 52:15 53:7,17 53:20,20 57:24 58:1,7,13,15 61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	26:18 34:21 44:8 61:12 66:6 75:7 77:20 82:17 115:19 122:5,6 122:8,14,15 133:14 147:4 148:2
removals 128:19	reproduce 39:2	result 24:11 33:7 52:11 70:16 95:14 103:7 104:10 104:15 105:8 116:7 118:6 119:6,8,8 121:9 123:17 127:14 131:13 145:23,24	28:24 32:11 34:15 44:6 50:16 51:8 52:15 53:7,17 53:20,20 57:24 58:1,7,13,15 61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	risks 19:10		
remove 87:21 94:3,6 97:24 110:24 111:10	required 52:4 55:1	resulted 32:4	50:16 51:8 52:15 53:7,17 53:20,20 57:24 58:1,7,13,15 61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	river 1:9 44:15 44:19,20,23 45:3,5,12,12 45:14,15,18 49:16 72:9 88:24,24		
removed 7:7 85:8	require 27:5 55:14	resulting 59:8 63:1 146:9	58:1,7,13,15 61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	rivers 2:18 44:11,21 60:3 60:3		
removing 132:12	requirements 62:4 133:10	results 8:16 10:4 17:24 24:16 28:7 29:10,14 30:23 32:3 34:9 35:7 37:17,18 42:4 56:3 145:9,11 146:11	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	role 53:16,21 58:11,12		
renders 17:9	requires 110:23 136:11	review 5:12 63:24 65:1 148:6	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	room 104:9		
repair 39:23 40:8 49:24	research 98:16	reviewed 40:4 62:21 64:6,8 64:12,23	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	Room-9-40 1:17		
repeat 47:2	reserve 141:23	revised 59:2	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	Rose 114:9 116:20		
repeated 70:13	reservoir 152:21	right 29:7 31:15 32:5,15 34:2,2 39:24 42:9 46:17 47:22 50:1,14 51:11 57:5 65:17 69:10 72:8 73:2 85:11 88:14,22 92:24 94:6 102:6 109:19 138:3 141:8,24 144:7	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	rotavirus 101:14 102:18 103:8 103:13 104:6 104:11,15 141:4		
rephrase 40:23 122:17	residual 42:16 43:5,12,24	risk 6:9,10,14,16 6:21 7:1 9:2	61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	rotaviruses 101:11,22		
replicate 84:16	resistant 97:16 110:13,17 124:10 126:23 126:24 129:10		61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	route 80:19 82:1 82:15 83:14		
report 1:14 4:13 4:15 9:11 15:4 21:4 28:3,6 50:17 58:24 59:6,13 60:17 61:18 65:10,17 97:2 117:12 135:5 144:9 147:6 148:3 152:4,5	respect 26:17 54:19 55:22 102:16 103:9 118:16 127:13		61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	routine 69:18		
reportable 146:3	respiratory 80:5 80:11,15,19 81:7,16,20 82:3,14 83:7 83:11 84:9,12 84:15,20,21 85:4 146:1		61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	rowers 142:12 151:9		
reported 10:3 11:24 14:20 15:11 79:12 92:6 96:2,4,7 145:15 155:7	responded 81:2		61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	rule 56:23 64:2 110:23 127:11		
