ORIGINAL

ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	R08-09
EFFLUENT LIMITATIONS FOR THE	)	(Rulemaking -
CHICAGO AREA WATERWAY SYSTEM	)	water.)
AND THE LOWER DES PLAINES	)	
RIVER: PROPOSED AMENDMENTS	)	
TO 35 Ill. Adm. Code Parts	)	
301, 302, 303, and 304	)	

TRANSCRIPT OF PROCEEDINGS had in the above-entitled cause before Hearing Officer Marie Tipsord, called by the Illinois Pollution Control Board, taken before MARGARET R. BEDDARD, a Notary Public within and for the County of Kane, State of Illinois, and a Certified Shorthand Reporter of said state, at Room N-505, 160 North LaSalle Street, Chicago, Illinois, on August 13, 2009, at 9:00 a.m.

PRESENT:

MS. MARIE TIPSORD, Hearing Officer
MR. THOMAS JOHNSON, Member
MR. ANAND RAO, Member
MR. G. TANNER GIRARD, Member
MR. GARY BLANKENSHIP, Member
MR. SHUNDAR LIN, Member

appeared on behalf of the Illinois Pollution Control Board;

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794
BY: MS. DEBORAH WILLIAMS and
MS. STEPHANIE DIERS

appeared on behalf of the Illinois Environmental Protection Agency;

MAYER, BROWN, LLP
71 South Wacker Drive
Chicago, Illinois 60606
BY: MR. THOMAS W. DIMOND

appeared on behalf of the Stepan Company;

HUNTON & WILLIAMS, LLP
1900 K Street, N.W.
Washington, D.C. 20006
BY: MS. SUSAN M. FRANZETTI

appeared on behalf of Midwest Generation.

REPORTED BY MARGARET R. BEDDARD, CSR.

I N D E X

ROBIN GARIBAY and CARL ADAMS	PAGE
By Illinois Environmental Protection Agency	11
By Midwest Generation	49

E X H I B I T S

EXHIBITS	MARKED FOR ID	RECEIVED
No. 318	8	
No. 319	8	
No. 320	9	
No. 321	10	
No. 322	10	

HEARING OFFICER TIPSORD: Good morning, everyone. My name is Marie Tipsord. I've been appointed by the Board to serve as hearing officer in this proceeding entitled 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 301, 302, 303, and 304. This is docket number R08-09.

With me today to my immediate left is Acting Chairman G. Tanner Girard, presiding board member. To his immediate left is Board Member Gary Blankenship. To the far left is Board Member Shundar Lin. And Board Member Andrea Moore will be joining us. To my far right is Board Member Thomas Johnson. To my immediate right is Anand Rao from our technical staff.

Yes, this is day 31 of hearings. We are continuing to hear testimony from members of the public, and today the purpose of the hearing is to hear the testimony from several witnesses. Those witnesses are Robin Garibay and Dr. Carl Adams testifying on behalf of Stepan Company. We'll also hear from Robert Albert from Exxon Mobil. We will begin with Ms. Garibay and Dr. Adams and then go to Mr. Albert.

The testimony will be marked as an exhibit and entered as if read. After marking the pre-filed testimony as an exhibit, we will then proceed to questions for the

testifiers. We will begin -- and this is solely based on the number of the questions filed -- with the IEPA, followed by Midwest Generation, then Environmental Law and Policy Center, and then finally the Metropolitan Water Reclamation District of Greater Chicago.

Anyone may ask a follow-up question, and you need not wait until your turn to ask questions. I do ask that you raise your hand and wait for me to acknowledge you. After I have acknowledged you, please state your name and whom you represent before you begin your questions. Please speak one at a time. If you speak over each other, the court reporter will not be able to get your questions on the record.

Please note that any questions asked by a board member or staff are intended to help build a complete record for the Board's decision and not to express any preconceived notion or bias.

Also, for those of you who will be with us tomorrow, we are back across the street in Room 9031 instead of here at the Bilandic Building.

With that, Dr. Girard?

ACTING CHAIRMAN GIRARD: Good morning. Welcome to hearing day 31 in this rulemaking. We look forward to your testimony and questions today. Thanks.

HEARING OFFICER TIPSORD: Thank you.

With that, would you like to introduce your witnesses and we'll swear them in?

MR. DIMOND: Sure.

My name is Tom Dimond. I'm an attorney from Mayor, Brown representing Stepan Company. With me today are Ms. Robin Garibay and Dr. Carl Adams of Environ Corporation who will be the testifying witnesses. Also, Jennifer Simon is here with me from my firm. And Dan Muno of Stepan Company is here as well. Although, he is not testifying.

HEARING OFFICER TIPSORD: With that, could we have the witnesses sworn in?

(WHEREUPON, the witnesses were duly sworn.)

HEARING OFFICER TIPSORD: We'll start with their testimony. We'll mark that as a pre-filed exhibit.

Were you going to do that as one exhibit or two? It read as if it was one. I didn't know if you wanted to try and separate them out.

MR. DIMOND: The combined report is a single -- is for both of them jointly, and they will testify jointly. Some of the questions that were asked will be natural for Ms. Garibay to respond. Others it will be natural for Dr. Adams to respond. They will simply handle the questions as they come.

HEARING OFFICER TIPSORD: With that, then we'll mark

it as one exhibit.

(WHEREUPON, a discussion was had off the record.)

HEARING OFFICER TIPSORD: All right. If there's no objection, we will mark the pre-filed testimony of Robin Garibay and Dr. Carl Adams as Exhibit No. 318.

MS. WILLIAMS: I don't have an objection.

I would just like to clarify, for the record. It looks like what you've been handed is the report. There was a filing that was titled pre-filed testimony as well.

HEARING OFFICER TIPSORD: Right. You're correct. What I have been handed does not include the introductory remarks, which is marked as the pre-filed testimony, but rather what was filed as Exhibit A when it was pre-filed, which is -- the introductory remarks were -- I took to be introductory remarks and that Exhibit A was the actual testimony.

MR. DIMOND: That is correct. The pre-filing is just introductory remarks of counsel summarizing what's in the report. The report itself, Exhibit A, is the testimony.

HEARING OFFICER TIPSORD: And thank you for that clarification, Ms. Williams. That would have gotten confusing later on, I'm sure. Thank you.

No objection? Then it's marked as Exhibit 318.

(WHEREUPON, said document was marked Exhibit No. 318, for identification, as of 08/13/2009.)

HEARING OFFICER TIPSORD: Go ahead, Mr. Dimond. Then you have some other exhibits?

MR. DIMOND: Thank you, Madam Hearing Officer.

I have four other exhibits that I would like to enter initially, and I've provided copies of these to counsel for Illinois EPA. The first is titled Stepan Company's Response to Question Number 4 of Illinois EPA's Pre-Filed Questions for Stepan Company's Witnesses Carl Adams and Robin Garibay. That question asked for information that had been provided to Environ by Stepan. Rather than have them try to list out all the documents verbally, we simply prepared a list and propose to enter that as an exhibit in response to that question.

HEARING OFFICER TIPSORD: If there's no objection, we'll mark that as Exhibit 319.

Seeing none, it's Exhibit 319.

(WHEREUPON, said document was marked Exhibit No. 319, for identification, as of 08/13/2009.)

MR. DIMOND: The second exhibit that we would like to enter is a revised Figure 4 to the report of Ms. Garibay and Dr. Adams. They made some corrections to this in the format

of the data, and the units are all the same. Although, they look a little different. But this is simply a corrected table to their report. It's also partly in response to question 37 of Illinois EPA's questions.

HEARING OFFICER TIPSORD: If there is no objection, we'll mark that as Exhibit 320.

Seeing none, it's Exhibit 320.

(WHEREUPON, said document was marked Exhibit No. 320, for identification, as of 08/13/2009.)

MR. DIMOND: The next exhibit which is in response to one of the Illinois EPA questions -- I think it's -- Illinois EPA question 14 asks for details of some of the cost evaluations. In response to that, we've provided 11 tables and four other documents that are cost quotations that are all presented as a group.

HEARING OFFICER TIPSORD: Just to back up, I don't know if I actually formally accepted Exhibit 320, but it's admitted.

We'll mark this group exhibit as Exhibit 321 if there's no objection.

Seeing none, we'll mark it as 321.

(WHEREUPON, said document was marked Exhibit No. 321, for identification, as of 08/13/2009.)

MR. DIMOND: And then the last exhibit is an article titled Comprehensive Temperature Model for Aerated Biological Systems written by Yerachmiel Argamon -- I'll spell that first name for you, Y-e-r-a-c-h-m-i-e-l -- and Carl E. Adams, Jr. It was published in Progressive Water Technology, Volume 9, pages 397 to 409, in 1977. This is an article that Dr. Adams authored and provided some of the basis for the calculations that he made in support of the pre-filed testimony.

HEARING OFFICER TIPSORD: If there's no objection, we'll mark that as Exhibit 322.

Seeing none, it's Exhibit 322.

(WHEREUPON, said document was marked Exhibit No. 322, for identification, as of 08/13/2009.)

MR. DIMOND: Thank you, Madam Hearing Officer. That's all we have this morning.

HEARING OFFICER TIPSORD: All right. With that, we will begin with the questions from the IEPA.

QUESTIONING ON BEHALF OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

MS. DIERS: Good morning. My name is Stephanie Diers. I will be asking questions on behalf of the Illinois EPA.

Pre-filed question number 1. Explain your analysis specifically with the impact related to temperature, dissolved oxygen, and disinfection?

DR. ADAMS: The analysis approach consisted of delineating the requirements, the ranges that would be applied to each of the parameters, and then selecting, evaluating, and costing that knowledge -- the appropriate technologies for each of those parameters. So that was the general approach. And then some of your other questions get into details on it. That is the way we approached it.

MS. DIERS: When did you begin the study for Stepan?

MS. GARIBAY: We were retained by Stepan in April of 2008.

MS. DIERS: And who participated in developing the task of this study?

MS. GARIBAY: For Stepan, it was Jeff Nelson, Dan Muno, and Bob Burke. For Mayer, Brown, it was a team headed by Tom Dimond. For Environ, it was a team headed by Carl Adams and myself.

MS. DIERS: And I believe question 4 was answered with the exhibit that was presented just a few minutes ago, which was Exhibit 319?

DR. ADAMS: That's correct.

MS. DIERS: Question 5. What other information did you obtain based on your knowledge and experience in the wastewater field?

DR. ADAMS: The additional information consisted of ambient parameters that are used in temperature development, the experience with other industrial applications for disinfection and DO, and the vast amount of experience on temperature cooling, and it is not an approach that's used elsewhere.

MS. GARIBAY: And one of the temperature models we used was Exhibit 322. And we also solicited quotes from vendors, equipment manufactures, which are part of 321.

MS. DIERS: Question 6. Who did you consult with at the Millsdale plant to develop your findings?

MS. GARIBAY: The Stepan team that I mentioned earlier. Dan Muno and Bob Burke were our key suppliers of information and data at site visits.

MS. DIERS: And when did you visit the plant?

MS. GARIBAY: In July 2008.

MS. DIERS: So just one time?

MS. GARIBAY: Yes.

MS. DIERS: Question 8. When you say that you supervised and requested efforts from several individuals, are you referring to individuals who work at Environ?

MS. GARIBAY: Yes. The individuals that were the background for this testimony work for Environ and under our direct supervision.

MS. DIERS: And what is Environ?

MS. GARIBAY: Environ is a global consulting firm in environmental health and safety. It was founded in the mid 1980s. In May of 2005, Environ acquired Advent Group, and Advent Group was started by Dr. Carl Adams and two other partners in 1985 specializing in industrial wastewater services. I joined Advent in 1987. We became Environ in May 2005.

MS. DIERS: Question 10. Dr. Adams, can you please explain your role in preparing this study?

DR. ADAMS: I basically served as technical director. As such, I was responsible for the technology, selection, evaluation, delineation, and supervising the cost analysis and operational design issues.

MS. DIERS: Question 11. Ms. Garibay, can you please explain your role in preparing this study?

MS. GARIBAY: My role was principal in charge of the

project, which was to make sure that we met our scope, objective, and deliverables. But from a technical aspect, taking the proposed rules, the rationale that was provided for the change to those rules, and projecting what a future MPS permit might look like with respect to limits and the requirements so that the engineers knew to what effluent quality they needed to engineer to.

MS. DIERS: 12. What was the time period for the 600 results generated to monitor the quality of effluent discharged to the Lower Des Plaines River?

MS. GARIBAY: That -- The 600 results that we're referring to there, that's in their current permit. They already have a slew of parameters that they monitor for and report to the Agency. And over a year, excluding flow, that represents 600 results of analyzing their effluent quality. So it's for a year period under their current MPS permits.

MS. DIERS: What year?

MS. GARIBAY: In a year, yeah. Their permit doesn't have any compliance schedules or anything like that. It's the same set of conditions for each year of the permit.

MS. DIERS: I guess I'm asking, what year did you look at? I mean, specific year. 2006? '07? '08? '09? I guess I'm not understanding.

MS. DIERS: In the MPS permit, they're required to

monitor the sudden frequency for 62 specific chemicals. When you look at the frequency that they have to analyze for those chemicals over a year to assess the quality of their effluent, they generate 600 results. For the study itself and in looking at temperature and DO and fecal coliform, it's the period of time noted in the specifics. So I think for temperature, if you look at the graph, which I'll do now -- I can't do this off the top of my head -- it was looking at data from 2006 to basically June of 2008.

MS. DIERS: And where is that in the report? What page are you looking at?

HEARING OFFICER TIPSORD: She's looking at Exhibit 320.

MS. GARIBAY: Well, basically the graphs -- the date range on the graphs. On figure 2, it shows starting April 1, 2006, and ending towards the end of June of 2008.

MS. DIERS: Question 13. How did you come up with the conditions on page 4 of your exhibit?

DR. ADAMS: I think you're referring to bulleted paragraphs, which basically are the lack of an adequate mixing zone approach and the prudent design of using a -- the inability to use a mixing zone so that, in our opinion, the temperature standards were applied to the end of pipe as we discharge and the fact that we use a three-degree design

factor in all our temperature calculations and approaches. And the mixing zone is based on the fact that the water coming to us is warmer than the period average is, so we're not going to get any advantage of mixing a flow augmentation or whatever with it. It's still too warm. And the second is we commonly use a three-degree safety factor to cover uncertainties in the design model, the design, and the operation of the temperature control device.

MS. DIERS: Does your analysis assume no reduction in heated effluent discharges from upstream sources?

DR. ADAMS: Yes.

MS. GARIBAY: Yes.

MS. DIERS: And why did you do that in your analysis?

MS. GARIBAY: Basically what we did is we took the I-55 temperatures that have been reported in the Midwest Generation reports and assigned that as the background concentration for Stepan. And we realize there is another discharger downstream between Stepan and the I-55 bridge. But, in addition, there is some aeration that will occur in that segment of the river. So we felt comfortable setting background temperatures for coming to Stepan and assigning that to I-55.

Then looking at that data, there were extended periods of time where the temperature in -- the temperature

at I-55 compared to the proposed period averages was greater. So there would be no ability to assimilate any more temperature from the Stepan discharge, so the temperature at the Stepan discharge would need to meet the period average. And then to account for the uncertainty that occurs in looking at the treatment technologies and modeling temperature and the way the facility operates, we took the period average with a safety factor -- or margin of safety of 3 degrees Fahrenheit.

HEARING OFFICER TIPSORD: Excuse me. I'd kind of like to ask a follow-up, if I may. If you can't answer, that's fine. I'm just curious.

Let's assume that the background concentrations of the water met the proposed water quality standards. I assume there's still some warming with Stepan's process -- Stepan's process. Would that change much your analysis? It would?

MS. GARIBAY: Yeah. I mean, first of all, doing thermal modeling, you're taking the heat coming from Stepan's discharge, the existing heat load in the system, and then you're trying to model the temperature. Unfortunately, it's not a simple mass balance. You're not able to just say, "I'm going to take a degree here at this flow and a degree from Stepan and mix them together, and that's my temperature." Normally, when you have a large river system and a small

discharger, so Stepan's -- the available dilution between Stepan and the Lower Des Plaines at this point is about 1000 to 1 when you're looking at volumetric dilution. Unfortunately, that doesn't help us really be able to answer the question how much heat could we put in from Stepan assuming there is a similar capacity for temperature and still be below the period average. It's not a straight forward modeling exercise. And, no, we didn't go there.

Generally, we normally see smaller discharges. If there is some assimilated capacity for heat, they can normally discharge at the temperatures that the wastewater is at when you have biological treatment. Biologically treated wastewaters inherently are warm.

HEARING OFFICER TIPSORD: Thank you.

MS. WILLIAMS: So you used data from the I-55 bridge?

MS. GARIBAY: Uh-huh.

MS. WILLIAMS: Doesn't that data already include any impacts from Stepan's thermal discharges because it's downstream?

MS. GARIBAY: Yeah. Like I said, there is one MGD at Stepan's discharge for every thousand MGD of the Des Plaines River.

MS. DIERS: In your analysis, are you assuming that the upstream facilities will not meet the water quality

standards?

MS. GARIBAY: We were only working with the data we had in place.

MS. DIERS: In your analysis, would it make a difference if the upstream facilities were meeting the water quality standard?

MS. GARIBAY: Similar to my response there, yes, it would make a difference to the analysis. How much, what type, how much lower than the period averages, would the water need to be upstream of Stepan to accommodate the heat input from Stepan, we didn't conduct that analysis. That analysis can be done. There are thermal models for systems. They're certainly a challenge because they're not a simple mass balance. But it would make a difference.

MR. DIMOND: Could I ask a follow-up here?

Ms. Garibay, are there periods of time where the discharge from Stepan, over the period of time that you looked at it, has a temperature profile that exceeds the period averages that are being proposed by Illinois EPA in this proceeding?

MS. GARIBAY: Yes.

MR. DIMOND: So if the water quality immediately prior to the Stepan discharge was below the proposed water quality standard by a very small amount, Stepan's discharge,

being greater than the proposed standards, might have the ability to push the overall water quality above the standards; is that fair?

MS. GARIBAY: Yes. And particularly in the winter.

MR. DIMOND: Thank you.

MS. WILLIAMS: Can I ask a follow-up on this point here? I think I'm confused.

So if the water quality at Stepan's intake point was mean water quality standards, wouldn't Stepan be entitled to a mixing zone at the discharge point?

MS. GARIBAY: A couple of things. Stepan's intake is not out of the river. Stepan's intake is from ground water.

MS. WILLIAMS: Okay. Do you want me to rephrase the question then?

MS. GARIBAY: Yeah.

MS. WILLIAMS: If at the point of Stepan's discharge and just above that water quality standards would be met, is it correct that Stepan would be granted a mixing zone for thermal discharges?

MS. GARIBAY: I'm not a permit writer. I can't answer that question.

MS. WILLIAMS: Did your answer to Mr. Dimond's question assume there would be no mixing zone? Did you assume no mixing zone?

MS. GARIBAY: For his answer to his question?

MS. WILLIAMS: Yeah.

MS. GARIBAY: No. I assumed that there would be the ability to have some assimilation of the thermal included. Thermal mixing zones are -- Typically, in our arena, we think of mixing zones for constituents -- chemical constituents. Thermal mixing zones we normally think in terms of you're happy to assess the ability of the receiving water to assimilate the heat because it's not a simple mass balance.

MS. WILLIAMS: But you're saying that the one MGD -- And I'm assuming sometimes it's less than that, correct?

MS. GARIBAY: The permit writer designed -- The permit writer average for calculating is 0.88. What we use for design is 1.1 MGD.

MS. WILLIAMS: And you're saying that that amount of discharge would cause a violation of the water quality standard if it was being met only marginally?

MS. GARIBAY: The delta between the period average and the discharge temperature of Stepan, particularly in the winter, depending on where someone is going to define where the period average has to be met could cause an exceedence of that period average.

MS. WILLIAMS: As an average or on a one-time basis?

MS. GARIBAY: Well, the one-time numbers are huge, so

the period average is really what drives you in compliance.

MS. WILLIAMS: So by how much do you think that Stepan would be able to --

MS. GARIBAY: I can't answer that question. As I said, thermal modeling is complex. It depends on two things. One is what other heat sources are coming in and how are you going to account for those, such as radiation, what heat is coming out, like, from re-aeration, and then, in addition, where you're going to define the point at which the temperature standard has to be met if it's going to be met in-stream. Is it ten feet from the discharge? Is it five feet from the discharge? So those are a bit too many variables to be able to provide an answer except to say it's possible because it's not impossible.

MS. WILLIAMS: That's the basis of your answer, that it's not impossible?

MS. GARIBAY: Exactly.

MS. WILLIAMS: Okay. That's fine.

MR. RAO: Just as a matter of clarification, the calculations that you have done is if Stepan is forced to comply at the discharge point?

MS. GARIBAY: Yes.

HEARING OFFICER TIPSORD: You need to identify yourself, for the record.

MR. ETTINGER: I'm Albert Ettinger, E-t-t-i-n-g-e-r. I used to work here from time to time. I represent a few environmental groups in this proceeding.

Have you done any analysis of what the upstream discharges of heat are and their potential impact on heat at the point of discharge?

MS. GARIBAY: No. We took the I-55 temperature data and assigned it as background.

MR. ETTINGER: So you haven't looked at what would happen to the I-55 temperatures if Midwest Generation were to comply with the proposed discharges it would have to comply with in order to meet the proposed standards?

MS. GARIBAY: No, we have not. Our scope was to take the current conditions and see how it -- Our charge was to look at the current conditions and to see how it would impact Stepan with the proposed changes.

MR. RAO: So if Stepan is allowed a mixing zone under these proposed regulations, some of these costs that we have talked about would no longer be applicable?

MS. GARIBAY: For temperature?

MR. RAO: Yeah.

MS. GARIBAY: The presumption being a lot of mixing zones to the point where you would be able to comply?

MR. RAO: Yes.

MS. GARIBAY: Yes.

MR. RAO: And at this time you have no idea, you know, how -- what would be the extent of that mixing zone?

MS. GARIBAY: No.

Well, currently?

MR. RAO: Yeah.

MS. GARIBAY: There would be no mixing zone. Based on our experience, when your background is already above the standards, you're not entitled to a mixing zone.

MR. RAO: Okay. Thanks.

HEARING OFFICER TIPSORD: Ms. Diers, I think we're back to you.

MS. DIERS: We're on question 14. Please provide the details of the evaluation you refer to on page 10 of Exhibit 318 with respect to the effluent bacteria standard proposed by Illinois EPA.

MR. DIMOND: And I would just reiterate. That's -- What we marked as Exhibit 321 is responsive to that question and really a little bit beyond it. I believe that the statement on page 10 of Exhibit 318 specifically relates to the cost for disinfection. The tables and the quotes that we provided you not only address the cost for disinfection, but they also address the cost analysis for complying with temperature requirements and for complying with dissolved

oxygen requirements. So we -- We went a little bit beyond your question as it was specifically phrased and provided you all that detail.

MS. DIERS: And why did you decide that effluent disinfection would be necessary?

DR. ADAMS: As opposed to the other options? Well, basically there are two options. One is to get the septic tanks and try to disinfect there or do it after the biological system source control, which would be to catch the septic tanks where the fecal coliform's coming from and try to chlorinate there. Secondly, would be to go ahead and mix everything in and get a much lower concentration and disinfect the entire spring.

The source control -- Number one at Stepan's plant, the sources cannot be collected into one source. There would be multiple, multiple. These things are all buried now, and they've been built over. They're really a mish-mash, and they all come together at the treatment plant at different points. It would be a very, very major effort to try to find each septic -- they know where they are, but to get each septic tank and put in the disinfectant.

It's very concentrated water. You're always worried in an infectible situation of adding chlorine in high concentrations that you're going to get into the organics

from the industry and form chlorinated organics, which gets you into more problems then you solve. That was looked at. It was obviously the way we would like to go, and we decided it was infeasible. And the chlorine addition system would have to be very, very precise to avoid over-chlorination and getting chlorine into the organics from the industry and forming the bad guys. And led us down to the treatment plant and to the effluent. And then we addressed different disinfection methods at the effluent. And I can get into that, if you want, later what they are.

MS. DIERS: Did you have data that shows that Stepan's effluent is exceeding 400 CFU fecal?

DR. ADAMS: Yes.

MS. GARIBAY: Yes.

MR. GIRARD: You referenced that you have about 15 septic systems. Do these septic systems just accept human waste, or does processed waste go into these systems?

DR. ADAMS: Only human waste, toilets. There's no laundry. It's mainly toilets that go into the septic tanks.

MR. GIRARD: So what sort of processing goes on in the septic tanks? Is it just some rudimentary, biological --

DR. ADAMS: There's an anaerobic chamber like a residential septic tank. It's very similar to residential. And you overflow into a drain field. Rather than a drain

field, these overflow and go to the sewer. It's anaerobically treated, and then the liquid residual is sent to the treatment plant where it's further treated with the organics and nitrogens and so forth.

MR. GIRARD: So it's only sent to your on-site treatment plant?

DR. ADAMS: Yes.

MR. GIRARD: Is there any municipal treatment plant nearby where this material could be sent?

DR. ADAMS: I don't think so. But if there were, there is one problem. If we could collect them all -- or get to the municipal, we could collect them all. They're really spread out. Some of them have been constructed over. They're not sitting in a line where we could go get them, or we'd make the source control more attractive. But they're spread out in different places.

As the plant's grow, they've been put in near a restroom rather than for central collection and go to a municipal. But I don't believe there's a municipal facility any closer than our treatment plant. We'd love to get it there. Believe me. It would be nice. We'd love to do that.

MR. RAO: Is there a possibility to get -- You know, in the area where I live, we have a septic tank service that comes in every now and then.

DR. ADAMS: They clean out the anaerobic thing. The liquid in your area is going back into a drain field somewhere.

MR. RAO: Yeah. It goes into the ground.

DR. ADAMS: Rather than do that on an industrial site, it is collected and put in a treatment plant where it does get further treatment. It's not in the groundwater and so forth. That's a good thing. The bad thing is this number of 400. Getting it down -- The only way to get it down is disinfection. We can't dilute it down or anything else. It's already gotten into the process, and it's partially treated. But all the organics and nitrogen and phosphorous are treated in the treatment plant there. We've got this residual fecal number.

MR. GIRARD: So the only source of the fecal indicators is from the human waste, not from any other --

DR. ADAMS: Yes. I say that with pretty good confidence. Yeah, that should be. There is miscellaneous.

MS. GARIBAY: They do have storm water that drains areas where there's known wildlife wondering through and geese, so there's probably some fecal coming in from, in particular, the geese.

MR. GIRARD: So does your storm water go into the septic systems also?

MS. GARIBAY: No. It goes into the wastewater treatment plant.

MR. GIRARD: Into the wastewater treatment plant?

MS. GARIBAY: Yes. To assist, there's a flow diagram that has the sources of wastewater into the treatment plant, and the storm water at the site is collected and sent through wastewater treatment prior to discharge. So we're pretty sure there's some fecal. We haven't conformed it analytically.

MR. GIRARD: So there are no gutters going into your -- into these lines?

MS. GARIBAY: No.

HEARING OFFICER TIPSORD: Is that Figure 5 that you were referring to, Ms. Garibay?

MS. GARIBAY: That would be Figure 1.

DR. ADAMS: Figure 1.

MS. DIERS: Do you know what the flow rate of the septic tanks are?

DR. ADAMS: It's estimated at 100,000 gallons a day. That's the number Stepan provided. About 10 percent of the total.

MS. DIERS: Have you done an analysis of the cost of segregating and collecting domestic wastewater?

MS. GARIBAY: No.

MS. DIERS: I think we're on question 15. On page 11 of Exhibit 318, you state the Illinois EPA has not developed the data to assess the assimilative capacity of the Upper Dresden Island Pool water for dissolved oxygen. In your opinion, what data would be needed to do such an analysis?

MS. GARIBAY: The data needed to develop an assimilative capacity study for DO has pretty clearly been defined by US EPA guidance, and actually Illinois State Water Survey has done a number of DO assimilative capacity studies. Both those are sort of references one can look to to find out what data's needed to develop the assimilative capacity for DO for a water body.

In developing the knowledge or the understanding of the assimilative capacity study for dissolved oxygen, you sort of start off with an inventory of understanding your DO sinks. In other words, those things that take up DO or consume dissolved oxygen and your dissolved oxygen sources that frame sort of the major data needs.

Certainly with some of the sinks of DO there is data available. That would be the ammonia, nitrogen levels, and the effluent to receiving water, the BOD 5 levels in the effluent, and the receiving water temperature, flow. However, there are also DO sinks that are very critical for being able to model and understand the assimilative capacity,

and that's ultimate carbonations BOD, ultimate nitrogenous BOD, the sediment oxygen demand. The sediment itself can be a DO sink.

On the DO sources side, there are sources of DO into a river, and the sources of the dissolved oxygen that are major components that we don't have data on are related to algae and algae respiration and also the re-aeration coefficients of the river. So those are some of the major data needs that are missing in understanding the assimilative capacity for dissolved oxygen.

MS. DIERS: Do you disagree with the Agency's conclusion that the Upper Dresden Island Pool is currently in compliance with the proposed DO standard?

MS. GARIBAY: Say that one more time.

MS. DIERS: Do you disagree with the Agency's conclusion in our Statement of Reasons that the Upper Dresden Island Pool is currently in compliance with the proposed DO standard?

MS. GARIBAY: Based on, once again, the 2004 to 2006 Midwest Generation reports and the I-55 bridge data, there were definitely periods of time that the DO was not met at the I-55 bridge, the proposed standards, for the two seasons.

MS. DIERS: Can you be more specific about the periods you were saying where you saw it would not have been

in compliance with the proposed DO standards?

MS. GARIBAY: Well, I don't have a Midwest Generation report in front of me. If I remember right, like, 2004 there were a few periods. When you got to 2005 and 2006, there were certainly more periods of time that they identified in the summary of their data where they weren't meeting either the seven-day average, the 30-day average, or the not-to-exceed-at-any-time numbers.

HEARING OFFICER TIPSORD: Ms. Garibay, when you refer to the Midwest Generation reports, are those documents in the record? I believe they are. Do you know what the exhibit is?

MR. DIMOND: Madam Hearing Officer, we provided the text of those reports to Environ. It's on the list of documents that we provided to them. I believe that they are in the record. We searched and tried to find the exhibit number and were unable to find it. But I believe they may have been put in at some point.

You know, we understand that those documents were prepared for -- in conjunction with adjusted standard proceeding 96-10 and thought that they would actually be in the docket for AS 96-10, but we were unable to find them on the docket on the Board's website. We suspect that the Board has them someplace. As to whether or not they've been marked

as an exhibit in this proceeding, as I said, we looked at the exhibit list, but we could not find them specifically.

HEARING OFFICER TIPSORD: Ms. Franzetti?

MS. FRANZETTI: Susan Franzetti from Midwest Generation.

Not that we have examined every exhibit that's been introduced in this proceeding, but, based on our general knowledge, we don't think the Midwest Generation reports for 2004 through 2006 have been made exhibits to this proceeding. The information is submitted to the Agency. The Agency has it. So that would just be one other check as to whether they have introduced it as an exhibit. But we can speak as well for ourselves and our general knowledge of the record. We don't think it's in the record.

MS. WILLIAMS: I may be mistaken, but I don't think it's in the record.

HEARING OFFICER TIPSORD: That being the case then, I'm going to ask that it be put in the record given Dr. Adams' and Ms. Garibay's reliance on it. If you want to or if you want to work on it with Ms. Franzetti and the Agency, but I do think we need to include it in the record.

MR. DIMOND: We do not have the full reports. We have the text of the reports that I provided to Environ, and we'd be happy to make copies of those and provide them as an

exhibit.

HEARING OFFICER TIPSORD: Thank you.

MS. FRANZETTI: Can I ask one follow-up question just to clarify?

With respect to the DO standards that Environ was looking at and comparing the I-55 data to, would those be the existing DO water quality standards, or are they the proposed DO standards under this proceeding?

MS. GARIBAY: We looked at the proposed standards.

HEARING OFFICER TIPSORD: Mr. Ettinger?

MR. ETTINGER: Is it your understanding that the proposed standards for the Upper Dresden Pool are any different from the current general use standards that are applicable below the I-55 bridge?

MS. GARIBAY: Yes. Yes, they're different.

MR. ETTINGER: In what way?

MS. GARIBAY: Well?

HEARING OFFICER TIPSORD: Ms. Garibay, could you speak to us?

MR. ETTINGER: I don't matter here.

MS. GARIBAY: The Upper Dresden Pool standards are 6 milligrams -- they're 6 milligrams per liter as a seven-day use and then not to exceed 5 at any time from March to July. And then from August to February, 5.5 milligrams per liter as

a 30-day mean, 4 milligrams as a seven-day mean, and 3.5 milligrams per liter at any time. And those are different than the current standards that Stepan would be facing.

MR. ETTINGER: Are they different from the current standards that are applicable at the I-55 bridge and below it?

MS. GARIBAY: I don't know. Our segment of water that we're looking at is I-55.

MR. ETTINGER: And I'm not asking you for your legal opinion. I'm just asking for the assumptions that are the basis for your conclusion.

Is it your assumption that what matters is the water body that you're discharging to even if that water flows to a water now that has a different standard?

MS. GARIBAY: Well, I'll answer it from a technical aspect.

MR. ETTINGER: Okay.

MS. GARIBAY: Typically, one does look at the assimilative capacity of the water body. So, as I was explaining, you have those DO sinks that you inventory, your DO sources. You collect the information about the kinetics and dynamics of the water body and put that into a model. Once again, US EPA has a number of them for different types

of watersheds. And it predicts out where the DO sags.

So you have all these sources and sinks. You have the dynamics going on. Eventually you get to a point in the model where at some point in the river there's what we call a DO sag. The DO dips. That could be anywhere from -- For a discharger, it could be anywhere from a half a mile downstream to five miles downstream. It all depends on the kinetics and what's going on with these sources of DO. In other words, where sources come in to consume dissolved oxygen as well as -- sorry -- those are the sinks -- as well as the ones that add oxygen.

To answer your question, no, I don't know if the DO sag is at the I-55 bridge. However, there was nothing in the IEPA rationale or description of how they were looking at these standards to give me any indication to do other than what we did, which was to look at DO in the pipe.

MR. ETTINGER: Okay. You've done no analysis as to whether any DO sag caused by the Stepan discharge occurs above or below the I-55 bridge?

MS. GARIBAY: As said in our statement, there is no data to make that type of assessment.

MR. ETTINGER: How far is the Stepan discharge above the I-55 bridge?

MS. GARIBAY: Can I phone a friend?

MR. DIMOND: I believe it's in the report.

MS. FRANZETTI: The front page of the pre-filed testimony. "The Millsdale plant is located about two to three miles upstream of the I-55 bridge." I do read what you file.

MS. WILLIAMS: But this is not in the record. This is the introductory comments.

HEARING OFFICER TIPSORD: It's also on page 3 of Exhibit 318.

MR. ETTINGER: I guess my question though is, is the discharge -- Does that refer to the discharge? You're talking about two to three miles -- nautical miles from the discharge point.

MS. GARIBAY: Right. Miles, not nautical.

MS. DIERS: Question 16. What were the cross-media impacts your study found?

DR. ADAMS: We have, I think, modified that in here. But mainly the areas where the air, sludge generation or solids generated, energy usage, carbon footprint, and sometimes expressed in population equivalents --

HEARING OFFICER TIPSORD: You need to keep your -- You trail off at the end, Dr. Adams.

DR. ADAMS: The cross-media impacts that we were concerned with that threw out most attention in public

discussions are the air, sludge/solids generation, energy utilization, chemical usage, and carbon footprint, and sometimes population equivalents are used as an expression.

MR. DIMOND: If I could just ask a follow-up.

Dr. Adams, did we -- did you and your team calculate numeric -- numeric equivalents for the air emissions that would be required for the technology for Stepan to comply with these proposed water quality standards?

DR. ADAMS: Yes, we did.

MR. DIMOND: Are those set forth in your report, which has been marked as Exhibit 318?

DR. ADAMS: Yes.

MR. DIMOND: Can you identify the page on which they are set forth?

DR. ADAMS: There will be three, one for disinfection, one for temperature, and one for DO. And the page numbers? For disinfection, page 11. For temperature, pages 8 and 9. For dissolved oxygen, page 13. This is combined here. I think this is DO. And then, finally, on page 14 a combined of all the others.

MR. DIMOND: Just for the record, for the combined of all the technologies, what was your estimate of the additional CO2 emissions that would be generated by the technologies necessary to comply with Illinois EPA's proposed

water quality standards?

DR. ADAMS: Approximately 130,000 tons.

MR. DIMOND: Thank you.

MS. DIERS: I think you already answered question 17. We'll go to 18.

What environmental damage would be caused by having Illinois EPA's proposal adopted? I believe you kind of touched on it just a second ago.

DR. ADAMS: Well, I think we just quantified the cross-media. That's really to me the environmental damage. Particularly with the temperature, you're not getting rid of it. You're transferring it. It doesn't go away unfortunately. Energy is here. And we transfer it to air or ground or something else, but it's there. And many times the devices we use to transfer it generate more energy from friction. Mechanical pumps running, blowers running, they generate energy from friction that wouldn't be in the equation overall.

MS. WILLIAMS: I'd like to ask a follow-up.

This question, when it talks about environmental damage, are you using that term to equate to Factor 3 -- I believe it's Factor 3 -- would cause more environmental damage then to leave in place?

DR. ADAMS: I'm not sure I --

MS. WILLIAMS: In the introductory comments, I think your counsel gets at this issue of UAA factors and that one of the factors requires us to look at whether a remedy would, quote, cause more environmental damage to correct than leave in place. Is that the type of environmental damage you're talking about here?

MR. DIMOND: I'm going to object. I mean, environmental damage was the term you used in your question.

MS. WILLIAMS: Right. I'm trying to explain. Our question was keying off of this use of that term from --

HEARING OFFICER TIPSORD: But that's something you just asked. You asked him to explain what he meant by -- Rephrase your question.

MS. WILLIAMS: I think my question was do you mean by environmental damage Factor -- I hope it's 3. I hope I'm not using the wrong factor -- of the use attainability factor? Is that what you mean? Yes or no?

MR. DIMOND: I'm going to object to the grounds that the witnesses are not making legal arguments. It is certainly Stepan's position that the impacts -- the cross-media impacts from -- It's certainly Stepan's legal position that the cross-media impacts that will be generated by the technologies necessary to achieve the proposed water quality standards are environmental damage that is

legitimately considered in a UAA analysis in determining what -- whether or not the proposed water quality standards are appropriate. That's certainly a legal position that I think we intend to argue. But I don't think that's a fair question to ask of expert witnesses.

HEARING OFFICER TIPSORD: And, Mr. Dimond, I think I'm going to have to ask you to be sworn in. I think you just answered and gave some positions that I think --

MR. DIMOND: Well, I think those are legal positions. I don't think they're testimony.

HEARING OFFICER TIPSORD: I would be more comfortable if you were sworn in given the response to the question because you are explaining some stuff that were in the pre-comments that are not a part of the record. I'd feel more comfortable if we swore you in.