reporter 103:21 155:5	response 67:11 67:13,22 68:4 68:9,12,18 79:4,6,11,15 79:16,18,20,22 79:24 80:4,5,7 80:10,13 81:4 81:8,19,22 83:20 92:15		61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	running 146:4,6 R08-9 1:9		
reports 30:19 40:6 107:20,21 117:17 141:23 142:2			61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	<hr/> S <hr/>		
			61:20,24 62:3 62:11,17 63:1 65:21 66:19,20 67:10,18,19,22 73:14,16,19,23 74:3,4,8,19 75:3,5 76:1,13 77:1,12,19,23 78:3,3,12 79:7 79:8,10,12 80:18 81:6 82:6,8 83:15 85:3 91:13 93:2 108:16 112:4,9,10,14 112:16,17,18 112:21 113:3,8 113:9,19 114:7 115:19 116:6 116:18,23 118:1,5,14,18 119:1,10 120:4 120:14,19,23 121:5,7,12 124:4,14 125:8 125:15,18,20 125:22 126:2,5 126:11 132:19 142:16,18,23 143:22 144:10 144:14,22 145:3 146:21 146:22 147:1,2 147:3,6 151:13	S 2:1 safe 24:6,21 25:13 53:1,3,9 53:11		

safer 126:14	49:2,5,11 75:2	section 139:18	seven 45:3	82:3,8 83:2
safety 53:4,6	75:21 92:3	security 24:20	several 26:23	85:16 86:1
59:10	sampling 6:8	see 48:13 60:11	51:3 78:7	87:9,12,13,16
Sag 47:5	7:23,24 18:4	131:3 133:24	108:17,18,22	87:18 88:2
sake 13:18	20:1 22:19	147:9	127:7	93:1 109:24
salmonella	42:5 50:2 56:2	seeing 21:3	severe 103:15	122:9 126:8
79:16 91:8	56:3,17 72:12	60:13 116:22	104:1 121:24	significantly
105:1,5,17	72:13 77:9	117:3 126:8	136:11 146:6	46:23 127:21
same 33:4 35:8	88:17 90:18	seem 54:21 81:9	severity 67:24	signs 146:14
37:20 61:18,21	92:8	seemed 135:6,10	103:11 115:2	similar 83:20
62:8 76:23	sanitary 47:5	seems 19:7 23:2	138:9,11	141:3
86:6 101:4	119:14	118:18	sewage 22:2	simple 19:18
136:12 137:15	saying 8:22 17:6	seen 5:16,20	80:17 84:19	23:21
137:16,21	17:11 34:22	42:4 63:5,13	85:3,5,6 94:14	simply 30:15
139:3 140:11	37:9 46:22	63:22 64:5	108:7,22	97:4 102:8
140:12 150:11	47:3 48:19	91:14 128:3,22	sewer 21:10	107:6
sample 7:3,8,10	52:16 53:17	141:23 145:8	22:1	since 5:8,8,15
7:11,13,14,19	54:8 74:1 78:4	145:10	sewers 23:7,24	6:13,16 21:21
7:21 8:2,3,7,10	78:6 81:12	selected 67:12	24:1,22 25:11	50:20 73:13
8:12,13,14,16	95:4 117:23	send 13:5 36:8	shed 84:18	81:17 105:24
8:17,18,20,23	122:24 141:10	37:7	shigella 106:4,7	108:3 141:22
9:4,14,16,17	says 20:15 31:16	Senior 2:6	107:11,16	143:24
9:18,19,20	34:10 94:12	sense 24:19 41:2	Ship 47:6	single 15:6,12
10:10,16,20,22	134:4 139:20	71:15 96:22	Shistosoma 6:1	41:13 92:21
11:8,13,22	140:1	99:22 113:7	Shivan 151:3,4	102:18,23
12:5,11,14,21	scenario 127:12	126:14 127:2	Shore 47:10	103:5,7 137:2
13:7,9,13,20	scenarios 120:15	sensitive 67:17	55:23	144:21,22
14:6,16 15:16	schistosoma	67:20 68:1,3,5	shortcomings	sir 7:17 11:16,16
15:22 16:1,16	4:22 5:9,18,21	68:10,15 69:21	73:23	20:10 33:9
16:17,23 17:1	school 101:20	113:24 114:5,7	shorthand 155:5	59:4 81:15
17:7,23 20:5,6	Science 65:20	114:16,19,22	155:7,10	82:24
20:13,16 28:19	117:1,7	115:4,8 116:17	show 9:1 35:24	site 97:5 152:22