MR. DIMOND: Fine.

(WHEREUPON, the witness was duly sworn.)

HEARING OFFICER TIPSORD: And now I'm thinking about the objection.

MS. WILLIAMS: I mean, I think we'll just explain, at least for the record. You know, we felt, when we prepared our questions, that this summary in the beginning was legitimate questions for the witnesses because it was

testimony of Robin Garibay and Carl Adams. And in that testimony, you know, Stepan has invoked this issue for consideration. We would like an answer to the question of whether it's Stepan's position that it would cause more environmental damage to treat for these factors --

HEARING OFFICER TIPSORD: And I think Mr. Dimond just answered that question, and we have him sworn in.

MS. WILLIAMS: And his position was then -- Then can I clarify?

HEARING OFFICER TIPSORD: That Stepan would argue that as a legal argument that that's true.

Am I misstating that?

MS. WILLIAMS: Well, I only heard you say that it's a factor to consider. Did you conclude that it would cause more environmental damage to treat for temperature, dissolved oxygen, and bacteria then to leave those in place?

MR. DIMOND: I don't think there is anything in either the report or our statement that says we've reached a conclusion that it's more. But it certainly is environmental damage that ought to be considered and the Illinois EPA did not consider at all in its proposal. I think it's fair for the Board to consider it.

MS. WILLIAMS: I think that answers the question. Thank you.

HEARING OFFICER TIPSORD: Ms. Diers?

MS. DIERS: We're on 19. When did Stepan begin to evaluate whether additional controls would be necessary to assure compliance with certain metals and salt criteria?

MS. GARIBAY: According to Stepan, they started also in 2008.

MS. DIERS: And what evaluation has been done with respect to this issue?

MS. GARIBAY: Stepan generated some data on chloride. As part of their MPS permit renewal, they had a dialogue with Mr. Twait on looking at their permit renewal application data on metals and seeing if they might be subject to discharge limits for metals. In that evaluation, it came to their attention that there's some missing data to have a complete evaluation.

MS. DIERS: And what has that data shown so far? Do you know?

MS. GARIBAY: With chloride, it definitely shows the seasonality that one expects in chloride in this part of the world where, due to use of road salt within the plant, we have higher chlorides in the wintertime. What it showed with respect to other metals is that we really need to understand background concentrations for total and dissolved metals and actually for in-stream chloride because, once again, that

implementation tool, taking the in-stream criteria to end-of-pipe limit, we're missing background concentrations.

MS. DIERS: Is Stepan currently collecting that data?

MS. GARIBAY: Not the background concentration data.

MS. DIERS: 22. What metals are you concerned with?

MS. GARIBAY: According to Stepan and Mr. Twait, the metals that would indicate there should be some concern about are copper, lead, nickel, and zinc.

MS. DIERS: I believe you answered 23.

24. Why did your conclusions not address the impact on the river directly?

MS. GARIBAY: Our task was to make sure that the effluent wouldn't impact the river based on the proposed standards that a company -- the redesignation of use. So the approach was that our effluent would meet the standards -- the proposed standards. Therefore, inherently there should be no river impact because we were meeting that proposed standard at end of pipe.

However, we did note in our findings that with the use of chlorination and dechlorination there will be an increase in chloride and sulfate in the effluent. We also noted that in chlorinating there is a small possibility of forming chlorinated organics. In addition, when you increase salt in a discharge, we may have a different response on

whole effluent toxicity testing with respect to one of the species. We did not go into detail or depth about those potential changes in effluent quality with respect to the proposed standards for chloride and sulfate or chlorinated organics or whole effluent toxicity.

MS. DIERS: I believe you answered 25 and 26.

27. On page 3 of your pre-filed testimony, you state, "Without the option of a mixing zone due to upstream sources of warm effluent and the general nature of the Lower Des Plaines River." What is the general nature of the Lower Des Plaines River that you're referring to in the context of the mixing zone?

MS. GARIBAY: In the context of the mixing zone, one of the considerations in deciding whether you're going to allow a mixing zone for implementation is whether there is nearby dischargers. In their case, there are nearby industrial dischargers. So we would consider one of the concerns to be overlapping mixing zones. So that's an example of the general nature that we were referring to.

MS. DIERS: Question 28. Do you think Stepan will have trouble meeting both the summer and winter temperatures?

DR. ADAMS: Yes.

MS. DIERS: Strike question 29.

Question 30. Are both closed-circuit and open,

direct-contact cooling towers infeasible?

DR. ADAMS: Yes, based on what you saw if you read the report. Neither one will evaporate cool enough to meet it without the help of a chiller. The performance of both towers are about equal. It's a matter of operational difficulties with an open --

HEARING OFFICER TIPSORD: Could you repeat that?

DR. ADAMS: I'll repeat it.

The performance of both closed-circuit cooling towers and open cooling towers is about the same. There are operational differences with them and operational problems, particularly with a foaming wastewater like Stepan with the open cooling towers. But neither one will meet the requirements during warmer months --

HEARING OFFICER TIPSORD: You trailed off at the end.

DR. ADAMS: Wet bulb temperature, which is a term used in cooling.

MS. DIERS: I'm going to go to question 32. Why are all your emissions figures from electric generators based on coal-fired utilities? Does Stepan get power from the grid? Do you know if Illinois generates as much power from nuclear as from coal?

MS. GARIBAY: The emission figures were based on coal-fired utilities. Midwest Generation Station 9 is about

a mile away, and there is actually a direct line from Station 9 to Stepan. Stepan does get some of their power off the grid. We certainly felt that between having the direct line to station number 9 that we were comfortable with saying that the power supplied to Stepan comes from coal-powered utilities.

HEARING OFFICER TIPSORD: You didn't answer the last of that. Do you know if the Illinois generates as much power from nuclear as from coal?

MS. GARIBAY: That wasn't part of our task.

MS. DIERS: And I strike question 33 and go to 34.

Were you proposing to add dissolved oxygen before the effluent goes through the cool tower?

DR. ADAMS: No. It doesn't make any sense to do that.

MS. DIERS: Strike 35 and go to 36.

On page 11 of your pre-filed testimony, you state, "Solid Waste: Generation is significant." Please explain the significant solid waste that would be generated by chlorination/dechlorination?

MS. GARIBAY: That's a mistake. It should be insignificant. There should be an i-n in front of the significant. If you could please correct it, we'd appreciate it. Sorry.

MS. DIERS: Finally, question 37. Can you just explain, I guess, the difference in Exhibit 320 -- Can you just explain what the difference is with these now?

MS. GARIBAY: Right. The -- Let me go back. The intent of this figure was to be able to show for each individual day the amount of cooling that would be required to meet the discharge limits for temperature. When it got put into the testimony, something happened. So the graft -- The graft should look like -- should look like a series of dots and each dot representing for each day the amount of cooling that was required.

So I believe one of the questions was what happens between June through October. So looking at June 1 to October 1, which is about 120 days, for 2006 there were 24 days that would require cooling. And then for 2007 there were 77 days that would require cooling. And that is what one would have taken from this graft if it hadn't shown up as a line. Basically if no cooling was required, there would be no dot for that day or in this case a triangle.

MS. DIERS: We're finished. Thank you.

HEARING OFFICER TIPSORD: Let's take a ten-minute break. We'll come back and start with Ms. Franzetti.

(WHEREUPON, a short recess was had.)

HEARING OFFICER TIPSORD: We'll begin with Mr. Franzetti's questions from Midwest Generation.

QUESTIONING ON BEHALF OF

MIDWEST GENERATION

MS. FRANZETTI: Good morning, Ms. Garibay and Dr. Adams. My name is Susan Franzetti. I represent Midwest Generation in this rulemaking proceeding.

I will try, as I go along, to eliminate questions that you have essentially provided the answer to in response to questions by the Agency. In the event I overlook the fact that one of my questions maybe has already been covered, I welcome you pointing that out to me because it is not my desire to go over things twice. I just may not have realized that it was covered in your earlier testimony.

With that, my first two questions really are aimed at what qualifies you to be an expert to testify about the issues you've covered in your report. With that, Question 1, what is your experience in working with wastewater treatment plants, including the type of treatment systems necessary to achieve effluent or water quality standards?

DR. ADAMS: I've had over 35 years experience purely in industrial wastewater management primarily with the organic chemical industry, refineries, and steel industries, so this particular situation fits exactly with the clients

I've been dealing with for 35 years. Most of my design experience has been in response to achieving water quality standards or technological limits on an effluent discharge. The processes have involved everything from biological, physical chemical treatment, membranes, water reuse, recycle, sludge handling and management, off-gas BOC, volatile organic chemical emissions and handling them and developing cost effective approaches.

MS. FRANZETTI: Ms. Garibay, would you like to tell us a bit about your experience that's relevant to the issues you're testifying on?

MS. GARIBAY: Well, I started with Advent back in 1987 and got thrown into what I call the fires of effluent limit guidelines for the organic chemicals, plastic, and synthetic fibers industry and also served on a water environment federation committee that was commenting on the technical support document for water quality-based toxics control and between that sort of was rapidly introduced to the technology-based limits for an industry and the need for water quality criteria and understanding how to implement those water quality criteria in discharge limits. So since 1987 as a consultant to, you know, organic chemicals, petroleum refineries, have worked on the relationship between technology-based limits, water quality-based effluent limits,

and making sure that we can protect the receiving waters, but at the same time keep an eye on the fact that we can't do it in a vacuum.

MS. FRANZETTI: I think I'm going to skip 3 -- Oh, I'm sorry. Let me ask Question 2.

Have you testified or consulted in other water quality standards rulemaking procedures?

MS. GARIBAY: I'll take it first.

In this particular state, I have testified in front of the Board for some site specific criteria rulemakings and the anti-degradation rulemaking, in Indiana for the adoption of the Great Lakes initiative into Indiana regulations and their earlier review of water quality standards and also in support of site specific criteria, similar in Minnesota related to site specific rulemaking and site specific criteria rulemaking in front of their board, and in Wisconsin for the adoption of the Great Lakes initiative into the Wisconsin rules and regulations. So that's some of the ones in Region 5.

DR. ADAMS: I've been involved as an expert witness in numerous legal cases that may or may not have gone to court on effluent water quality standards. In Illinois, I've spoke at three public sessions on ammonia standards representing Mobil. And then I represented the soap and

detergent manufacturers, Cecil. We were trying to get the oil and greases classified to go into public sewers -- municipal sewers. And that's been my Illinois.

MS. FRANZETTI: By Cecil in the last remark, you were referring to Dr. Cecil Ruhane formerly of the Metropolitan Water Reclamation District?

DR. ADAMS: That's correct.

MS. FRANZETTI: Thank you.

Off the record.

(WHEREUPON, a discussion was had off the record.)

MS. FRANZETTI: Moving on, I am going to skip 3 in terms of, I think, just based on your prior answers and my further study after filing these questions. Can I just modify it to say this? Am I correct that your Figure 1 that was attached to your report, Exhibit 318, on the left-hand side going down the column, so to speak, that starts with process wastewater, does that list the various types of wastewater that are coming into the Stepan wastewater treatment plant?

DR. ADAMS: That's correct.

MS. FRANZETTI: Okay. For the record, I've already identified the first one. Process WW means process wastewater. Would you just briefly go through and tell us

what the different waste streams are that are all coming into the Stepan wastewater treatment facility?

DR. ADAMS: The process wastewater is from the production of the various products. These are wash-downs, clean-outs, residues after a product is made that enter a sewer and come directly to the treatment plant. The utility wastewaters are from generally the boiler operations and may consider -- and I think I gave you cooling tower blow-down -- but boiler blow-down, unexchanged resin, reverse osmosis. Sanitary we talked about. It's pre-treated with septic tanks. Decant wastewater -- I've forgotten. The decant in the middle is from a sludge. This may be from the digesters where they digest the sludge in decant. Non-contact stormwater is stormwater that could be potentially contaminated, but doesn't fall in a production area. It's around the plant and they treat that there. And then a sludge basin decant, after they've treated and digested their sludges, they store it in a basin.

MS. FRANZETTI: Moving on to Question 4, how does the temperature of the wastewater that enters the Millsdale Plant's wastewater treatment process affect the proper functioning of the wastewater treatment process?

DR. ADAMS: The heart of Stepan's plant is a biological treatment system. They use bacteria and

miscellaneous organisms to degrade the components of the wastewater, and 99 percent of the components are biodegradable. They're chewed up and eaten, converted to CO2, water, and sludge.

This plant, as to probably 90 percent of the organic chemical plants in the world, work in mesophilia biological range. That's about 15 degrees up to about 40 degrees centigrade, so 103 down to about 35, 40 degrees Fahrenheit. The ideal -- That's the extremes to the range they will live. The ideal range is to be within 25 to 35 centigrade or somewhere in the range of 65 to 95 Fahrenheit. Even further restricted, we like to get into 85 to 90 degree Fahrenheit. The bugs are happy. They eat. We're not shocking them with temperature.

MS. FRANZETTI: I'm sorry. That's 85 to --

DR. ADAMS: To 90 degrees Fahrenheit.

We work very well at 65, 70, 75 degrees. And many times you've got to stay there without heating up. So the acceptable range is generally in the 60 to 90 degree Fahrenheit range of operation. And that's from summer to winter without having elaborate temperature controls.

As the temperature gets cooler, the performance can deteriorate or, as a minimum, the stability and robustness of the system becomes more sensitive. You loose the ability to

take shocks and upsets as you get cooler. As you get hotter, past 95 to 98 degrees Fahrenheit, you begin to have settling problems and more TSS leaving the system. So temperature is very important in the operation of a biological treatment system.

MS. FRANZETTI: Thank you. I think that answers Question 5, but take a look. I'll read it while you're taking a look.

Does the operational temperature range of the wastewater in the Millsdale Plant's wastewater treatment process need to be maintained throughout the year? If so, explain why. I think you've already explained to us kind of what the ranges are. Maybe you can explain why that's so important to maintain.

DR. ADAMS: Yes. The fact that Stepan is a multi-product, campaign-scheduling production company -- I think there's over 1500 products -- means you're having a variable dot coming to your bacteria. They're seeing cleaning soaps today, industrial cleansers. You want conditions to be as stable as possible so that they're only responding to the change in food. Temperature, PH, all that are very important.

So the why is to keep it as consistent, even summer to winter, as you can. It can be quite a chore to do that.

But that's the reason for wanting a temperature range that's fairly consistent in a 10 or 15 degree swing maximum.

MS. FRANZETTI: I'm going to move into Thermal Compliance, Section 3 of my questions, and Question 6.

You state at page 4 of your testimony that, "It is very evident that maintaining heat within the biological treatment process and then being required to remove the heat prior to discharge of the effluent is contrary to most, if not all, laws of nature on conservation and carbon footprint." Could you just explain a bit further what you meant by this statement?

DR. ADAMS: Basically it's against all principles of cost effectiveness and conservation of resources to heat something up to make it effective and then cool it down immediately following that for regulatory purpose unless there's a major, major driver. What's even more difficult is trying to control the temperature at the front end of a system, which is more economical because you've got a bigger -- higher temperature, so it's easier to cool. It's cheaper. But then you hurt yourself in a biosystem.

You also have a heat input from a biosystem from biologically degrading organisms. You get a heat input exothermic reaction that gives you heat that you have no control over. So following that and having to cool down, it

would be much more engineering acceptable to take one point back here and cool this stuff and be done with it. We're not allowed to do that with biological systems. We have to keep pampering them with temperature control during the year.

Then we have another system afterwards. We can't optimize it. We have to take what we did to make the bugs happy and cool it down. It's not, from a technical standpoint, a good approach at all. And the law of nature can apply to an engineer.

MS. FRANZETTI: Thank you. I understand.

Move on to Question 7. You further state at page 4 of your testimony that, "The energy that creates the heat in the wastewater treatment plant effluent cannot be destroyed and can only be removed from the effluent by transferring it to some other environmental media, for example ambient air, through processes that themselves required energy resources and the production of more energy and heat."

Now, I believe, with respect to my questions, you testified earlier about the generation of approximately 130,000 tons per year of CO2 emissions. Is there anything in addition to that, with respect to my questions here, that you would like to add to your testimony?

DR. ADAMS: Only that, when we enter into a design or a concept of cooling, 99 percent of the approaches are going

to involve mechanical equipment. The only thing that doesn't is a massive operation pond. That's assuming you get evaporation.

But assuming mechanical equipment, mechanical equipment is using energy to transfer this heat around, and it's creating energy through the friction. The pumps are making energy from electrical -- where we take a volt of electricity. You get about 80 percent efficiency out of it. The rest of it is going to heat what we just made. Then on top of that we're transferring that heat generally to the air. Again, in cooling, we're usually using an evaporation somewhere. That's the most economical way to cool.

In this case, because of our temperatures, we're having to use a chiller also, which is using a chemical, propylene glycol or something, to exchange the heat. But we're still putting the heat in the air. It's not going anywhere else. We're making some extra heat with the mechanical equipment. It's just got to be a real good reason. We're just using resources.

MS. FRANZETTI: Now, following up on that, Question 8, have you estimated how much heat would need to be removed from Stepan's wastewater discharge in order to comply with the proposed regulations?

DR. ADAMS: Yes. And we've expressed this heat in

BTU's per hour that has to be removed. And that was the curve that Ms. Garibay was showing you. That curve represents BTU's per hour for each day.

MS. FRANZETTI: If you would, just so the record is clear, which figure?

MS. GARIBAY: It's Figure 4. It's the dot Figure 4.

MS. FRANZETTI: The revised Figure 4?

MS. GARIBAY: Right.

HEARING OFFICER TIPSORD: Exhibit 320.

MS. FRANZETTI: Exhibit 320. Thank you.

I don't think 9 has been covered. I'll read. While I'm reading it, you can remind us as to whether it has been or not.

Your testimony at page 5 describes seven technologies/processes you evaluated for end-of-pipe temperature reduction (cooling ponds, flow augmentation, cooling towers, heat exchange, chillers, cooling air, and surface aeration in tanks) after biological treatment of the wastewater? In other words, so all of those are technologies that would be add-on technologies after the biological treatment of the wastewater occurs, correct?

DR. ADAMS: Partially correct.

MS. FRANZETTI: Okay. What's not correct?

DR. ADAMS: One of the things you would like to do is

combine. Something I'm doing. Maybe putting air into the system with coolant. Instead of bubbling air through a biological system -- they need air to breathe and eat and chew -- I would sit a sprayer on top and spray air in that way. It would also be cooling.

The problem is -- There are many problems with that. The surface aerators we don't design much anymore because of the maintenance problem. Two, if you've got a wastewater that has foamy potential, which we have here, the motors burn out quickly. They get covered with foam. It's really a maintenance nightmare. We've taken many, many of them out. Thirdly, they don't fit into our existing tanks. They're deep tanks that were made to conserve energy. These have a big sprayer. To put enough in to cool, you're sending water all over the plant sides. It's a mess.

MS. FRANZETTI: Like a big fountain?

DR. ADAMS: Yeah, like a big fountain.

In fact, there's sprayer coolers. We did look at them. It seemed infeasible. We looked at sticking them in the effluent tank, tank no. 8, putting a spray cooler in there. It's just too big, the amount of power we need. We've got to go to a separate device.

There is one other method that we've used in Asia where we actually take the bacteria, bring them to a cooler,

and stick them back in the plant. It works, but it's a nightmare. It's foul. It's plugged all the time. It's a nightmare. We've been forced into that. We did look at that, and really and truly we've got to keep our bugs happy with one temperature and we've got to meet a discharge with another. We need a separate process, which is more money.

MS. FRANZETTI: Did I understand that correctly? You're saying you would take the bugs and cool them, put them in the fridge, so to speak, and then take them out and put them back into the aeration basins?

DR. ADAMS: We've got three plants in Brazil that did that.

MS. GARIBAY: It doesn't work real well.

MS. FRANZETTI: I am sure the bugs are not liking it.

DR. ADAMS: It was the only cooling approach that we -- Because that famous wet bulb temperature is really bad there. It was the only approach we could get a two-degree drop from the bugs. And we had special bugs, night flyers, that need a little cooler wastewaters. We know a lot about temperature. When we shiver at it, it's because we've had a lot of experience with it.

MS. FRANZETTI: And now you're saying environmentally and you yourself personally?

DR. ADAMS: Yes. I wrote that paper. I have all the

temperature problems in the world.

MS. FRANZETTI: I think that answers what the intent of my question was in 9.

DR. ADAMS: We looked in tanks. We could use the tanks, but it wouldn't work.

MS. FRANZETTI: Okay. Just so it's clear after that, of the seven temperature control technologies and processes you evaluated for the Stepan Plant -- and this is Question 10 -- which ones did you conclude were not feasible?

DR. ADAMS: Were not feasible?

MS. FRANZETTI: Yeah.

DR. ADAMS: The evaporation ponds with mechanical supplement, let's say spray cooler, because of area of volume and the foaming that was going to be spreading around the neighborhood. The heat exchangers, cooling towers. The open-cooling tower, which is probably one of the most cost effective, will be a mess because of foaming here. It's going to be plugged and foul continuously. Well, the circuit cooling tower would not get the drop we needed by itself. Independently, it would not get the temperature drop needed, so we had to do it in conjunction with the chiller. Cooling the air from blower to blower are hot. Air comes out. You get about one to two degrees impact with that. We've done that several times. It's not an effective way to cool, but

we looked at it. And surface aeration in the tanks I explained earlier.

So those were all discarded as independently being able to do it. The most efficient way was to use the closed-circuit because we have no foam air fouling with it and a chiller to help us get the water down when we need it.

MS. FRANZETTI: I'm going to step out of my pre-filed questions here for a moment.

Based on that answer, as well as some of your earlier testimony, I think some people might question the extent of the margin of safety used here, which I think was approximately three degrees; is that right?

DR. ADAMS: That's correct.

MS. FRANZETTI: And you just mentioned the technology that might get you a degree or two reduction. Is the fact that Stepan makes so many different products and, hence, its wastewater varies from product to product or what's in production at any given time, is that a contributing factor to your selection of the margin of safety of three degrees?

DR. ADAMS: No. The margin of safety -- We're going into the three degrees -- the famous Carl's three degrees. I set the number, so I defend it.

Our model -- This number -- When we design a facility for an industry, we've got to guarantee 100 percent

compliance. Now, if that's $10 million and 99 percent is 6 million, we'll discuss it. But generally we start with 100 percent, and I'd say 99 percent of the time that's the number.

Temperature is a magic thing because you're dealing with a lot of ambient statistics from 30 years of data to decide what your design conditions are, including cloud cover, humidity, solar radiation, everything you can think of. It's a good model from 1977. But there is a big deal of uncertainty. The model is one to one-and-a-half degrees in error. That's what we allow, that that modeling we're doing has a one to one-and-a-half degree flex in it that we're just not sure about.

In the design, we design conditions. We go to vendors. We get two or three different designs trying to say I'm different. I'm better. We put a half degree to a degree on that for the uncertainty of who's right and then the operation of the thing. Every one of these cooling devices, even though we claim they're non-fouling, we've got the velocity through these pipes that gets the scum on there and it inhibits some of your transport. And it's not really a fouling. It's just an inherent thing with the closed-circuit cooling towers, so we allow half a degree. It comes up about three degrees.

We say we're covered. We can guarantee you'll be in compliance. It's prudent engineering. It's not a conservative on conservative. You'd be dumb not to do that. If you're guaranteeing it, you would really have to put that three degrees in there on this equipment.

MS. WILLIAMS: When you say you really have to use your Carl's three degrees, do you always apply Carl's three degrees to the period average?

DR. ADAMS: We generally always put the 3 to 5 percent -- It's about a 3 to 5 percent factor on top of the temperature. When you're working in 90 degrees, 60 degrees, 70 degrees, the three degrees is about a 3 to 5 percent range.

MS. WILLIAMS: Did you understand my question of using -- I don't understand how your analysis accounts for the fact that the standard only needs to be met as an average. It doesn't need to be met every day.

MS. GARIBAY: But, in effect, for an operating facility you always design for a monthly average. If the permit rider gives you a monthly average permit limit, the best way to assure compliance is that you achieve that monthly average every day. Yes, you're grateful there is a daily max because there can be spills. There can be leaks. There can be upsets. But you don't design for spills, leaks,

and upsets. You design compliance for an average. For temperature, what was presented as a standard was a period average.

MS. WILLIAMS: Do you understand we're not talking about an effluent limit here? We're talking about an ambient limit. With ambient limit, the average also has to take into account variation of flow in the system as well. That's why I'm asking about this.

MS. GARIBAY: And we do understand. I mean, you know, I feel like I have a good familiarity with how in-stream standards function.

For instance, aquatic criteria is a four-day average. You then look at a mixing zone that looks at the duration and frequency of that four-day average. You have a statistical methodology where you take a four-day average to a monthly average permit limit. We haven't seen anything in the rationale or in permit fact sheets that explains how this rule is going to be implemented into monthly average discharge limits.

We have a standard with no implementation, including answering the question we were asked earlier. How are you going to do a thermal model? What are you going to look at to look at assimilated capacity for temperature? From an engineering basis for the purpose of this task as saying

Stepan -- to Stepan what could happen, all we're left with is we've got an in-stream period average. We have no idea how that goes to end of pipe. We already know that background is above that period of average. We're only left with the ability to say the period average would apply in the pipe.

DR. ADAMS: Let me answer your question on design.

We design on a max. We operate on an average for operating costs. The operating costs are based on an average. The design has to be on a design max. I'm talking about the design of the system. The design of the system is based on a design average and a design max. The angle average, that number point A to A, is only used for operating cost. Then from that we take statistical data in a normal design, and we look for the design average as a sustained period that will influence performance or economics. That's usually a three- to eight-week period over five years if we get those data. We say that's our design. It's not a max. It's a design. It's probably 20, 30 percent higher than the annual average. Then we put in aeration equipment, the temperature capability to control our design max, which is not the max, max. But it's probably a 98 percent, 99 percent number that we have the capability to get by that period. And that's how we design systems.

Then operating, the average cost and carbon footprint

and other stuff, sludge generation, we look at an average. We may not operate the equipment at max all the time. And that's what we did here. With the temperature, we assumed our chiller would be running quite a bit of the time, but not all the time. But we had to design to handle 9.4 million BTU per hour because that's what could come out of here.

MS. FRANZETTI: Am I correct in understanding that you followed Environ's typical design approach here?

DR. ADAMS: Yeah. And our three degrees is on the max and it's on the average and it's on the low number. It's on each dot in there we add to it in that Figure 4 or whatever.

MS. FRANZETTI: So the answer's yes to that question?

DR. ADAMS: Yeah.

MS. FRANZETTI: So you were not applying any extra level of conservatism here than what you normally do when you do this type of work of designing wastewater treatment systems to achieve compliance with effluent limitations or water quality standards?

MS. GARIBAY: Right. From the engineering aspect, absolutely. From the how good does effluent quality need to be, we had some data gaps that I've already keyed up for. We don't know how certain things are going to be implemented.

MS. FRANZETTI: Right.

And you don't know -- I mean, another thing you don't know is, assuming Midwest Generation complies with whatever the ultimate standards are, whether that will translate to that -- the water that is passing by the Stepan plant is still no better than just being at the water quality standard, correct?

MS. GARIBAY: Right.

MS. FRANZETTI: And is that part of your concern earlier? When you were talking about difficulty in making assumption about availability of mixing zone, you don't have a basis right now to know whether and how and when the receiving water is going to be either above, at, or just below, or way below the then applicable thermal water quality standard?

MS. GARIBAY: Right. The only data that we can make this evaluation on is data that's available to us, the data that basically is current conditions. We certainly don't have the data that says not only what would happen with upstream sources, but actually with the other things that impact temperature. Such as, this year it has been cold, wet, and rainy. Across this entire watershed and in Lake Michigan the waters are all below what they were in 2006 and 2007 where, once again, across this midwest watershed all the temperatures were higher. I mean, it's not just point

sources that are going to be impacting the temperature of the receiving water.

MS. FRANZETTI: And flow obviously is a factor in that as well?

MS. GARIBAY: Yes, absolutely.

MS. FRANZETTI: And I take it -- Are you familiar enough with the Upper Dresden Pool area that we're talking about to be aware that the flow level can really vary in that pool?

MS. GARIBAY: Yes.

MS. FRANZETTI: You're aware that at times there's little to no flow going through that?

MS. GARIBAY: Exactly.

MS. FRANZETTI: And that would affect as well the availability of a mixing zone potentially in combination with other factors?

MS. GARIBAY: Exactly. And greatly impact at a similar capacity, too, for both temperature and DO.

MS. FRANZETTI: I do think I want to ask Question 11 given just a moment. With respect to Question 11, I will read it and then let me explain what I'm looking for.

Beginning on page 8 of your testimony, you describe the economic costs involved in the technology of adding a cooling tower in combination with a heat exchanger/chiller

combination at the Millsdale Plant and identify a capital cost of $1,640,000 and O&M costs of $1,300,000 per year.

I recognize that they're there on the bottom of the page 8 of your report and there are some parentheticals included. They are for each figure. They give a little bit of description. With respect to the capital cost, what are the main components there that go into making that cost as high as 1.64 million?

DR. ADAMS: The obvious equipment cost as delivered from a vendor. That would be pre done to design standards. Then the inner piping, electrical. And there is quite a bit of electrical associated with a chiller that would have to be provided, the infrastructure to support. Then there's the actual installation itself, which can be two or three times the cost of the equipment, and the engineering fees. What is not included is start-up and operation. That's not included in that cost.

MS. FRANZETTI: Okay. Why is the O&M so high at 1.3 million a year? What's the biggest component of that?

DR. ADAMS: Electrical. Running the chiller. The chiller is 30 percent more than just the cooling tower.

MS. FRANZETTI: I'm going to move on. Just a few questions on disinfection.

Question 12. Why would Stepan have to disinfect its

wastewater in order to comply with the proposed fecal coliform standard in the proposed rules?

MS. GARIBAY: Well, basically Stepan has about 15 septic systems spread throughout the plant. The overflow, the liquid part of the septic system, goes -- commingles with their processed wastewater. They collected samples in 2008 and -- limited sampling, but all the results were greater than 400 at the final discharge point at the final effluent tank.

MS. FRANZETTI: All the samples were above?

MS. GARIBAY: Uh-huh.

MS. FRANZETTI: Okay. Move on to Question 13. On pages 9 and 10 of your testimony, you review the technologies considered for disinfection. Could you explain -- And this can be brief because, to some extent, I think you have covered this in some of your answer to the Agency's questions. Explain why you concluded that the only feasible option would be chlorination followed by dechlorination.

DR. ADAMS: I think I explained why source control would be extremely difficult. It would be quite a bit of digging the tanks up. The options end of pipe -- The three ones that are most common worldwide are chlorination, which is probably 80 percent, then using peroxide or ozone in combination with a catalyst, UV light. So light is very

important to make it work and would reduce the dosage to it. This wastewater is colored and UV lights don't penetrate the water very well, so it's not an effective method of catalytic. The other catalysts that can be used is ferric iron, and you get tremendous amounts of sludge with it. It's just not worth fooling with it. It's a mess. We've had to use it in some cases with chemical oxidation, but not with disinfection. So really peroxide and ozone are sort of high in the sky things to do. But they're not only very expensive. It's just not feasible and the foaming could very easily -- We don't know. We haven't tested it. But we have had examples with foam. It scums up the glass for the UV lights, and you have to keep them clean. There are even some that have windshield wipers on them put in to try and make them work. So, in our opinion, the peroxide and ozone are not feasible at this point without considerable testing and proof.

Chlorine is the other option, and it's the standard option. We say chlorine. And it will have to be controlled very well. The cost -- You consider good control to keep from over-chlorinating the organics in the water. Then when you put chlorine in you must dechlorinate.

MS. FRANZETTI: With respect to staying, again, with chlorination/dechlorination, a similar question to my

question regarding your costing out of the thermal control option.

With respect to your assessment of the costs involved in chlorination/dechlorination, namely capital costs of $1,771,000 and annual O&M costs of $650,000 a year, could you explain at about the same depth of detail as you did for the thermal controls what are the main reasons why those costs are as high as they are?

DR. ADAMS: Well, so high, I guess, is relative as to who's spending the money. But the reason the numbers are what they are --

MS. FRANZETTI: I wasn't accusing you of padding.

DR. ADAMS: No. We don't get by with that.

The capital costs include the same components, the equipment cost, which in this case are tanks; pumps -- very good control pumps; PH control equipment, which is instrumentation; and a storage building and equipment to bring the chlorine in. We did not decide in here whether it would be chlorine gas or a solid form that would be liquified, hyperchloride. At this usage, it would probably be chlorine gas. But it's the equipment cost. Then the installation is about twice the equipment costs, and you've got engineering and quite a bit of instrumentation with this. That's the capital.

The operating costs are chemicals primarily here. It's a chemical, where it was energy before. The energy cost was the chlorine or lower -- quite a bit lower. It's primarily chemicals.

THE COURT: Dr. Lin, do you have a question?

DR. LIN: Yes.

What chlorine dose did they design?

DR. ADAMS: It's probably in our worksheets that we provided. It's probably here. I don't remember. But I would say we designed for residual of probably -- We are using sodium hyperchloride, by the way. I did see that in here.

I've got a yearly usage that I'll have to back out. I have got a yearly usage here. I can do that in a few minutes and give it to you. And I've got a total cost for the sodium hyperchloride. But these worksheets should have the numbers in them somewhere. But I'll divide that with the flow and get a concentration.

MS. FRANZETTI: Do you want to do that now or do it at break?

DR. ADAMS: Let me do it at break.

MR. DIMOND: Why don't we do it at break. We'll provide the information subsequent.

HEARING OFFICER TIPSORD: Thank you. Go ahead.

MS. FRANZETTI: Then I'll keep going.

Move on to Question 15. On page 11 -- It's up above the beginning of Section 5 referring on the left to the category Environmental Impact. And then you list categories like effluent quality, land use, solid waste, air emissions, electrical usage. I'm going to revise my question a little bit and narrow it down.

With respect to your reference to land use minus 5700 square feet, is that how much additional area of the plant will be taken up by the addition of the treatment technology you're identifying here?

DR. ADAMS: That's correct.

MS. FRANZETTI: And I think we've already talked about solid waste generation significantly in the prior question.

MS. GARIBAY: Insignificant.

MS. FRANZETTI: Insignificant. Right, exactly.

With respect to air emissions, they would be insignificant with respect to meeting a fecal coliform standard, correct? Am I reading that right?

DR. ADAMS: Yes.

MS. GARIBAY: From the actual treatment system itself. From the actual tanks -- you know, the chlorine and dechlorination system itself, the air emissions would be

insignificant.

MS. FRANZETTI: As differentiated from your testimony with respect to having to add on technology to meet the thermal standards?

MS. GARIBAY: Right. For instance, an open cooling tower. One of the things that we keyed up in its evaluation is there are air emissions from open circuit cooling towers.

MS. FRANZETTI: All right. Move on to Dissolved Oxygen, Question 16. I think you've answered the first part of it, so I would like to focus instead on -- And we're back now to talking a bit about the assimilative capacity of the Upper Dresden Island Pool.

What was the basis for your conclusion that IEPA will implement the proposed more stringent DO criteria as an end-of-pipe limit -- that that's possible that IEPA will implement the DO water quality standard as an end-of-pipe limit? For example, have you ever seen that done in an MPS permit in Illinois?

MS. GARIBAY: Yeah. And we had two reasons for our conclusion. The first I alluded to earlier, which is an assimilative capacity had to be done, so we would assume DO would apply at end of pipe. In this case, we also did a bit of homework for looking at permits in the Lower Des Plaines watershed to see what has happened with DO. And there's been

two recent permits -- recent, in my term, meaning 2004, 2005 on -- the city of Lockport and the city of Crest Hill, where the DO limit was applied at end of pipe.

Not only was the DO limit applied at end of pipe, but it was 6 milligrams per liter at end of pipe. Not only was it 6 milligrams per liter at end of pipe, but it was a grab sample at three times a week. And it was worded as thou shall not be below 6 milligrams per liter. It wasn't worded as a seven-day average or a 30-day average. It was worded as a single grab, end of pipe, 6 milligrams per liter.

So we felt pretty comfortable at that point with saying we don't know what rationale or capacity model they would use to look at in-stream DO, and then we had these two permits specific to this watershed.

MS. FRANZETTI: Moving on --

MR. ETTINGER: Did you look at what the dilution was available in the Lockport permit or the other permit that you spoke of?

MS. GARIBAY: As dilution in mixing zones, as I mentioned earlier, we can't presume what would happen.

MR. ETTINGER: So you're presuming that there would be no mixing zone?

MS. GARIBAY: Well, there was no mixing zone at these facilities either.

MR. ETTINGER: I understand. But you didn't look at whether there was dilution available at those particular --

MS. GARIBAY: In other words, whether the facility had applied for a mixing zone and the Illinois EPA denied it?

MR. ETTINGER: Or what the flow was at the plants to which those facilities were discharged.

MS. GARIBAY: Oh, just the flatout available dilution?

MR. ETTINGER: Yes.

MS. GARIBAY: Not the mixing zone?

MR. ETTINGER: Yes.

MS. GARIBAY: Okay. Both of them run into creeks and immediately go into the Des Plaines.

MR. ETTINGER: And their permits were based on a flow based on the creek?

MS. GARIBAY: I don't know. It wasn't established in the fact sheet what was done.

MR. ETTINGER: Okay.

MS. FRANZETTI: Move to Question 17, the top of page 12 of your report. What do you mean by the statement, "Temperature and conductivity of Stepan's treated effluent impacts the ability of the treated effluent to saturate to a level to achieve potential DO"?

MS. GARIBAY: Dissolved oxygen is exactly that. It's

oxygen dissolved in water. So the characteristics of the water impacts how much oxygen can be held in that water. It's similar to a salt. Any dissolved salt solude has a limitation to how much can be dissolved. You add enough salt to water and eventually the salt stops solubilizing. A similar concept with oxygen. Salt is one of the things that competes with oxygen to be dissolved in water. So the conductivity of water, which is an indication of the salt of the water, in and of itself impacts how much oxygen can then be held in the water.

Similarly, temperature. The temperature of water affects the ability of water to solubilize a solude, like a salt or an oxygen. It's why, if you ever have very cold water and you throw salt in it, the salt crystal remains as a salt crystal. Whereas in boiling water, you throw salt in it, and it dissolves just like that.

For Stepan, the conductivity of its wastewater is about 3,000. Let's say the temperature's around 35 degrees Celsius. 100 percent saturation or 100 percent DO would equal about 6.6 milligrams per liter. That's as much oxygen as you can stuff into that wastewater. If you drop that down to 17 degrees Celsius and drop the conductivity down to around 500 and put as much oxygen in it as you can by -- in fact, to the 100 percent saturation, that number would be up

around 9.2 milligrams per liter. So that's what we're meaning when we say that, you know, there is limitations to how much oxygen you can put in a system. Those limitations are temperature and conductivity, and if you were a human being or a water bottle, what altitude you're at. Barometric pressure is the other component that plays a roll in it.

MS. FRANZETTI: And so how is the level of DO a factor in the biological wastewater treatment at the Stepan treatment plant?