29:13,18,23	scientific 58:24	117:24 121:17	98:5	sitting 56:24
30:1,6,7,8,16	89:20	121:20,24	showed 33:13	situation 45:1
30:18,21 31:4	Scientist 2:6	136:13	118:4	102:9 115:10
31:7,11,24	season 48:21	sensitivity 69:6	showing 42:2	145:22
32:2,16,17,20	seat 25:4,6	69:13 117:20	98:12	situations 40:7
33:4,14,15,20	second 66:1	sent 9:15,20	shown 7:4 27:14	69:22 115:1
33:23 35:14,21	135:16 139:19	10:22 13:16	30:19 32:9	133:16
48:19	secondary 22:3	30:7,21 32:21	33:5,16 89:17	size 7:13 44:23
samples 6:20	23:8 57:6,15	sentence 86:22	95:12 119:21	sizes 6:20
10:18 14:10	57:20 85:3,5	133:23 134:7	SHUNDAR 2:7	skip 50:5 53:22
15:24 16:10	85:13,17,22,24	139:17,20,24	Sierra 2:19	56:15 67:7
17:1,6,15,19	86:5,7 87:10	separate 32:17	significance	skipping 58:19
17:21 20:18	117:18 129:20	81:1 121:3	92:1	small 6:20 8:6
26:23 28:8	130:6,9 134:16	service 110:23	significant	8:12,14,17,17
32:7 37:1,21	135:6 148:2	session 4:3	14:13,19 15:3	8:22 9:7 10:15
37:23 48:3,10	secretions	set 73:3,20 99:17	25:10 45:8	11:3 16:5,5
48:14,20,24	138:18 139:21	sets 33:8	49:20 52:5	17:7,20 23:16

24:18 25:22	somewhere	107:17,22	staff 64:20,23	statistics 104:7
26:22 32:19	10:13 11:2	110:24 113:11	stages 115:21	status 69:7
smaller 7:10,13	SOP 34:5,13	113:12 114:6	120:3	119:24
33:22 54:11	sorry 14:24	124:16 127:8	stagnation 42:24	Stefanie 2:10
sneeze 93:7	19:23 47:2,24	130:1,2,17	stand 38:9 66:12	step 24:13
some 4:7,8 6:8	48:7,12 58:21	131:6 133:23	standard 20:18	111:13 134:17
8:5 20:19	64:18 65:11	135:23 136:24	36:13 52:8,13	134:24
26:15 27:1,18	66:2 76:3 93:8	139:15	54:9 56:20,22	steps 134:20
30:8 32:19	112:7 131:3	specifically 9:7	57:20 86:18,24	still 17:7 23:9
39:22 40:1,6	134:2 136:4	10:6 26:13	97:17 98:5	24:22 25:9
40:24 41:23	148:12,19	34:16,20 36:10	105:13 112:15	51:12 82:4
43:1 44:17	sorts 77:14	38:1 40:6	122:19 124:17	87:21 115:21
49:4 58:19	sound 38:3	52:10 63:9	125:5 132:13	120:3 128:5
68:23 73:22	sounds 5:6	85:9,12 92:5	133:7	136:11 148:12
74:3 84:10,20	73:24 101:23	94:22 98:11	standards 1:5	stomach 138:17
84:22 85:19,20	124:10 129:7	104:10 106:8	119:15	139:21 141:18
85:23 91:21	source 21:15	106:14 110:3	start 4:5 88:9	stop 78:15
92:15,17	25:17,20 55:21	114:5 116:3	113:7 154:2	137:23 150:4
108:20 111:19	61:15 88:11	118:3 128:7	started 65:3	stopped 133:6
112:2 115:18	96:11 100:3,5	129:4,21	starting 65:12	store 152:22
122:24 123:24	117:8 130:20	130:18 134:18	state 43:21 62:9	stories 105:8
125:12 126:15	146:15,17	134:18,24	129:17 155:1	storms 77:3
131:18 132:11	152:23	140:20 141:18	stated 51:3	stream 38:19,22
132:24 133:2	sources 21:9	150:7	53:10,15 56:16	127:22
134:14 135:21	25:12 42:9,20	specifics 35:11	61:18 81:5,19	strongly 122:8
139:8,9 140:12	43:8 49:20,22	86:20	90:18 102:20	studied 127:1
140:13,16,18	50:12,16,24	specify 102:4	107:10 114:17	studies 65:22,24