DR. ADAMS: The desired oxygen for bug maintenance and processability is in the two to four milligrams per liter range. If we attempt to operate higher than that, we have two things that happen. Number one, we displace a lot of water because we're blowing in 80 percent nitrogen, 20 percent oxygen. We displace a lot of water, which generally was not allowed for in design. I haven't checked that design element here, but usually our blowers are designed at air coming in to give it two to three, four milligrams per liter. Secondly, the foaming becomes almost unbearable. You have tremendous foaming, which cranks the oxygen up.

Two, it's a waste of energy in the tank, which you're not using that. We need two to four. Generally, two to three is a design number that you use throughout. So that's

a requirement. A minimum of two, preferably three, is -- we have to have. Anything over that is a luxury as far as that system's concerned and a possible detriment as far as foaming and water displacement.

MS. FRANZETTI: Move from that and move to the gist of my next question. Can you explain then why you concluded that the only feasible option would be hydrogen peroxide addition in order to attain dissolved oxygen standards?

DR. ADAMS: We -- The mechanical device is to increase the oxygen. A chemical addition are real potential foaming nightmares because we're having to get quite a bit of oxygen in to keep the level going out to the river from where it's put in. The other options were just not feasible. Peroxide was the most economic. It was the least energy requirement. It was a substantial chemical cost, but from all sides it was the most effective -- cost effective method to go with. It didn't require any PH control.

MS. FRANZETTI: Stay with the option of hydrogen peroxide addition. Move to the next question, 19. Would you, again, briefly explain how you arrived at the cost of 250,000 in capital costs and annual O&M of 650,000 a year?

DR. ADAMS: Capital cost is relatively low with peroxide. It's the metering.

MS. GARIBAY: It's 25,000 in capital.

MS. FRANZETTI: Oh, I'm sorry.

DR. ADAMS: Oh, I'm sorry. Yeah.

The capital cost is low because it's a tank and a metering pump. The O&M costs are primarily chemicals, the peroxide cost. There is some minor labor and electrical, but it's the peroxide.

MS. FRANZETTI: I'm going to further narrow Question 20 because I understand the meaning of some of the phrases now, but I do still want to ask you what you were referring to with respect to the environmental impact on effluent quality where you say could change chemical composition by oxidizing certain chemicals?

DR. ADAMS: Peroxide is a very effective chemical oxidant. In fact, it and ozone are considered two of the more effective organic oxidants. Generally, a catalyst is needed. We're not using a catalyst here, so we're really not in a good position to predict what's going to happen to the organics with the peroxide.

But there will be organics that pass through the biological plant that were nonbiodegradable. They either were raw waste or they were metabolites that were formed by the bacteria during the bioprocess. Peroxide has a potential of breaking these compounds into shorter chain and increasing the BOD of an effluent. That's a fear factor of using it

without testing, which we haven't done here. They can break down these longer organics, which were not biodegradable, into shorter chain and increase the BOD of the effluent. All of a sudden they become biodegradable. We've got much evidence of that.

Without a catalyst, I don't know what will happen. Generally, it needs a catalyst to do that. We're not putting a catalyst in here. That's the unknown factor.

MS. FRANZETTI: All right. I'm going to move to the last three questions I have under Findings. It's Section 6, Findings. My question is Question 21.

Based on your review, what is the total potential economic impact on Stepan from the proposed use classification and water quality standards for the Upper Dresden Island Pool?

DR. ADAMS: I think the best thing is to read the note. The capital cost is $3.436 million, O&M cost 2.6 million per year. There will be an increase in chloride and sulfate in the effluent quality, which is a detriment. The land usage will be an additional 7,000 square feet, about .2 acres. The solid waste is generally insignificant. Air emissions is primarily insignificant. Electrical usage 117.8 million kilowatt hours per year. The equivalent population is about 9,000 residential customers or 32,000

people. CO2 admissions 129 or 130,000 tons a year, SOX emissions 3,057 tons a year, NOX emissions 236 tons a year, and additional mercury emissions 24.2 pounds per year.

MS. FRANZETTI: And basically that was what's stated on page 14?

DR. ADAMS: Yes.

MS. FRANZETTI: Of Exhibit 318?

DR. ADAMS: Yes.

MS. FRANZETTI: Now, you also state in your Findings section of your testimony that -- I'm on my Question 22 -- "In managing the wastewater to achieve consistent and complete compliance with the IEPA proposed discharge limits Outfall 001, Stepan will have to install and operate technologies that are well beyond the treatment considered best for organic chemical manufacturing plants." Please explain what you are referring to as the treatment considered best for organic chemical manufacturing plants?

DR. ADAMS: I'll give a technical answer to that, and Robin can supplement me with the regulatory.

In my opinion -- and I think it's documented and substantiated -- best as referred to the exemplary operating plants in the organic chemical industries, the ones that install and operate proper technologies and had exercised best management practices or source control within the

management of their wastewater prior to discharge to the treatment plant. So best included in-house management of wastewaters to decrease, equalize, smooth out wastewaters, and then the application of what was considered best technology, which was a properly designed and properly operated activated sludge facility. Stepan --

MS. FRANZETTI: Can I interrupt you just for a second?

DR. ADAMS: Yes.

MS. FRANZETTI: Dr. Adams, are you getting that information as to what does constitute the best of the exemplary OCPSF facility from information contained in such US EPA documents as the control technology documents for the OCPSF federal categorical standards?

DR. ADAMS: I'll let Robin answer the exact regulatory --

MS. FRANZETTI: I'm trying to understand where the source of your information on those plants is coming from.

DR. ADAMS: The source of my information was during the '80s and '90s when this was being applied in the beginning. Exemplary referred to -- And I believe that is in their properly designed and managed activated sludge facility. I do not think the term "best" applied to tertiary filtration. That was considered extra.

Stepan has a very sophisticated activated sludge, the most economical activated sludge the tank would require. They have two systems, one following the other, a two-stage, two-sludge activated sludge. It's more expensive than a standard. It's two sets of organisms, each one acclimated to what they're receiving. It's a very sophisticated system. They also have dual medial filters at the end of their plant, which very few industries have. That's a sophistication that, in my opinion, is beyond best. I'll let Robin address the regulations on it because they evolve and change with time.

My interpretation and in dealing with regulators was a well-managed effluent from production, a well-designed and well-operated activated sludge plant. And carbon and filters were not included in "best" if you followed the other categories. I'll let Robin address them.

MS. FRANZETTI: Before you let Robin address, can I make sure I understand?

In summary, do I understand your testimony correctly if I were to say that Stepan has in place currently a wastewater treatment plant that in some respects goes beyond even what's considered best treatment?

DR. ADAMS: In my opinion, yes.

MS. FRANZETTI: Now, Ms. Garibay, if you would like

to expound on the regulatory aspects that Dr. Adams --

MS. GARIBAY: Yeah. Where Carl was heading was, when best available technology was first defined for organic chemicals and fibers, which Stepan falls under that category of industry, it certainly didn't contemplate two-stage biological treatment and polishing with final filters. And that definition has not changed over time.

What sort of has changed over time is, as chemical plants are challenged to have effluent meet water quality standards, there has been more attention to how you actually manage that plant and what you do for source control and best management practices. You know, are you treating the wastewater treatment plant like a process unit, or are you treating it like a garbage dumpster?

In this case, you know, Stepan is treating their wastewater treatment plant like a process unit. They are showing the attention that one would do for a unit that's making the product that you make money off of. And where that shows up is in their best management practices and what they're doing in looking at source control.

MR. ETTINGER: Is Stepan operating the only sort of chemical plant like this in the Midwest?

MS. GARIBAY: Can I phone a friend?

According to Stepan -- According to Stepan, there is

no other Stepan plants in the Midwest that make these products. I mean, are there others that fall in the zip code?

MR. ETTINGER: Right. Are there others --

MS. GARIBAY: Oh, yes. There are definitely -- You know, it's a broad enough zip code that there are other manufacturers that fall in the standard industrial category and would be covered under OCPSF. Flint --

HEARING OFFICER TIPSORD: You have to talk to us.

MS. GARIBAY: The question that I rephrased was are there other facilities that are under the same categorical effluent limits as Stepan is subject to; i.e., the organic chemicals, plastics, synthetic fibers. My answer was, if that's the question, yes, there are, including across the river from Stepan, which is Flint Mills Resources, is an OCPSF categorical industry.

MR. ETTINGER: And do you know of other such plants located on general-use waters across Illinois?

MS. GARIBAY: Yes.

MR. ETTINGER: And are they able to comply with their permits?

MS. FRANZETTI: I'll -- Objection. Unless she has studied those permits.

MR. ETTINGER: Well, do you have other clients in the

Midwest in that category who are discharging into general-use waters?

MS. GARIBAY: Other clients in the Midwest?

MR. ETTINGER: Yes.

MR. DIMOND: I'm going to object. It goes beyond the scope of her testimony.

HEARING OFFICER TIPSORD: Are there -- Do you have personal knowledge of other clients in Illinois who are discharging, in this category, to general-use waters that might be having issues with permits? And, "I don't know," is sufficient if you don't.

Let's narrow it. Do you have a client in Illinois that is in this category discharging to general-use waters?

MS. GARIBAY: Not currently.

HEARING OFFICER TIPSORD: Thank you.

MS. GARIBAY: I mean, not current clients.

MS. FRANZETTI: Let me try and put this in what I think is a relevant context.

Does it make a difference whether you are dealing with a plant that had to meet OCPSF or general-use standards from the get-go versus a plant like Stepan where they were subject -- they weren't subject to general-use standards, they have been subject to secondary-contact standards, and now may have to face compliance with substantially stricter

limits? Is that making a difference in terms of why there are limited options here and their cost is relatively high? I'm sorry. That was a rather long-winded question. Let me rephrase it.

What these questions are trying to grapple with is what you said here -- what you found here in terms of it seems to be limited options, relatively high cost, why isn't this the same thing that any other OCPSF facility has faced in the country? What's different here?

MS. GARIBAY: Well, on temperature, when I think about some of our other OCPSF clients, it was an issue. As I mentioned earlier, one of the times I sat in front of this august board was to ask for a perseverance from the temperature criteria and then a site specific thermal limit for what was then an operating facility, which was the Borden Chemical Plant in Illiopolis, and we were granted a site specific thermal limit.

The Illiopolis plant was an OCPSF plant when it was running. The biological treatment system was a sound, well-managed OCPSF wastewater treatment system. It met those limits. As a matter of fact, the reason we needed alternative effluent limits is in that case they had to nitrify. They had to make sure they had the bug population to destroy ammonia. In doing that, they had to add steam to

their wastewater treatment unit in the wintertime to assure that that bug population was viable to meet the ammonia limit, which was a water quality-based ammonia limit. However, it meant they weren't meeting the thermal discharge limits.

So they went through the process with IEPA creating a variance and then through the rulemaking process. And that rule is still in the Illinois rules of site specific temperature.

Is that what you were getting at?

MS. FRANZETTI: Yeah. That's a good example.

MS. WILLIAMS: Can I ask a question?

MS. FRANZETTI: Sure.

MS. WILLIAMS: Let's talk about the Borden facility you were just talking about.

Did that facility also have a cooling pond or ditch to assist with cooling treatment?

MS. GARIBAY: When they looked at the -- When we made the application for both the variance and, in our testimony to the Board, we went through the alternatives analysis similar to this situation where you're saying, "What are our alternatives? We've got to have a warm aeration basin. What are our alternatives to now cool down to meet the thermal limits," yes, we looked at serpentine ditches, cooling ponds,

you know, cooling towers, in many ways the same suite of options that we looked at here. Their effluent quality is different. They don't make chemicals that could result in some of the foaming issues, but they had some other issues related to fouling. Out of that analysis came the fact that we were also faced with a technology that was going to cause major impacts with respect to multi-media.

Now, in looking at serpentine ditches and cooling ponds for that particular facility, it was not viewed as an option both because of land availability and where it would have to be routed to to even get to enough land or to buy the cornfield next door to put in a large enough cooling pond.

MS. WILLIAMS: Are you saying they didn't have a serpentine ditch or that they did?

MS. GARIBAY: They did not. This is some of what we looked at.

MS. WILLIAMS: For Borden?

MS. GARIBAY: Yeah. They had an oxidation ditch. That's your biological treatment. Yes, it did go through a serpentine ditch when it was discharged, but it wasn't a serpentine ditch that was necessarily built for cooling.

MS. WILLIAMS: But it provided some cooling?

MS. GARIBAY: It did provide some cooling.

MS. WILLIAMS: Are you aware of any OCPSF facilities

for whom cooling towers do represent best degree of treatment?

MS. GARIBAY: No.

MS. WILLIAMS: So you're not aware of any that use them or you're not aware that --

MS. GARIBAY: That use cooling towers after their activated sludge system?

MS. WILLIAMS: Correct.

MS. GARIBAY: No. Just to clarify, cooling towers post their activated sludge system, right.

THE COURT: Go ahead, Mr. Dimond?

MR. DIMOND: Did the court reporter get on the record that Dr. Adams had an answer as well?

HEARING OFFICER TIPSORD: No, I don't believe so.

MR. DIMOND: Okay. Dr. Adams, are you aware of any OCPSF facilities that use a cooling tower following the activated sludge treatment?

DR. ADAMS: No.

HEARING OFFICER TIPSORD: Thank you, Mr. Dimond. I wasn't sure if that was an aside or an answer.

MS. WILLIAMS: I just have one more.

Ms. Franzetti was asking a question earlier about the difference between retrofitting, I believe, to meet new standards versus being built initially to comply with

standards that are on the books. Are you aware of whether the Borden facility we ever talking about or any other OCPSF facilities in Illinois preexisted the OCPSF regulations?

MS. GARIBAY: Yes, I did.

MS. WILLIAMS: Thank you.

That's all.

MS. FRANZETTI: And I may have misspoken my question, so let me clarify it.

With respect to changing from general use to -- I'm sorry -- changing from secondary contact, less stringent water quality standards to the more stringent proposed water quality standards here, Borden was not facing those additional layers of restrictive discharge standards, correct?

MS. GARIBAY: No, they weren't.

MS. FRANZETTI: Move on then to my last question, Question 23. On page 15 of your testimony, at the end of the second paragraph, you state, "In our experience, the economic reasonableness to smaller dischargers and the overall significant multi-media impacts of technically feasible controls ought to be thoroughly considered in any proposal to modify water quality uses or water quality standards." Would you briefly describe the, quote, unquote, experience you are referring to in this testimony?

MS. GARIBAY: Okay. I think, as I mentioned earlier, when I first started working with Advent, I got thrown into OCPSF right off the bat. One of the considerations EPA went through in looking at how to define best practical technology and best available technology for that industry is they looked at all the options. They did look at multi-media impacts. In the development document for OCPSF, there's consideration of energy impacts and solid waste.

Then they looked at the option specific to the smaller chemical manufacturers. It was decided that the economic analysis that EPA conducted -- that for the smaller manufacturers that BAT, best available technology, that was going to be required of all direct dischargers would not be the basis for the smaller dischargers. And the smaller dischargers in the OCPSF is 5 million pounds product per year, and it would be defined as BT or best practical technology.

Basically, in the OCPSF process that EPA went through in looking at the impacts to the industry to upgrade their treatment, they carved out technologies specific to smaller dischargers. As well as in even the overall universe of evaluating a technology, they looked at the multi-media impacts. That's one example.

MS. FRANZETTI: Can I just ask you a follow-up on

that? I was not aware of that.

My question is, you say that for the smaller dischargers that are in the OCPSF standard EPA used a BPT instead of a BAT standard, so was the BPT standard that applied to the smaller discharger somewhat more lenient than the BAT standard?

MS. GARIBAY: Yes, it was.

MS. FRANZETTI: Oh, okay.

HEARING OFFICER TIPSORD: A point of clarification. When you refer to EPA, you mean US EPA?

MS. GARIBAY: Yes.

MS. FRANZETTI: I don't know if you remember where you were in your answer. If you wanted to add more about your experience --

MS. GARIBAY: And then sort of now taking that to the next level of improving wastewater management is looking at what happened with the water quality standards process. Where we see the consideration of the multi-media impacts and the feasibility of technologies is in consideration by boards such as the Illinois Pollution Control Board or by regulatory agencies in looking at alternatives analysis, whether that alternatives analysis is in support of alternatives technologies, whether that's in support of site specific criteria, whether it's, in terms of variances, from water

quality criteria or even in terms of establishing non-degradation standards. So in these processes and decisions making where we are asked for that information on multi-media impact and technical feasibility, we then see that considered by the decision makers in making their decisions on what is appropriate.

MS. FRANZETTI: Thank you very much.

I do not have any further questions.

HEARING OFFICER TIPSORD: Do you know what? It's almost 12:00 o'clock. Let's go ahead and take a lunch break. We'll be back around 1:00 and we'll start then.

(WHEREUPON, the hearing was adjourned until 1:00 p.m., August 13, 2009.)

STATE OF ILLINOIS)
) SS:
COUNTY OF K A N E)

I, MARGARET R. BEDDARD, a Certified Shorthand Reporter of the State of Illinois, do hereby certify that I reported in shorthand the proceedings had at the hearing aforesaid and that the foregoing is a true, complete, and correct transcript of the proceedings of said hearing as appears from my stenographic notes so taken and transcribed by me.

IN WITNESS WHEREOF, I do hereunto set my hand at Chicago, Illinois, this 14th day of August 2009.

Margaret Beddard

Certified Shorthand Reporter

CSR Certificate No. 84-3565.