142:1,17,24	52:22 59:23	speculate 25:1	122:7 124:9	66:7,8,12,12
143:23 144:2	60:18 61:4,8	45:6 71:21	statement 54:17	68:13,21,23
144:13,15	71:19 94:22	80:10 82:16	60:1,16 64:1	69:1,17 70:6,9
145:2 149:16	95:1,13,20,21	83:21	65:2,5,19 77:7	83:22 85:15
150:21	123:10	speculation	89:14 90:11	98:3,5,10
somebody 58:11	sourcing 133:23	140:4	130:19 134:10	116:4,10 118:4
146:3	so-called 83:16	spending 83:2	136:6 138:1,5	118:19 124:18
somehow 28:6	speak 44:8 52:9	125:10	138:16 140:22	127:7 128:18
someone 19:1	53:5 54:24	spent 91:23	statements	128:20,22
26:3 53:16,21	110:3 128:21	153:3	65:10 67:9,16	131:10,20
125:21 144:4	153:19	spike 131:10	states 4:18 5:13	132:7,11,21,22
149:9	speaking 53:13	spiked 131:20	31:14 48:12,14	133:17 136:21
something 13:13	65:13 68:21	split 12:8 32:20	48:24 55:6	138:5 139:1,1
24:10 25:18	70:8 88:20	35:15 37:23	56:4 60:8	139:5 140:1,10
57:23 58:1,10	98:20,24	splitting 33:21	100:13,14	140:24 142:15
78:6 82:5	110:14	spoke 130:10	105:9 107:24	144:11,17
86:13 87:23	speaks 62:16	132:10	114:15 115:13	146:24 148:6
97:6 112:10	special 39:3	spoken 129:17	115:15 120:1	148:14,24
125:14 146:2	specific 36:1	142:9	station 46:21	149:2,8,10,13
sometimes 59:7	71:9 73:10	spread 84:22	47:12	149:15,16
somewhat 45:16	76:9,21 86:5	SS 155:1	stations 46:15	150:6 151:8,20
77:1,2	96:20 106:1	SS-34 4:16	72:12,14	study 15:11

20:20 21:4	sure 10:17 32:21	T 60:11	140:20	testimony 26:13
42:6 68:19	40:3 43:10	table 6:22 10:6,8	talks 117:17	26:24 27:11
82:13 85:10	48:18 51:18	28:3,8 30:20	147:6 152:5	35:2 36:1
108:24 109:3	61:16 64:15,17	31:16 89:22	technical 56:21	37:24 38:8
119:12 127:6	65:7,16 69:1	90:13,20 94:11	technique 32:9	40:5,18 44:10
135:5 138:22	74:16 76:2	97:15 108:19	135:24	52:2 62:16
142:18 143:2,2	86:16 90:8	108:23 124:9	technologies	64:2,5,9,13,23
143:23 144:12	102:2 112:2,23	124:16 147:12	123:13 124:20	67:9 87:1,4
144:21 145:6	130:23 134:1	147:15	technology 41:3	97:21 114:17
149:20 150:10	148:12 153:23	tables 147:9,17	124:17	124:11 126:20
150:21,24	surface 110:19	take 4:2 8:4,6	tell 6:23 52:13	130:21 132:10
151:2	127:11	12:6,14,18	71:16 85:10	134:3 149:15
stuff 12:12	Surveillance	14:2 18:2	90:14 100:14	151:3
sub 8:13	4:17	33:20 36:24	100:16 105:14	testing 31:7
subject 17:18	survey 55:12	58:12 67:20	127:18	32:15
subjects 139:2	surveyed 60:3	76:13,17 83:15	telling 34:3,11	tests 35:8
141:2	susceptibilities	88:4 111:6	105:16	textbook 86:24
subparagraph	139:13	130:19 135:4	temperature	textbooks 86:18
122:17	susceptible	151:7	39:13	thank 48:8 65:6
subparts 54:7	136:17,19	taken 7:3,14 8:2	ten 9:13,17,22	87:17 108:9
subpopulations	swallow 148:15	9:19 17:8	10:1,19,20,21	117:10 154:1,4
67:21 68:1,3,5	swallowed	24:13 47:18	11:4 78:24	their 9:15 55:2
115:4,8,10	142:11,21	48:5,10,14,20	102:11	56:3 64:19
121:18,20	148:8 151:9	49:1,12 67:17	tend 73:15 75:5	87:8 107:7
122:1	sweeping 41:11	75:3,7,21 88:6	76:1,24 91:13	115:24,24
subsample	swim 21:21	92:8 138:17	tends 103:18	116:1 119:24
13:16	swimming 18:6	155:11	tens 104:14	120:1,7,7
subsection 134:4	18:12 60:5	takes 132:5	tenth 8:9 16:6	128:16 134:6
subsequently	106:16,18,24	taking 7:11	term 136:15	141:18,19
4:10 5:4	117:16 118:8	12:10 16:8	terms 18:5 25:10	146:5
substantial 22:7	118:21,22	17:2,4 71:5,16	25:11 40:9,18	themselves
104:22	119:3,6,16,17	134:20	40:20 44:21	113:19
success 105:7	120:6 148:9	talk 13:23	48:4,4 51:9	thing 12:20
successful	149:2,6 150:14	118:19 135:9	61:11 70:21	23:15 25:21
105:23	150:15,18	talked 6:5,19	91:10 97:22	36:23 74:5
suffer 115:17	151:22	18:5 26:16,21	101:23,24	83:10 84:14
Suffice 107:23	symptomatic	27:13,15 73:22	106:4 118:17	137:21 144:4,5
sufficient 92:21	99:20	133:15	129:8,9 144:10	things 26:23
99:13 102:18	symptoms 96:13	talking 11:18	test 28:10 31:20	33:23 59:12
102:23	146:24	14:8,11,12	32:14 35:4	67:6 75:11
suggest 140:6	system 1:8 73:8	33:19 43:16	36:1,3,7,9	83:9 103:18
suggested	75:18 105:20	44:24 46:1,3,4	41:20	111:1 115:24
119:15	128:16 130:3	47:6 57:10,11	tested 30:15,18	117:19 120:6
Suite 2:14 3:3	130:15	75:11 77:16	37:10	134:20,22
sunlight 39:13	systems 97:21	82:11 95:7	testified 35:13	144:8 145:24
supply 107:7	108:3 111:6	102:10 103:11	37:9,13 71:8	think 6:7 10:16
support 22:7	115:21 120:2	107:9,13	149:10	22:9 25:12
97:13	128:7 129:7	120:18 122:18	testify 36:19	26:14 38:9,10
supposed 79:1		130:5 135:11	126:18	38:11 50:6
	T			

55:18 61:5	27:14,14 91:24	83:17 101:16	22:8,10 33:8	under-reported
62:13 75:9,10	101:20,21	101:17 118:2	35:8,10,16	96:10,17
76:4 78:1	127:1 146:7	treat 121:4	70:10 72:8,18	145:20
80:24 90:6	times 51:3 56:19	128:1,1,6	74:24 81:1	unequal 74:24
91:23 109:17	56:21 57:3	treated 22:3	84:4 94:24	unexposure
112:1 113:3,22	59:13 60:18	28:17 89:16	105:3,6 116:4	70:13
126:19 129:16	61:13 78:7	90:3 95:24	116:10 118:4	unfortunately
132:23 135:13	94:8 113:14	96:5,17 97:3	144:8	153:11
144:9 147:6	133:11	97:11 100:15	type 36:11 41:7	uninfectivity
thinking 25:1	timing 97:22	100:18 101:7	41:13 43:1	81:7
57:1	tiny 15:15 16:9,9	108:7 120:23	86:5,6 141:7	United 5:13 55:5
third 104:3	16:15 17:21	121:18	151:14	56:4 60:8
THOMAS 2:5	TIPSORD 2:4	treating 99:11	types 35:5 83:5	100:13 105:9
Thompson 1:16	4:1,11 5:5 6:12	treatment 21:14	98:11,13,19	107:24 114:15
THORNBURG	20:11,21 38:7	22:3,4 23:1,13	99:1,4,15	115:13
3:2	54:4 60:7	42:3,11,12	125:24 133:9	University 13:6
thorough 19:9	78:23 88:3	46:12,17,19,24	134:22 141:1	13:17 30:21
though 13:10	89:11 116:14	47:7,9 49:18	147:13	31:11
24:22 28:13,17	116:16 117:10	50:20,23 55:13	typhoid 105:2,7	unless 36:10
110:10 119:14	153:8,19 154:1	60:20 61:14	105:10,19	37:5 128:17
124:8 125:2	title 152:7	72:3,24 73:6	typical 105:12	146:5
thought 36:5,6	today 90:7	74:12,23 77:22	typically 79:7	unrepresentat...