A

ability 17:2 20:2 21:4,8 54:24 67:5 79:22 80:12
able 5:12 17:21 18:4 22:3,13 23:23 30:24 48:5 63:4 89:20
about 18:2 23:19 26:15 29:20 31:23 35:22 37:3,12 39:20 40:6 41:19 44:7 45:2 46:5,10 46:24 48:14 49:16 50:10 53:10 54:7,7,8 57:19 58:8 61:19 62:23 64:13,23 65:10 65:12 66:5,5,8 67:10 69:9,10 70:8 72:3 74:6 74:22 76:14 77:11 80:18,20 84:20,24 91:11 92:14,15 94:22 95:2 97:13
above 20:2,17 24:8 36:19,22 67:4 69:12 72:10 76:2
above-entitled 1:9
absolutely 68:21 70:5
accept 26:16
acceptable 54:19 57:1
accepted 9:18
acclimated 87:5
accommodate 19:10
According 43:5 44:6 88:24,24
account 17:5 22:7 66:7
accounts 65:15
accusing 74:12
achieve 40:23 49:20 65:21 68:18 79:23 85:11
achieving 50:2
acknowledge 5:8
acknowledged 5:9
acquired 13:11
acres 84:21
across 5:18 69:21,23 89:14 89:18
Acting 4:8 5:21
activated 86:6 86:22 87:1,2,4 87:14 94:7,10 94:17
actual 7:16 71:14 76:22,23
actually 9:18 30:8 32:21 43:24 47:1 60:24 69:19 88:10
Adams 3:2 4:19 4:21 6:6,22 7:6 8:11,24 10:7 10:10 11:9,24 12:4,8 13:12 13:16,18 15:19 16:11 25:6 26:13,18,22 27:7,10 28:1,5 28:17 29:16,19 33:19 37:17,22 37:23 38:5,9 38:12,15 39:2 39:9,24 42:1 45:22 46:2,8 46:16 47:14 49:5,21 51:20 52:7,21 53:3 53:23 54:16 55:15 56:12 57:23 58:24 59:22,24 60:17 61:11,15,24 62:4,10,12 63:13,20 65:9 67:6 68:9,14 71:9,20 72:19 74:9,13 75:8 75:21 76:12,21 81:10 82:9,22 83:2,13 84:16 85:6,8,18 86:9 86:10,15,19 87:23 88:1 94:13,15,18
add 36:11 47:12 57:22 68:11 77:3 80:4 91:24 97:13
adding 25:23 70:23
addition 16:19 22:8 26:4 44:23 57:21 76:10 82:8,10 82:19
additional 12:8 38:23 43:3 76:9 84:20 85:3 95:13
address 24:22 24:23 44:10 87:9,16,17
addressed 26:8
add-on 59:20
adequate 15:20
adjourned 98:12
adjusted 32:20
Adm 1:6 4:6
admissions 85:1
admitted 9:19
adopted 39:7
adoption 51:11 51:17
advantage 16:4
Advent 13:11,12 13:14 50:12 96:2
Aerated 10:5
aeration 16:19 59:18 61:10 63:1 67:19 92:22
aerators 60:7
affect 53:21 70:14
affects 80:12
aforesaid 99:9
after 4:23 5:8 25:8 52:14 53:5,17 59:18 59:20 62:6 94:6
afterwards 57:5
again 31:19 35:24 43:24 58:11 69:23 73:23 82:20
against 56:12
agencies 97:21
Agency 2:7,11 3:3 11:2 14:14 33:10,10,21 49:10
Agency's 31:11 31:15 72:16
ago 12:2 39:8
ahead 8:4 25:11 75:24 94:11 98:10
aimed 49:15
air 37:18 38:1,6 39:13 57:15 58:11,16 59:17 60:1,2,3,4 62:22,22 63:5 76:5,18,24 77:7 81:18 84:21
Albert 4:20,21 23:1
algae 31:7,7
allow 45:15 64:11,23
allowed 23:17 57:3 81:16
alluded 77:20
almost 81:19 98:10
along 49:8
already 14:13 18:17 24:8 28:11 39:4 49:11 52:22 55:12 67:3 68:22 76:13
alternative 91:22
alternatives 92:20,22,23 97:21,22,22
Although 6:9 9:1
altitude 81:5
always 25:22 65:7,9,19
ambient 12:9 57:15 64:6 66:5,6
Amendments 1:6 4:6
ammonia 30:20 51:23 91:24 92:2,3
amount 12:11 19:24 21:15 48:6,10 60:21
amounts 73:5
anaerobic 26:22 28:1
anaerobically 27:2
analysis 11:6,9 13:20 16:9,13 17:16 18:23 19:4,8,11,12 23:4 24:23 29:22 30:5 36:17 41:1 65:15 92:20 93:5 96:11 97:21,22
analytically 29:9
analyze 15:2
analyzing 14:15
Anand 2:3 4:13
Andrea 4:11

angle 67:11
annual 67:19 74:5 82:21
another 16:17 57:5 61:6 69:1
answer 17:11 18:4 20:21,22 21:1 22:4,13 22:15 35:16 36:12 42:3 47:7 49:9 63:9 67:6 72:16 85:18 86:15 89:13 94:13,20 97:13
answered 12:1 39:4 41:8 42:7 44:9 45:6 77:9
answering 66:21
answers 42:23 52:13 55:6 62:2
answer's 68:13
anti-degradati... 51:11
anymore 60:7
Anyone 5:6
anything 14:19 28:10 42:17 57:20 66:16 82:2
anywhere 36:5,6 58:17
appeared 2:5,10 2:14,18
appears 99:11
applicable 23:19 34:14 35:6 69:13
application 43:11 86:4 92:19
applications 12:10
applied 11:11 15:23 78:3,4 79:4 86:20,23 97:5
apply 57:9 65:7 67:5 77:22
applying 68:15
appointed 4:2
appreciate 47:23
approach 11:9 11:14 12:12 15:21 44:15 57:8 61:15,17 68:8
approached 11:15
approaches 16:1 50:8 57:24
appropriate 11:12 41:3 98:6
approximately 39:2 57:19 63:12
April 11:17 15:15
aquatic 66:12
area 1:5 4:5 27:23 28:2 53:15 62:13 70:7 76:9
areas 28:20 37:18
arena 21:5
Argamon 10:6
argue 41:4 42:10
argument 42:11
arguments 40:19
around 53:16 58:5 62:14 80:18,23 81:1 98:11
arrived 82:20
article 10:4,9
Asia 60:23
aside 94:20
asked 5:13 6:21 8:12 40:12,12 66:21 98:3
asking 11:4 14:21 35:10,11 66:8 94:22
asks 9:13
aspect 14:2 35:17 68:20
aspects 88:1
assess 15:3 21:8 30:3
assessment 36:21 74:3
assigned 16:16 23:8
assigning 16:21
assimilate 17:2 21:9
assimilated 18:10 66:23
assimilation 21:4
assimilative 30:3,7,9,11,14 30:24 31:9 35:20 77:11,21
assist 29:4 92:17
associated 71:12
assume 16:9 17:13,14 20:23 20:24 77:21
assumed 21:3 68:3
assuming 18:6 18:23 21:11 58:2,4 69:2
assumption 35:13 69:10
assumptions 35:11
assure 43:4 65:21 92:1
attached 52:16
attain 82:8
attainability 40:16
attempt 81:12
attention 37:24 43:14 88:10,17
attorney 6:4
attractive 27:15
augmentation 16:4 59:16
august 1:15 34:24 91:13 98:13 99:14
authored 10:10
availability 69:10 70:15 93:10
available 18:1 30:20 69:16 78:17 79:2,7 88:3 96:5,12
Avenue 2:7
average 16:3 17:4,8 18:7 21:13,18,21,22 21:23 22:1 32:7,7 65:8,17 65:19,20,22 66:1,3,6,12,14 66:15,16,18 67:2,4,5,7,9,11 67:12,14,19,24 68:1,10 78:9,9
averages 17:1 19:9,19
avoid 26:5
aware 70:8,11 93:24 94:4,5 94:15 95:1 97:1
away 39:12 47:1
a.m 1:15

B

B 3:7
back 5:18 9:17 24:12 28:2 48:4,22 50:12 57:2 61:1,10 75:13 77:10 98:11
background 13:6 16:16,21 17:13 23:8 24:8 43:23 44:2,4 67:3
bacteria 24:15 42:16 53:24 55:18 60:24 83:22
bad 26:7 28:8 61:16
balance 17:21 19:14 21:9
Barometric 81:5
based 5:1 12:6 16:2 24:7 31:19 33:7 44:13 46:2,19 46:23 52:13 63:9 67:8,11 79:14,15 84:12
basically 13:18 15:9,14,20 16:14 25:7 48:18 56:12 69:17 72:3 85:4 96:18
basin 53:17,18 92:22
basins 61:10
basis 10:10 21:23 22:15 35:12 66:24 69:11 77:13 96:14
bat 96:3,12 97:4 97:6
became 13:14
become 84:4
becomes 54:24 81:19
BEDDARD 1:12 2:20 99:7
before 1:10,11 5:10 47:12 75:2 87:17
begin 4:20 5:1 5:10 10:22 11:16 43:2 49:1 55:2
beginning 41:23 70:22 76:3 86:21
behalf 2:5,10,14 2:18 4:19 11:1 11:4 49:3
being 19:19 20:1 21:17 23:22

30:24 33:17 56:7 63:3 69:5 81:5 86:20 94:24
believe 12:1 24:19 27:19,21 32:11,15,17 37:1 39:7,22 44:9 45:6 48:12 57:18 86:21 94:14,23
below 18:7 19:23 34:14 35:6 36:19 69:13,13,22 78:8
best 65:21 84:16 85:15,17,21,24 86:2,4,11,23 87:9,15,22 88:3,11,19 94:1 96:4,5,12 96:16
better 64:16 69:5
between 16:18 18:1 21:18 47:3 48:13 50:18,23 94:23
beyond 24:19 25:1 85:14 87:9,21 90:5
bias 5:16
big 60:14,16,17 60:21 64:9
bigger 56:19
biggest 71:19
Bilandic 5:19
biodegradable 54:3 84:2,4
biological 10:5 18:12 25:9 26:21 50:4 53:24 54:6 55:4 56:6 57:3 59:18,20 60:3 81:8 83:20 88:6 91:19 93:19
biologically 18:12 56:22
bioprocess 83:22
biosystem 56:20 56:21
bit 22:12 24:19 25:1 50:10 56:10 68:4 71:5,11 72:20 74:23 75:3 76:7 77:11,22 82:11
Blankenship 2:4 4:10
blower 62:22,22
blowers 39:16 81:17
blowing 81:14
blow-down 53:8 53:9
board 1:1,11 2:6 4:2,9,10,11,11 4:12 5:13 32:23 42:22 51:10,16 91:13 92:20 97:20
boards 97:19
Board's 5:15 32:23
Bob 11:22 12:20
BOC 50:6
BOD 30:21 31:1 31:2 83:24 84:3
body 30:12 35:14,20,23
boiler 53:7,9
boiling 80:15
books 95:1
Borden 91:15 92:14 93:17 95:2,12
both 6:20 30:10 45:21,24 46:4 46:9 70:18 79:12 92:19 93:10
bottle 81:5
bottom 71:3
Box 2:8
BPT 97:3,4
Brazil 61:11
break 48:22 75:20,21,22 84:1 98:10
breaking 83:23
breathe 60:3
bridge 16:18 18:15 31:20,22 34:14 35:6 36:13,19,23 37:4
brief 72:15
briefly 52:24 82:20 95:23
bring 60:24 74:18
broad 89:6
Brown 2:12 6:5 11:22
BT 96:16
BTU 68:5
BTU's 59:1,3
bubbling 60:2
bug 81:10 91:23 92:2
bugs 54:13 57:6 61:4,8,14,18 61:18
build 5:14
building 5:19 74:17
built 25:17 93:21 94:24
bulb 46:16 61:16
bulleted 15:19
buried 25:16
Burke 11:22 12:20
burn 60:9
buy 93:11

C

calculate 38:5
calculating 21:13
calculations 10:11 16:1 22:20
call 36:4 50:13
called 1:10
came 43:13 93:5
campaign-sch... 55:16
capability 67:20 67:22
capacity 18:6,10 30:3,7,9,11,14 30:24 31:10 35:20 66:23 70:18 77:11,21 78:12
capital 71:1,6 74:4,14,24 82:21,22,24 83:3 84:17
carbon 37:19 38:2 56:9 67:24 87:14
carbonations 31:1
Carl 3:2 4:18 6:6 7:6 8:11 10:7 11:24 13:12 42:1 88:2
Carl's 63:21 65:7,7
carved 96:20
case 33:17 45:16 48:19 58:13 74:15 77:22 88:15 91:22
cases 51:21 73:7
catalyst 72:24 83:15,16 84:6 84:7,8
catalysts 73:4
catalytic 73:4
catch 25:9
categorical 86:14 89:11,16
categories 76:4 87:16
category 76:4 88:4 89:7 90:1 90:9,13
cause 1:10 21:16 21:21 39:22 40:4 42:4,14 93:6
caused 36:18 39:6
Cecil 52:1,4,5
Celsius 80:19,22
Center 5:3
centigrade 54:8 54:10
central 27:18
certain 43:4 68:23 83:12
certainly 19:13 30:19 32:5 40:20,21 41:3 42:19 47:3 69:17 88:5
Certificate 99:21
Certified 1:13 99:7,19
certify 99:8
CFU 26:12
chain 83:23 84:3
Chairman 4:8 5:21
challenge 19:13
challenged 88:9
chamber 26:22
change 14:4 17:16 55:21 83:11 87:10
changed 88:7,8
changes 23:16 45:3
changing 95:9 95:10
characteristics 80:1
charge 13:24 23:14
cheaper 56:20
check 33:11
checked 81:16
chemical 21:6 38:2 49:23

50:5,7 54:6 58:14 73:7 75:2 82:10,15 83:11,13 85:15 85:17,22 88:8 88:22 91:16 96:10
chemicals 15:1,3 50:14,22 75:1 75:4 83:4,12 88:4 89:13 93:3
chew 60:4
chewed 54:3
Chicago 1:5,14 2:13 4:4 5:5 99:14
chiller 46:4 58:14 62:21 63:6 68:4 71:12,20,21
chillers 59:17
chloride 43:9,18 43:19,24 44:21 45:4 84:18
chlorides 43:21
chlorinate 25:11
chlorinated 26:1 44:23 45:4
chlorinating 44:22
chlorination 44:20 72:18,22
chlorination/d... 47:20 73:24 74:4
chlorine 25:23 26:4,6 73:18 73:19,22 74:18 74:19,21 75:3 75:7 76:23
chore 55:24
circuit 62:18 77:7
city 78:2,2
claim 64:19
clarification 7:22 22:19 97:9
clarify 7:8 34:4 42:9 94:9 95:8
classification 84:14
classified 52:2
clean 28:1 73:13
cleaning 55:19
cleansers 55:19
clean-outs 53:5
clear 59:5 62:6
clearly 30:7
client 90:12
clients 49:24 89:24 90:3,8 90:16 91:11
closed-circuit 45:24 46:9 63:5 64:22
closer 27:20
cloud 64:7
coal 46:22 47:9
coal-fired 46:20 46:24
coal-powered 47:5
code 1:6 4:6 89:3,6
coefficients 31:8
cold 69:20 80:13
coliform 15:5 72:2 76:19
coliform's 25:10
collect 27:11,12 35:22
collected 25:15 28:6 29:6 72:6
collecting 29:23 44:3
collection 27:18
colored 73:2
column 52:17
combination 70:15,24 71:1 72:24
combine 60:1
combined 6:19 38:19,20,21
come 6:23 15:17 25:18 36:9 48:22 53:6 68:6
comes 27:24 47:5 62:22 64:23
comfortable 16:20 41:11,15 47:4 78:11
coming 16:3,21 17:18 22:6,8 25:10 28:21 52:19 53:1 55:18 81:18 86:18
commenting 50:16
comments 37:7 40:1
commingles 72:5
committee 50:16
common 72:22
commonly 16:6
company 2:14 4:19 6:5,8 44:14 55:16
Company's 8:9 8:11
compared 17:1
comparing 34:6
competes 80:7
complete 5:14 43:14 85:12 99:10
complex 22:5
compliance 14:19 22:1 31:13,17 32:1 43:4 56:4 64:1 65:2,21 66:1 68:18 85:12 90:24
complies 69:2
comply 22:21 23:11,11,23 38:7,24 58:22 72:1 89:20 94:24
complying 24:23 24:24
component 71:19 81:6
components 31:6 54:1,2 71:7 74:14
composition 83:12
compounds 83:23
Comprehensive 10:5
concentrated 25:22
concentration 16:17 25:12 44:4 75:18
concentrations 17:13 25:24 43:23 44:2
concept 57:24 80:6
concern 44:7 69:8
concerned 37:24 44:5 82:3
concerns 45:18
conclude 42:14 62:9
concluded 72:17 82:6
conclusion 31:12,16 35:12 42:19 77:13,20
conclusions 44:10
conditions 14:20 15:18 23:14,15 55:20 64:7,14 69:17
conduct 19:11
conducted 96:11
conductivity 79:21 80:8,17 80:22 81:4
confidence 28:18
conformed 29:8
confused 20:7
confusing 7:23
conjunction 32:20 62:21
conservation 56:9,13
conservatism 68:16
conservative 65:3,3
conserve 60:13
consider 42:14 42:21,22 45:17 53:8 73:20
considerable 73:16
consideration 42:3 96:8 97:18,19
considerations 45:14 96:3
considered 41:1 42:20 72:14 83:14 85:14,16 86:4,24 87:22 95:21 98:5
consisted 11:9 12:8
consistent 55:23 56:2 85:11
constituents 21:6,6
constitute 86:11
constructed 27:13
consult 12:17
consultant 50:22
consulted 51:6
consulting 13:9
consume 30:17 36:9
contact 95:10
contained 86:12
contaminated 53:15
contemplate 88:5
context 45:11,13 90:18
continuing 4:15

continuously 62:18
contrary 56:8
contributing 63:18
control 1:1,11 2:6 16:8 25:9 25:14 27:15 50:18 56:17,24 57:4 62:7 67:20 72:19 73:20 74:1,16 74:16 82:17 85:24 86:13 88:11,20 97:20
controlled 73:19
controls 43:3 54:21 74:7 95:21
converted 54:3
cool 46:3 47:13 56:14,19,24 57:2,7 58:12 60:14 61:8 62:24 92:23
coolant 60:2
cooler 54:22 55:1 60:20,24 61:19 62:13
coolers 60:18
cooling 12:12 46:1,9,10,13 46:17 48:6,11 48:15,16,18 53:8 57:24 58:11 59:16,17 59:17 60:5 61:15 62:15,19 62:21 64:18,23 70:23 71:21 77:5,7 92:16 92:17,24 93:1 93:8,12,21,22 93:23 94:1,6,9 94:16
copies 8:8 33:24
copper 44:8
cornfield 93:12
Corporation 6:6
correct 7:11,18 12:4 20:18 21:11 40:4 47:23 52:7,15 52:21 59:21,22 59:23 63:13 68:7 69:6 76:12,20 94:8 95:14 99:10
corrected 9:2
corrections 8:24
correctly 61:7 87:19
cost 9:13,15 13:20 24:21,22 24:23 29:22 50:7 56:13 62:16 67:13,24 71:2,6,7,9,15 71:17 73:20 74:15,21 75:2 75:15 82:15,16 82:20,22 83:3 83:5 84:17,17 91:2,7
costing 11:12 74:1
costs 23:18 67:8 67:8 70:23 71:2 74:3,4,5,7 74:14,22 75:1 82:21 83:4
counsel 7:19 8:8 40:2
country 91:9
County 1:12 99:3
couple 20:11
court 5:11 51:22 75:5 94:11,12
cover 16:6 64:8
covered 49:11 49:14,17 59:11 60:10 65:1 72:16 89:8
CO2 38:23 54:4 57:20 85:1
cranks 81:20
creates 57:12
creating 58:6 92:6
creek 79:15
creeks 79:12
Crest 78:2
criteria 43:4 44:1 50:20,21 51:10,14,16 66:12 77:14 91:14 97:24 98:1
critical 30:23
cross-media 37:15,23 39:10 40:21,22
crystal 80:14,15
CSR 2:20 99:21
curious 17:12
current 14:12 14:16 23:14,15 34:13 35:3,5 69:17 90:16
currently 24:5 31:12,17 44:3 87:20 90:14
curve 59:2,2
customers 84:24

D

D 3:1
daily 65:23
damage 39:6,10 39:21,23 40:4 40:5,8,15,24 42:5,15,20
Dan 6:8 11:21 12:20
data 9:1 12:21 15:9 16:23 18:15,17 19:2 23:7 26:11 30:3,5,6,18,19 31:6,9,20 32:6 34:6 36:21 43:9,11,14,16 44:3,4 64:6 67:13,17 68:22 69:15,16,16,18
data's 30:11
date 15:14
day 4:15 5:22 29:19 48:6,10 48:19 59:3 65:17,22 99:14
days 48:14,15,16
deal 64:9
dealing 50:1 64:5 87:12 90:19
DEBORAH 2:9
decant 53:11,11 53:13,17
dechlorinate 73:22
dechlorination 44:20 72:18 76:24
decide 25:4 64:7 74:18
decided 26:3 96:10
deciding 45:14
decision 5:15 98:5
decisions 98:3,6
decrease 86:3
deep 60:13
defend 63:22
define 21:20 22:9 96:4
defined 30:8 88:3 96:16
definitely 31:21 43:18 89:5
definition 88:7
degrade 54:1
degrading 56:22
degree 17:22,22 54:12,19 56:2 63:15 64:12,16 64:16,23 94:1
degrees 17:9 54:7,7,8,16,17 55:2 62:23 63:12,19,21,21 64:10,24 65:5 65:7,8,11,11 65:12,12 68:9 80:18,22
delineating 11:10
delineation 13:20
deliverables 14:2
delivered 71:9
delta 21:18
demand 31:2
denied 79:4
depending 21:20
depends 22:5 36:7
depth 45:2 74:6
Des 1:5 4:5 14:10 18:2,21 45:10,11 77:23 79:13
describe 70:22 95:23
describes 59:14
description 36:14 71:6
design 13:21 15:21,24 16:7 16:7 21:14 50:1 57:23 60:7 63:23 64:7,14,14 65:19,24 66:1 67:6,7,9,9,10 67:10,11,11,14 67:14,17,18,20 67:23 68:5,8 71:10 75:7 81:16,17,24
designed 21:12 75:10 81:18 86:5,22
designing 68:17
designs 64:15
desire 49:13
desired 81:10
destroy 91:24
destroyed 57:13
detail 25:3 45:2 74:6
details 9:13