88:18	together 143:23	85:2,3,13,22		7:20
thousand	144:11	86:1,5,7 87:10	U	unrivaled
104:13	tomorrow 154:2	110:23,24	ultraviolet	153:15
thousands	top 47:24 100:8	111:6,11 123:9	111:15	unsafe 59:24
104:14	100:17	124:22 125:5	uncommon	60:18
three 47:13	topic 90:6	127:11,13	128:5	untreated 22:2
72:24 101:13	torrents 5:17	128:4,20 129:3	under 43:10	100:18 101:7
threshold 92:17	total 10:17 11:8	129:12,13,20	65:18 67:10	108:7
through 6:23	11:13 21:21	130:6 132:18	114:2 115:17	upstream 42:2
7:3 12:6 22:23	28:8 74:21	132:21 133:2,9	134:4	42:23 43:2,13
23:13 28:9	133:7 147:10	134:5,16	underestimated	73:9,12,18
32:19 42:24	totally 48:6	treatments	17:13	74:9,20 75:14
57:1 69:9	touched 40:24	126:1	understand 28:7	75:20
82:14 83:14,18	Tounes 14:20	tribunal 5:2	55:18 69:5	urban 44:11
83:18 84:22	toward 65:11	true 28:14 59:5	74:13 88:1	use 13:23 37:23
89:7 90:12	toxicologist 44:7	59:16 62:9	understanding	38:2 41:22
97:14 101:16	tract 84:17	68:11 70:2	6:24 7:16	43:12 53:8
101:17 107:2,3	93:12 141:19	84:23 110:20	28:20 29:2	54:22 74:9
111:10 118:2,8	traditional	135:18 155:9	30:6 43:19	76:15,18,23
118:10,15	37:23 110:13	truly 44:22	45:19,22 54:20	79:23 81:12
119:3,5 120:6	110:17 111:11	try 30:13 88:4	55:21 56:1	99:5,8,15
121:6 122:20	transcript 6:13	trying 38:4 47:7	57:18 74:11	128:8 131:17
124:2 126:10	155:10	53:8	75:15 102:17	132:5 136:15
132:13 135:6	transmission	twice 37:10	120:13 143:4	144:10 145:13
144:14	81:16,18	two 13:4,15 14:9	under-predict...	used 6:9 18:3
thumb 56:23	transmitted	14:12 15:21	133:14	31:13 36:16,17
time 12:18 17:5	81:20 83:12,13	18:14 20:3	under-recogni...	36:18 37:12,15

week 22:8	118:10 120:22	54:6 63:19	29:21 30:5,13	93:11,20 94:1
Weekly 4:15	121:14,18	65:4	30:17 31:10	94:7,16 95:5,9
weeks 21:19	122:9,13	willing 26:4,5	32:6,16 33:9	95:18 96:1,19
22:8 70:10	129:12 133:17	58:14,15	34:3 35:1,9,11	97:19 98:1,18
well 8:21 54:12	133:18 135:11	wireless 5:1	36:12,17,19	98:21,24 99:3
59:16 73:21	136:15 141:2	word 41:18	37:11 38:11,16	99:13,24 100:2
79:21 91:8,20	143:19 147:17	87:12	38:20 39:10	100:5,8,13,16
92:19 93:11	148:3 150:13	words 15:8 63:4	40:1,11,21	100:23 101:4
99:8 105:14	152:1,13	131:2	41:7 42:4,10	101:14 102:2,6
109:1 110:20	weren't 10:17	work 58:24	42:12 43:4,20	102:16 104:19
111:19 112:13	29:15 35:19	101:21 111:18	44:3,7,17,22	104:24 105:5
114:4 125:16	67:17 91:11	workshop 59:1	45:4,11 46:9	105:21 106:1,7
130:17 132:8	Western 54:14	59:13 66:4	46:11,18 47:2	106:11,13,15
132:23 139:4	55:9,13	world 54:14	47:9,19,23	106:17,22
143:15,18	wet 17:5 21:9	55:7 104:3	48:6,9,22 49:8	107:2,5,8,19
144:16 150:24	22:9 50:14,18	worst 127:12	49:21 50:2,10	108:5,17 109:5
153:6	50:21,24 60:22	wouldn't 22:12	50:15 51:2,14	109:10,19,22
well-known	61:4,8 71:24	22:14 45:5	51:19 52:9	110:2,16 111:8
96:9 145:19	75:4 76:6,23	73:15 75:24	53:10,15 54:18	111:20 112:21
went 26:20	77:10,19 78:2	95:9 120:11	55:12,20,24	113:5 114:4
32:18	we'll 58:5 60:12	129:5 132:15	56:24 57:17	117:5,22
were 4:4 6:20	88:4 89:13	137:5 144:16	58:10,21 59:4	118:24 119:21
10:18 11:11	153:17 154:2,3	144:22	59:11,21 60:10	120:18,21
13:4,9,15	we're 75:9	written 11:7	60:21 61:1,7	121:6,16
15:21 16:7	122:18 126:15	87:2 115:11	61:23 62:5,10	122:11 123:11
20:9,19 23:6	134:1	wrong 26:10	62:13,19 63:3	124:15 125:16
23:18,22 24:14	we've 6:5 7:9	34:12 41:1	63:12,16,22	126:24 127:5
27:3 28:9 29:5	19:13 20:17	52:17 112:3	64:4,8,12,22	127:23 128:17
29:9,11,14,16	26:15,21 27:13	wrote 11:2	65:7,13,16	129:2,11 130:4
29:16,19 30:2	27:15 32:1	W-A-C-H-U-...	66:13 67:1,15	130:18 131:5
30:23,24 31:18	40:24 50:6	116:24	68:11,18,22	132:23 133:19
32:7,8,10	58:19 61:9		69:11,16,22	134:2,13 135:8
33:10,11,13	73:21 78:23	X	70:4,7,15 71:3	135:12 136:1
34:12 35:19	97:21 105:14	X 135:13	71:20 72:22	136:14 137:24
36:3,10,22	105:16 109:17		73:2,10,21	138:2,7,13,21
37:1,19,20	112:7 113:13	Y	74:18 75:9	139:16 140:1,5
40:14 42:16,16	129:17 141:23	Yates 4:13 5:11	76:2,9,16,20	141:8,10,15
42:17 43:5	142:9	5:20 6:2,19	77:5,15 78:4	142:6,14 143:4
48:10,14,19	while 120:16	7:17,24 8:24	78:16 79:9	143:9,15
49:1,11 65:10	123:19 129:18	9:5 10:21	80:9 81:14	144:16 145:5,8
67:11,16 75:7	138:9	11:16,20,23	82:10,23 83:4	145:14 147:3,8
75:12,13,14,22	whole 12:19	12:13 14:14	83:21 84:3	147:22 148:4
79:6 85:15	16:22 20:13	15:1 16:3,14	85:9,20,23	148:11,18