11:15 24:14
detergent 52:1
deteriorate 54:23
determining 41:1
detriment 82:3 84:19
develop 12:18 30:6,11
developed 30:2
developing 11:19 30:13 50:7
development 12:9 96:7
device 16:8 60:22 82:9
devices 39:15 64:18
diagram 29:4
dialogue 43:10
Diers 2:9 11:3,4 11:16,19 12:1 12:5,17,22,24 13:2,8,16,22 14:8,17,21,24 15:10,17 16:9 16:13 18:23 19:4 24:11,13 25:4 26:11 29:17,22 30:1 31:11,15,23 37:15 39:4 43:1,2,7,16 44:3,5,9 45:6 45:20,23 46:18 47:11,16 48:1 48:20
difference 19:5 19:8,14 48:2,3 90:19 91:1 94:23
differences 46:11
different 9:2 25:18 26:8 27:16 34:13,15 35:3,5,15,24 44:24 53:1 63:16 64:15,16 91:9 93:3
differentiated 77:2
difficult 56:16 72:20
difficulties 46:6
difficulty 69:9
digest 53:13
digested 53:17
digesters 53:12
digging 72:21
dilute 28:10
dilution 18:1,3 78:16,19 79:2 79:8
Dimond 2:13 6:3,4,19 7:18 8:4,6,22 9:11 10:4,19 11:23 19:15,22 20:5 24:17 32:13 33:22 37:1 38:4,10,13,21 39:3 40:7,18 41:6,9,16 42:6 42:17 75:22 90:5 94:11,12 94:15,19
Dimond's 20:22
dips 36:5
direct 13:7 47:1 47:3 96:13
directly 44:11 53:6
director 13:18
direct-contact 46:1
disagree 31:11 31:15
discarded 63:3
discharge 15:24 17:3,4,19 18:11,21 19:17 19:23,24 20:10 20:16 21:16,19 22:11,12,21 23:6 29:7 36:18,22 37:11 37:11,13 43:12 44:24 48:7 50:3,21 56:8 58:22 61:5 66:19 72:8 85:12 86:1 92:4 95:13
discharged 14:10 79:6 93:20
discharger 16:18 18:1 36:6 97:5
dischargers 45:16,17 95:19 96:13,14,15,21 97:3
discharges 16:10 18:9,18 20:19 23:5,11
discharging 35:14 90:1,9 90:13
discuss 64:2
discussion 7:2 52:10
discussions 38:1
disinfect 25:8,13 71:24
disinfectant 25:21
disinfection 11:8 12:11 24:21,22 25:5 26:9 28:10 38:16,17 71:23 72:14 73:8
displace 81:13 81:15
displacement 82:4
dissolved 11:8 24:24 30:4,14 30:17,17 31:5 31:10 36:9 38:18 42:15 43:23 47:12 77:8 79:24 80:1,3,4,7 82:8
dissolves 80:16
District 5:4 52:6
ditch 92:16 93:14,18,20,21
ditches 92:24 93:8
divide 75:17
docket 4:7 32:22 32:23
document 8:1 8:19 9:8 10:1 10:16 50:17 96:7
documented 85:20
documents 8:14 9:15 32:10,15 32:19 86:13,13
doing 17:17 60:1 64:11 88:20 91:24
domestic 29:23
done 19:12 22:20 23:4 29:22 30:9 36:17 43:7 57:2 62:23 71:10 77:17,21 79:17 84:1
door 93:12
dosage 73:1
dose 75:7
dot 48:10,19 55:18 59:6 68:11
dots 48:10
down 26:7 28:9 28:9,10 52:17 54:8 56:14,24 57:7 63:6 76:7 80:21,22 84:2 92:23
downstream 16:18 18:19 36:7,7
Dr 4:18,21 5:20 6:6,22 7:6 8:24 10:10 11:9 12:4,8 13:12 13:16,18 15:19 16:11 25:6 26:13,18,22 27:7,10 28:1,5 28:17 29:16,19 33:19 37:17,22 37:23 38:5,9 38:12,15 39:2 39:9,24 45:22 46:2,8,16 47:14 49:5,21 51:20 52:5,7 52:21 53:3,23 54:16 55:15 56:12 57:23 58:24 59:22,24 60:17 61:11,15 61:24 62:4,10 62:12 63:13,20 65:9 67:6 68:9 68:14 71:9,20 72:19 74:9,13 75:5,6,8,21 76:12,21 81:10 82:9,22 83:2 83:13 84:16 85:6,8,18 86:9 86:10,15,19 87:23 88:1 94:13,15,18
drain 26:24,24 28:2
drains 28:19
Dresden 30:4 31:12,16 34:12 34:21 70:7 77:12 84:15
Drive 2:12
driver 56:16
drives 22:1
drop 61:18 62:19,20 80:21 80:22
dual 87:7
due 43:20 45:8
duly 6:12 41:17
dumb 65:3
dumpster 88:14

duration 66:13
during 46:14 57:4 83:22 86:19
dynamics 35:23 36:3
D.C 2:16

E

E 3:1,7 10:7 99:3
each 5:11 11:11 11:13 14:20 25:20,20 48:5 48:10,10 59:3 68:11 71:5 87:5
earlier 12:20 49:14 51:13 57:19 63:2,9 66:21 69:9 77:20 78:20 91:12 94:22 96:1
easier 56:19
easily 73:10
East 2:7
eat 54:13 60:3
eaten 54:3
economic 70:23 82:14 84:13 95:18 96:11
economical 56:18 58:12 87:2
economics 67:15
effect 65:18
effective 50:8 56:14 62:17,24 73:3 82:16,16 83:13,15
effectiveness 56:13
efficiency 58:8
efficient 63:4
effluent 1:4 4:4 14:6,9,15 15:4 16:10 24:15 25:4 26:8,9,12 30:21,22 44:13 44:15,21 45:1 45:3,5,9 47:13 49:20 50:3,13 50:24 51:22 56:8 57:13,14 60:20 66:5 68:18,21 72:8 76:5 79:21,22 83:11,24 84:3 84:19 87:13 88:9 89:12 91:22 93:2
effort 25:19
efforts 13:3
eight-week 67:16
either 32:6 42:18 69:12 78:24 83:20
elaborate 54:21
electric 46:19
electrical 58:7 71:11,12,20 76:6 83:5 84:22
electricity 58:8
element 81:17
eliminate 49:8
elsewhere 12:13
emission 46:23
emissions 38:6 38:23 46:19 50:7 57:20 76:5,18,24 77:7 84:22 85:2,2,3
end 15:16,23 37:22 44:18 46:15 56:17 67:3 72:21 77:22 78:3,4,5 78:6,10 87:7 95:17
ending 15:16
end-of-pipe 44:2 59:15 77:15,16
energy 37:19 38:1 39:13,15 39:17 57:12,16 57:17 58:5,6,7 60:13 75:2,2 81:22 82:14 96:8
engineer 14:7 57:9
engineering 57:1 65:2 66:24 68:20 71:15 74:23
engineers 14:6
enough 46:3 60:14 70:7 80:4 89:6 93:11,12
enter 8:7,15,23 53:5 57:23
entered 4:23
enters 53:20
entire 25:13 69:21
entitled 4:3 20:9 24:9
Environ 6:6 8:13 11:23 13:4,6,8,9,11 13:14 32:14 33:23 34:5
environment 50:16
environmental 2:7,10 3:3 5:3 11:2 13:10 23:3 39:6,10 39:20,22 40:4 40:5,8,15,24 42:5,15,19 57:15 76:4 83:10
environmenta... 61:22
Environ's 68:8
EPA 8:9 9:12,13 11:5 19:19 24:16 30:2,8 35:24 42:20 79:4 86:13 96:3,11,18 97:3,10,10
EPA's 8:10 9:4 38:24 39:7
equal 46:5 80:20
equalize 86:3
equate 39:21
equation 39:18
equipment 12:16 58:1,4,5 58:18 65:5 67:19 68:2 71:9,15 74:15 74:16,17,21,22
equivalent 84:23
equivalents 37:20 38:3,6
error 64:11
essentially 49:9
established 79:16
establishing 98:1
estimate 38:22
estimated 29:19 58:21
Ettinger 23:1,1 23:9 34:10,11 34:16,20 35:5 35:10,18 36:17 36:22 37:10 78:16,21 79:1 79:5,9,11,14 79:18 88:21 89:4,17,20,24 90:4
evaluate 43:3
evaluated 59:15 62:8
evaluating 11:12 96:22
evaluation 13:20 24:14 43:7,13 43:15 69:16 77:6
evaluations 9:14
evaporate 46:3
evaporation 58:3,11 62:12
even 35:14 54:11 55:23 56:16 64:19 73:13 87:22 93:11 96:21 98:1
event 49:10
eventually 36:3 80:5
ever 77:17 80:13 95:2
every 18:21 27:24 33:6 64:18 65:17,22
everyone 4:1
everything 25:12 50:4 64:8
evidence 84:5
evident 56:6
evolve 87:10
exact 86:15
exactly 22:17 49:24 70:13,17 76:17 79:24
examined 33:6
example 45:19 57:15 77:17 92:11 96:23
examples 73:12
exceed 34:23
exceedence 21:21
exceeding 26:12
exceeds 19:18
except 22:13
exchange 58:15 59:17
exchangers 62:15
exchanger/chi... 70:24
excluding 14:14
Excuse 17:10
exemplary 85:21 86:12,21
exercise 18:8
exercised 85:23
exhibit 4:22,24 6:15,16 7:1,6 7:14,16,20,24

8:2,15,17,18 8:20,22 9:6,7,9 9:11,18,20,20 10:2,4,14,15 10:17 12:2,3 12:15 15:13,18 24:15,18,20 30:2 32:11,16 33:1,2,6,12 34:1 37:9 38:11 48:2 52:16 59:9,10 85:7
exhibits 3:8 8:5 8:7 33:9
existing 17:19 34:7 60:12
exothermic 56:23
expects 43:19
expensive 73:9 87:4
experience 12:6 12:10,11 24:8 49:18,21 50:2 50:10 61:21 95:18,23 97:14
expert 41:5 49:16 51:20
explain 11:6 13:17,23 40:9 40:12 41:21 47:18 48:2,3 55:12,13 56:10 70:21 72:14,17 74:6 82:6,20 85:16
explained 55:12 63:2 72:19
explaining 35:21 41:13
explains 66:17
expound 88:1
express 5:15
expressed 37:20 58:24
expression 38:3
extended 16:23
extent 24:3 63:10 72:15
extra 58:17 68:15 86:24
extremely 72:20
extremes 54:9
Exxon 4:20
eye 51:2
E-t-t-i-n-g-e-r 23:1

F

face 90:24
faced 91:8 93:6
facilities 18:24 19:5 78:24 79:6 89:11 93:24 94:16 95:3
facility 17:7 27:19 53:2 63:23 65:19 79:3 86:6,12 86:23 91:8,15 92:14,16 93:9 95:2
facing 35:4 95:12
fact 15:24 16:2 49:10 51:2 55:15 60:18 63:15 65:16 66:17 79:17 80:24 83:14 91:21 93:5
factor 16:1,6 17:8 39:21,22 40:15,16,16 42:14 63:18 65:10 70:3 81:8 83:24 84:8
factors 40:2,3 42:5 70:16
Fahrenheit 17:9 54:8,11,12,16 54:20 55:2
fair 20:3 41:4 42:21
fairly 56:2
fall 53:15 89:2,7
falls 88:4
familiar 70:6
familiarity 66:10
famous 61:16 63:21
far 4:10,12 36:22 43:16 82:2,3
fear 83:24
feasibility 97:19 98:4
feasible 62:9,10 72:17 73:10,16 82:7,13 95:20
February 34:24
fecal 15:5 25:10 26:12 28:14,15 28:21 29:8 72:1 76:19
federal 86:14
federation 50:16
feel 41:14 66:10
fees 71:15
feet 22:11,12 76:9 84:20
felt 16:20 41:22 47:3 78:11
ferric 73:4
few 12:2 23:2 32:4 71:22 75:14 87:8
fibers 50:15 88:4 89:13
field 12:7 26:24 27:1 28:2
figure 8:23 15:15 29:13,15 29:16 48:5 52:15 59:5,6,6 59:7 68:11 71:5
figures 46:19,23
file 37:5
filed 5:2 7:14
filing 7:10 52:14
filters 87:7,14 88:6
filtration 86:24
final 72:8,8 88:6
finally 5:4 38:19 48:1
find 25:19 30:10 32:16,17,22 33:2
findings 12:18 44:19 84:10,11 85:9
fine 17:12 22:18 41:16
finished 48:20
fires 50:13
firm 6:8 13:9
first 8:9 10:7 17:17 49:15 51:8 52:23 77:9,20 88:3 96:2
fit 60:12
fits 49:24
five 22:11 36:7 67:16
flatout 79:7
flex 64:12
Flint 89:8,15
flow 14:14 16:4 17:22 29:4,17 30:22 59:16 66:7 70:3,8,12 75:18 79:5,14
flows 35:14
flyers 61:18
foam 60:10 63:5 73:12
foaming 46:12 62:14,17 73:10 81:19,20 82:3 82:11 93:4
foamy 60:9
focus 77:10
followed 5:2 68:8 72:18 87:15
following 56:15 56:24 58:20 87:3 94:16
follow-up 5:6 17:11 19:15 20:6 34:3 38:4 39:19 96:24
food 55:21
fooling 73:6
footprint 37:19 38:2 56:10 67:24
forced 22:20 61:3
foregoing 99:10
forgotten 53:11
form 26:1 74:19
formally 9:18
format 8:24
formed 83:21
formerly 52:5
forming 26:7 44:23
forth 27:4 28:8 38:10,14
forward 5:22 18:8
foul 61:2 62:18
fouling 63:5 64:22 93:5
found 37:16 91:6
founded 13:10
fountain 60:16 60:17
four 8:7 9:15 81:11,18,23
four-day 66:12 66:14,15
frame 30:18
Franzetti 2:17 33:3,4,4,20 34:3 37:2 48:22 49:5,6 50:9 51:4 52:4 52:8,12,22 53:19 54:15 55:6 56:3 57:10 58:20 59:4,7,10,23 60:16 61:7,14 61:22 62:2,6 62:11 63:7,14 68:7,13,15,24

69:8 70:3,6,11 70:14,19 71:18 71:22 72:10,12 73:23 74:12 75:19 76:1,13 76:17 77:2,8 78:15 79:19 81:7 82:5,18 83:1,7 84:9 85:4,7,9 86:7 86:10,17 87:17 87:24 89:22 90:17 92:11,13 94:22 95:7,16 96:24 97:8,12 98:7
Franzetti's 49:2
frequency 15:1 15:2 66:14
friction 39:16,17 58:6
fridge 61:9
friend 36:24 88:23
from 4:13,16,17 4:20,20 6:4,8 10:22 12:15 13:3 14:2 15:9 16:10 17:3,18 17:22 18:5,15 18:18 19:11,17 20:12 22:8,11 22:12 23:2 25:10 26:1,6 28:16,16,21 33:4 34:13,23 34:24 35:5,16 36:5,6 37:12 39:15,17 40:10 40:21 46:19,20 46:21,22 47:1 47:5,9,9 48:17 49:2 50:4 53:3 53:7,12,12 54:20 56:21,21 57:7,14 58:7 58:22 61:18 62:22 63:17 64:6,9 66:23 67:13 68:20,21 71:10 73:21 76:22,23 77:2 77:7 82:5,12 82:15 84:13 86:12,18 87:13 89:15 90:21 91:13 95:9,10 97:24 99:11
front 32:3 37:2 47:22 51:9,16 56:17 91:12
full 33:22
function 66:11
functioning 53:22
further 27:3 28:7 52:14 54:11 56:10 57:11 83:7 98:8
future 14:4

G

G 2:3 4:9
gallons 29:19
gaps 68:22
garbage 88:14
Garibay 3:2 4:18,21 6:6,21 7:6 8:11,23 11:17,21 12:14 12:19,23 13:1 13:5,9,22,24 14:11,18 15:14 16:12,14 17:17 18:16,20 19:2 19:7,16,21 20:4,11,15,20 21:1,3,12,18 21:24 22:4,17 22:22 23:7,13 23:20,22 24:1 24:4,7 26:14 28:19 29:1,4 29:12,14,15,24 30:6 31:14,19 32:2,9 34:9,15 34:17,18,21 35:8,16,19 36:20,24 37:14 42:1 43:5,9,18 44:4,6,12 45:13 46:23 47:10,21 48:4 49:5 50:9,12 51:8 59:2,6,8 61:13 65:18 66:9 68:20 69:7,15 70:5 70:10,13,17 72:3,11 76:16 76:22 77:5,19 78:19,23 79:3 79:7,10,12,16 79:24 82:24 87:24 88:2,23 89:5,10,19 90:3,14,16 91:10 92:18 93:15,18,23 94:3,6,9 95:4 95:15 96:1 97:7,11,15
Garibay's 33:19
Gary 2:4 4:10
gas 74:19,21
gave 41:8 53:8
geese 28:21,22
general 11:14 33:7,13 34:13 45:9,10,19 95:9
generally 18:9 53:7 54:19 58:10 64:2 65:9 81:16,23 83:15 84:7,21
general-use 89:18 90:1,9 90:13,20,22
generate 15:4 39:15,17
generated 14:9 37:19 38:23 40:22 43:9 47:19
generates 46:21 47:8
generation 2:18 3:4 5:3 16:16 23:10 31:20 32:2,10 33:5,8 37:18 38:1 46:24 47:18 49:2,4,6 57:19 68:1 69:2 76:14
generators 46:19
gets 26:1 40:2 54:22 64:20
getting 26:6 28:9 39:11 86:10 92:10
get-go 90:21
Girard 2:3 4:9 5:20,21 26:15 26:20 27:5,8 28:15,23 29:3 29:10
gist 82:5
give 36:15 71:5 75:15 81:18 85:18
given 33:18 41:12 63:18 70:20
gives 56:23 65:20
glass 73:12
global 13:9
glycol 58:15
go 4:21 8:4 18:8 25:11 26:3,17 26:19 27:1,14 27:18 28:23 39:5,12 45:2 46:18 47:11,16 48:4 49:8,13 52:2,24 60:22 64:14 71:7 75:24 79:13 82:17 93:19 94:11 98:10
goes 26:20 28:4 29:1 47:13 67:3 72:5 87:21 90:5
going 6:16 16:4 17:22 21:20 22:7,9,10 25:24 28:2 29:10 33:18 36:3,8 40:7,18 41:7 45:14 46:18 51:4 52:12,17 56:3 57:24 58:9,16 62:14,18 63:7 63:20 66:18,22 66:22 68:23 69:12 70:1,12 71:22 76:1,6 82:12 83:7,17 84:9 90:5 93:6 96:13
gone 51:21
good 4:1 5:21 11:3 28:8,17 49:5 57:8 58:18 64:9 66:10 68:21 73:20 74:16 83:17 92:11
gotten 7:22 28:11
grab 78:6,10
graft 48:8,9,17
Grand 2:7
granted 20:18 91:16
graph 15:7
graphs 15:14,15
grapple 91:5
grateful 65:22
greases 52:2
Great 51:12,17
greater 5:5 17:1 20:1 72:7
greatly 70:17
grid 46:20 47:3
ground 20:12 28:4 39:14
grounds 40:18
groundwater 28:7

group 9:16,20 13:11,12
groups 23:3
grow 27:17
guarantee 63:24 65:1
guaranteeing 65:4
guess 14:21,23 37:10 48:2 74:9
guidance 30:8
guidelines 50:14
gutters 29:10
guys 26:7