88:8,17 89:6	31:9 38:3 74:5	17:11 18:8,13	86:4,16,24	149:14 150:4
91:16 92:9	75:23	18:24 19:22	87:11,15,19	150:16,22
96:24 106:19	widths 75:21	20:3,12 21:12	88:14,22 89:4	151:1,11,23
109:11,12,13	wild 109:24	22:18 23:11,18	89:7 90:10,17	152:8,20 153:5
109:13,21	Williams 2:11	24:8,24 25:15	91:14,20 92:11	153:11,14
116:10 118:8	42:22 53:24	26:1,12 27:13	92:19 93:6,8	year 105:4,7
		28:4,20 29:2,8		

106:6	1997 4:18,19	114:18,21	795-3707 2:16
years 5:8 19:14	1998 4:18	127:4 151:4,15	<hr/>
19:14,14 89:6	<hr/>	300 7:3,10,12,13	8
young 101:19	2	11:10,19,21	<hr/>
102:5 103:14	2 10:13 11:12	12:2,19,24	8 44:9 60:16
103:14,16,19	15:17 16:4	15:17 16:4	134:3
120:15	18:16 27:10	17:8,8 18:2,15	8.3 9:21 10:23
<hr/>	119:11	18:23	13:21 14:2,4
Z	2-3 6:10	300,000 106:5	<hr/>
zero 16:16 51:16	2.4 12:2	300-ish 10:10	9
51:23 92:13	20 13:10 86:12	301 1:12	<hr/>
Zivan 149:21	114:14,20	302 1:12	9 54:3,4,5,6,17
Zorus 135:7	127:3	303 1:12	60:16
<hr/>	20,000 46:1 47:1	304 1:12	90 86:13
0	47:6	312 2:16 3:5	99 87:13,18,21
0.56789 15:7	200 23:24	33 2:14	88:2 135:14
02 18:10	200-ish 10:10	35 1:11	
084-0003437	2000 4:15	357-1313 3:5	
155:17	2002 89:8	<hr/>	
<hr/>	2003 130:23	4	
1	134:7	40 60:2 84:7	
1 11:13 89:22	2004 115:15	400 5:24 41:4	
90:13,20 97:15	117:2 137:8,10	52:8,12 122:19	
1:15 1:16	2006 148:23	123:6 132:13	
10 10:24 13:5,8	151:5	41 84:7	
13:16,19,21,24	2008 21:1 35:4	4400 3:3	
14:1,4 86:12	2009 1:16	49 4:15	
89:14 99:19	23 10:13 94:12	<hr/>	
112:1 122:17	95:16	5	
10,000 27:20	24 141:15	5 1:15 56:6	
47:14 87:22	25 65:12 67:8	61:19 65:18	
100 17:15 94:9	114:17	88:18	
11 129:16,18	255 21:2,3	5:00 153:11	
133:22 134:10	256 60:13,14	50 15:10 21:7	
11A 135:17	257 116:21,22	87:24 92:22	
11B 136:5	258 117:2,4	93:2 139:12	
12 5:8 53:23	26 4:15 71:23	147:20	
136:3 141:4	29 79:4	500 150:10	
142:8	299.8 18:18,19	511 147:12,15	
125 17:6,15,19	<hr/>	5500 46:4	
1300 2:14	3	59 147:10	
14 56:16	3 16:8 28:3	<hr/>	
15 99:20	44:10 55:17	6	
18 10:13	88:12	<hr/>	
18B 58:21	3.5 30:20	60601 2:15	
18D 58:20	3.7 10:6	60606-2833 3:4	
19 115:17	3:00 79:1,2	<hr/>	
19,538 47:10	3:30 88:5	7	
1996 114:13,24	30 13:1,3,5,6,14	7.52 28:15,17	
116:19	18:6,18 86:12	70 45:1,21	
		71 6:14 10:7	