H

H 3:7
half 36:6 64:16 64:23
hand 5:8 99:13
handed 7:9,12
handle 6:23 68:5
handling 50:6,7
happen 23:10 67:1 69:18 78:20 81:13 83:17 84:6
happened 48:8 77:24 97:17
happens 48:12
happy 21:8 33:24 54:13 57:7 61:4
having 39:6 47:3 54:21 55:17 56:24 58:14 77:3 82:11 90:10
head 15:8
headed 11:23,23
heading 88:2
health 13:10
hear 4:16,17,20
heard 42:13
hearing 1:10 2:2 4:1,3,17 5:22 5:24 6:10,14 6:24 7:4,11,21 8:4,6,16 9:5,17 10:13,19,21 15:12 17:10 18:14 22:23 24:11 29:13 32:9,13 33:3 33:17 34:2,10 34:18 37:8,21 40:11 41:6,11 41:19 42:6,10 43:1 46:7,15 47:7 48:21 49:1 59:9 75:24 89:9 90:7,15 94:14 94:19 97:9 98:9,12 99:9 99:11
hearings 4:15
heart 53:23
heat 17:18,19 18:5,10 19:10 21:9 22:6,7 23:5,5 56:6,7 56:13,21,22,23 57:12,17 58:5 58:9,10,15,16 58:17,21,24 59:17 62:15 70:24
heated 16:10
heating 54:18
held 80:2,10
help 5:14 18:4 46:4 63:6
hence 63:16
her 90:6
hereunto 99:13
high 25:23 71:8 71:18 73:8 74:8,9 91:2,7
higher 43:21 56:19 67:18 69:24 81:12
Hill 78:2
him 40:12 42:7
homework 77:23
hope 40:15,15
hot 62:22
hotter 55:1
hour 59:1,3 68:6
hours 84:23
huge 21:24
human 26:16,18 28:16 81:4
humidity 64:8
HUNTON 2:15
hurt 56:20
hydrogen 82:7 82:18
hyperchloride 74:20 75:11,16

I

ID 3:8
idea 24:2 67:2
ideal 54:9,10
identification 8:2,20 9:9 10:2 10:17
identified 32:5 52:23
identify 22:23 38:13 71:1
identifying 76:11
IEPA 5:2 10:22 36:14 77:13,15 85:12 92:6
Ill 1:6 4:6
Illinois 1:1,11 1:13,15 2:5,7,8 2:10,13 3:3 8:9 8:10 9:4,12,13 11:2,4 19:19 24:16 30:2,8 38:24 39:7 42:20 46:21 47:8 51:22 52:3 77:18 79:4 89:18 90:8,12 92:8 95:3 97:20 99:1,8,14
Illiopolis 91:16 91:18
immediate 4:8,9 4:13
immediately 19:22 56:15 79:13
impact 11:7 23:5,15 44:10 44:13,17 62:23 69:20 70:17 76:4 83:10 84:13 98:4
impacting 70:1
impacts 18:18 37:16,23 40:20 40:21,22 79:22 80:2,9 93:7 95:20 96:7,8 96:19,23 97:18
implement 50:20 77:14,16
implementation 44:1 45:15 66:20
implemented 66:18 68:23
important 55:4 55:14,22 73:1
impossible 22:14,16
improving 97:16
inability 15:22
include 7:12 18:17 33:21 74:14
included 21:4 71:5,16,16 86:2 87:15
including 49:19 64:7 66:20 89:14
increase 44:21 44:23 82:10 84:3,18
increasing 83:23
independently 62:20 63:3
Indiana 51:11 51:12
indicate 44:7
indication 36:15 80:8
indicators 28:16
individual 48:6
individuals 13:3 13:4,5
industrial 12:10 13:13 28:5 45:17 49:22 55:19 89:7
industries 49:23 85:22 87:8
industry 26:1,6 49:23 50:15,19 63:24 88:5 89:16 96:5,19
infeasible 26:4 46:1 60:19
infectible 25:23
influence 67:15
information 8:12 12:5,8,21 33:10 35:22 75:23 86:11,12 86:18,19 98:3
infrastructure 71:13
inherent 64:22
inherently 18:13 44:16
inhibits 64:21
initially 8:8 94:24
initiative 51:12 51:17
inner 71:11
input 19:11 56:21,22
insignificant 47:22 76:16,17 76:19 77:1 84:21,22
install 85:13,23
installation 71:14 74:22
instance 66:12 77:5
instead 5:18 60:2 77:10 97:4
instrumentation 74:17,23

intake 20:8,11 20:12
intend 41:4
intended 5:14
intent 48:5 62:2
interpretation 87:12
interrupt 86:7
introduce 6:1
introduced 33:7 33:12 50:18
introductory 7:12,15,16,19 37:7 40:1
inventory 30:15 35:21
invoked 42:2
involve 58:1
involved 50:4 51:20 70:23 74:3
in-house 86:2
in-stream 22:11 43:24 44:1 66:11 67:2 78:13
iron 73:5
Island 30:4 31:12,17 77:12 84:15
issue 40:2 42:2 43:8 91:11
issues 13:21 49:17 50:10 90:10 93:4,4
i-n 47:22
I-55 16:15,18,22 17:1 18:15 23:7,10 31:20 31:22 34:6,14 35:6,9 36:13 36:19,23 37:4
i.e 89:12

J

Jeff 11:21
Jennifer 6:7
Johnson 2:2 4:13
joined 13:14
joining 4:12
jointly 6:20,20
Jr 10:8
July 12:23 34:23
June 15:9,16 48:13,13
just 7:8,18 9:17 12:2,24 17:12 17:21 20:17 22:19 24:17 26:16,21 33:11 34:3 35:11 38:4,21 39:8,9 40:12 41:8,21 42:6 48:1,3 49:13 52:13,14 52:24 56:10 58:9,18,19 59:4 60:21 62:6 63:14 64:12,22 69:5 69:12,24 70:20 71:21,22 73:6 73:10 79:7 80:16 82:13 86:7 92:15 94:9,21 96:24

K

K 2:16 99:3
Kane 1:12
keep 37:21 51:2 55:23 57:3 61:4 73:13,20 76:1 82:12
key 12:20
keyed 68:22 77:6
keying 40:10
kilowatt 84:23
kind 17:10 39:7 55:12
kinetics 35:22 36:8
knew 14:6
know 6:17 9:18 24:3 25:20 27:22 29:17 32:11,19 35:8 36:12 41:22 42:2 43:17 46:21 47:8 50:22 61:19 66:10 67:3 68:23 69:1,2 69:11 73:11 76:23 78:12 79:16 81:2 84:6 88:12,15 89:6,17 90:10 93:1 97:12 98:9
knowledge 11:12 12:6 30:13 33:8,13 90:8
known 28:20

L

labor 83:5
lack 15:20
Lake 69:21
Lakes 51:12,17
land 76:5,8 84:20 93:10,11
large 17:24 93:12
LaSalle 1:14
last 10:4 47:7 52:4 84:10 95:16
later 7:23 26:10
laundry 26:19
law 5:3 57:8
laws 56:9
layers 95:13
lead 44:8
leaks 65:23,24
least 41:22 82:14
leave 39:23 40:4 42:16
leaving 55:3
led 26:7
left 4:8,10,10 67:1,4 76:3
left-hand 52:16
legal 35:10 40:19,21 41:3 41:9 42:11 51:21
legitimate 41:24
legitimately 41:1
lenient 97:5
less 21:11 95:10
let 48:4 51:5 67:6 70:21 75:21 86:15 87:9,16,17 90:17 91:3 95:8
let's 17:13 48:21 62:13 80:18 90:12 92:14 98:10
level 68:16 70:8 79:23 81:7 82:12 97:16
levels 30:20,21
light 72:24,24
lights 73:2,12
like 6:1 7:8,9 8:7 8:22 14:5,19 17:11 18:20 22:8 26:3,22 32:3 39:19 42:3 46:12 48:9,9 50:9 54:12 57:22 59:24 60:16,17 66:10 76:5 77:10 80:12,16 87:24 88:13,14 88:16,22 90:21
liking 61:14
limit 44:2 50:14 65:20 66:5,6,6 66:16 77:15,17 78:3,4 91:14 91:17 92:3,3
limitation 80:4
limitations 1:4 4:4 68:18 81:2 81:3
limited 72:7 91:2,7
limits 14:5 43:13 48:7 50:3,19 50:21,24,24 66:19 85:12 89:12 91:1,21 91:22 92:5,24
Lin 2:4 4:11 75:5,6
line 27:14 47:1,4 48:18
lines 29:11
liquid 27:2 28:2 72:5
liquified 74:20
list 8:13,14 32:14 33:2 52:18 76:4
liter 34:22,24 35:2 78:5,6,8 78:10 80:20 81:1,11,19
little 9:2 24:19 25:1 61:19 70:12 71:5 76:6
live 27:23 54:9
LLP 2:12,15
load 17:19
located 37:3 89:18
Lockport 78:2 78:17
longer 23:19 84:2
long-winded 91:3
look 5:22 9:2 14:5,22 15:2,7 23:15 30:10 35:19 36:16 40:3 48:9,9 55:7,8 60:18 61:3 66:13,22 66:23 67:14 68:1 78:13,16 79:1 96:6
looked 19:18 23:9 26:2 33:1 34:9 60:19 62:4 63:1 92:18,24 93:2

93:16 96:6,9 96:22
looking 15:5,8 15:11,12 16:23 17:6 18:3 34:6 35:9 36:14 43:11 48:13 70:21 77:23 88:20 93:8 96:4,19 97:16 97:21
looks 7:9 66:13
loose 54:24
lot 23:22 61:19 61:21 64:6 81:13,15
love 27:20,21
low 68:10 82:22 83:3
lower 1:5 4:5 14:10 18:2 19:9 25:12 45:9,10 75:3,3 77:23
lunch 98:10
luxury 82:2

M

M 2:17
Madam 8:6 10:19 32:13
made 8:24 10:11 33:9 53:5 58:9 60:13 92:18
magic 64:5
main 71:7 74:7
mainly 26:19 37:18
maintain 55:14
maintained 55:11
maintaining 56:6
maintenance 60:8,11 81:10
major 25:19 30:18 31:6,8 56:16,16 93:7
make 14:1 19:4 19:8,14 27:15 33:24 36:21 44:12 47:14 56:14 57:6 69:15 73:1,14 87:18 88:18 89:1 90:19 91:23 93:3
makers 98:5
makes 63:16
making 40:19 51:1 58:7,17 69:9 71:7 88:18 91:1 98:3,5
manage 88:11
managed 86:22
management 49:22 50:6 85:24 86:1,2 88:12,19 97:16
managing 85:11
manufacturers 52:1 89:7 96:10,12
manufactures 12:16
manufacturing 85:15,17
many 22:12 39:14 54:17 60:6,11,11 63:16 93:1
March 34:23
MARGARET 1:11 2:20 99:7
margin 17:8 63:11,19,20
marginally 21:17
Marie 1:10 2:2 4:2
mark 6:15,24 7:5 8:17 9:6,20 9:22 10:14
marked 3:8 4:22 7:13,24 8:1,19 9:8 10:1,16 24:18 32:24 38:11
marking 4:23
mass 17:21 19:14 21:9
massive 58:2
material 27:9
matter 1:3 22:19 34:20 46:5 91:21
matters 35:13
max 65:23 67:7 67:9,11,17,20 67:21,21 68:2 68:10
maximum 56:2
may 5:6 13:11 13:15 17:11 32:17 33:15 44:24 49:13 51:21,21 53:7 53:12 68:2 90:24 95:7
maybe 49:11 55:13 60:1
Mayer 2:12 11:22
Mayor 6:4
mean 14:22 17:17 20:9 35:1,1 40:7,14 40:17 41:21 66:9 69:1,24 79:20 89:2 90:16 97:10
meaning 78:1 81:2 83:8
means 52:23 55:17
meant 40:12 56:11 92:4
mechanical 39:16 58:1,4,4 58:18 62:12 82:9
media 57:15
medial 87:7
meet 17:4 18:24 23:12 44:15 46:3,13 48:7 61:5 77:3 88:9 90:20 92:2,23 94:23
meeting 19:5 32:6 44:17 45:21 76:19 92:4
member 2:2,3,3 2:4,4 4:9,10,11 4:11,12 5:14
members 4:16
membranes 50:5
mentioned 12:19 63:14 78:20 91:12 96:1
mercury 85:3
mesophilia 54:6
mess 60:15 62:17 73:6
met 14:1 17:14 20:17 21:17,21 22:10,10 31:21 65:16,17 91:20
metabolites 83:21
metals 43:4,12 43:13,22,23 44:5,7
metering 82:23 83:4
method 60:23 73:3 82:16
methodology 66:15
methods 26:9
Metropolitan 5:4 52:5
MGD 18:20,21 21:10,14
Michigan 69:22
mid 13:10
middle 53:12
midwest 2:18 3:4 5:3 16:15 23:10 31:20 32:2,10 33:4,8 46:24 49:2,4,6 69:2,23 88:22 89:1 90:1,3
might 14:5 20:1 43:12 63:10,15 90:10
mile 36:6 47:1
miles 36:7 37:4 37:12,12,14
milligrams 34:22,22,24 35:1,2 78:5,6,8 78:10 80:20 81:1,11,19
million 64:1,2 68:5 71:8,19 84:17,18,23 96:15
Mills 89:15
Millsdale 12:18 37:3 53:20 55:10 71:1
minimum 54:23 82:1
Minnesota 51:14
minor 83:5
minus 76:8
minutes 12:2 75:15
miscellaneous 28:18 54:1
mish-mash 25:17
missing 31:9 43:14 44:2
misspoken 95:7
misstating 42:12
mistake 47:21
mistaken 33:15
mix 17:23 25:11
mixing 15:21,22 16:2,4 20:10 20:18,23,24 21:5,6,7 23:17 23:22 24:3,7,9 45:8,12,13,15 45:18 66:13 69:10 70:15 78:19,22,23 79:4,10

Mobil 4:20 51:24
model 10:5 16:7 17:20 30:24 35:23 36:4 63:23 64:9,10 66:22 78:12
modeling 17:6 17:18 18:8 22:5 64:11
models 12:14 19:12
modified 37:17
modify 52:15 95:22
moment 63:8 70:20
money 61:6 74:10 88:18
monitor 14:9,13 15:1
monthly 65:19 65:20,22 66:15 66:18
months 46:14
Moore 4:11
more 17:2 26:2 27:15 31:14,23 32:5 39:15,22 40:4 41:11,15 42:4,15,19 54:24 55:3 56:16,18 57:1 57:17 61:6 71:21 77:14 83:15 87:4 88:10 94:21 95:11 97:5,13
morning 4:1 5:21 10:20 11:3 49:5
most 37:24 50:1 56:8 58:12 62:16 63:4 72:22 82:14,16 87:2
motors 60:9
move 56:3 57:11 71:22 72:12 76:2 77:8 79:19 82:5,5 82:19 84:9 95:16
Moving 52:12 53:19 78:15
MPS 14:5,16,24 43:10 77:17
much 17:16 18:5 19:8,9 22:2 25:12 46:21 47:8 57:1 58:21 60:7 76:9 80:2,4,9 80:20,23 81:3 84:4 98:7
multiple 25:16 25:16
multi-media 93:7 95:20 96:6,22 97:18 98:4
multi-product 55:16
municipal 27:8 27:12,19,19 52:2
Muno 6:8 11:22 12:20
must 73:22
myself 11:24

N

N 3:1 99:3
name 4:2 5:9 6:4 10:7 11:3 49:6
namely 74:4
narrow 76:7 83:7 90:12
natural 6:21,22
nature 45:9,10 45:19 56:9 57:8
nautical 37:12 37:14
near 27:17
nearby 27:9 45:16,16
necessarily 93:21
necessary 25:5 38:24 40:23 43:3 49:19
need 5:6 17:4 19:10 22:23 33:21 37:21 43:22 50:19 55:11 58:21 60:3,21 61:6 61:19 63:6 65:17 68:21 81:23
needed 14:7 30:5,6,11 62:19,20 83:16 91:21
needs 30:18 31:9 65:16 84:7
neighborhood 62:15
neither 46:3,13
Nelson 11:21
new 94:23
next 9:11 82:6 82:19 93:12 97:16
nice 27:21
nickel 44:8
night 61:18
nightmare 60:11 61:2,3
nightmares 82:11
nitrify 91:23
nitrogen 28:12 30:20 81:14
nitrogenous 31:1
nitrogens 27:4
nonbiodegrad... 83:20
none 8:18 9:7,22 10:15
Non-contact 53:13
non-degradati... 98:2
non-fouling 64:19
normal 67:13
normally 17:24 18:9,11 21:7 68:16
North 1:14 2:7
Notary 1:12
note 5:13 44:19 84:17
noted 15:6 44:22
notes 99:12
nothing 36:13
notion 5:16
not-to-exceed-... 32:8
NOX 85:2
nuclear 46:21 47:9
number 4:7 5:2 8:10 11:6 25:14 28:8,14 29:20 30:9 32:17 35:24 47:4 63:22,23 64:4 67:12,22 68:10 80:24 81:13,24
numbers 21:24 32:8 38:17 74:10 75:17
numeric 38:6,6
numerous 51:21
N-505 1:14
N.W 2:16

O

object 40:7,18 90:5
objection 7:5,7 7:24 8:16 9:5 9:21 10:13 41:20 89:22
objective 14:2
obtain 12:6
obvious 71:9
obviously 26:3 70:3
occur 16:19
occurs 17:5 36:18 59:21
OCPSF 86:12 86:14 89:8,16 90:20 91:8,11 91:18,20 93:24 94:16 95:2,3 96:3,7,15,18 97:3
October 48:13 48:14
off 7:2 15:8 30:15 37:22 40:10 46:15 47:2 52:9,10 88:18 96:3
officer 1:10 2:2 4:1,3 5:24 6:10 6:14,24 7:4,11 7:21 8:4,6,16 9:5,17 10:13 10:19,21 15:12 17:10 18:14 22:23 24:11 29:13 32:9,13 33:3,17 34:2 34:10,18 37:8 37:21 40:11 41:6,11,19 42:6,10 43:1 46:7,15 47:7 48:21 49:1 59:9 75:24 89:9 90:7,15 94:14,19 97:9 98:9
off-gas 50:6
Oh 51:4 79:7 83:1,2 89:5 97:8
oil 52:1
okay 20:13 22:18 24:10 35:18 36:17 52:22 59:23 62:6 71:18 72:12 79:12,18 94:15 96:1 97:8
once 31:19 35:24 43:24 69:23

one 5:10 6:16,17 7:1 9:12 12:14 12:24 18:20 21:10 22:6 25:7,14,15 27:11 30:10 31:14 33:11 34:3 35:19 38:15,16,16 40:2 43:19 45:1,13,17 46:3,13 48:12 48:17 49:11 52:23 57:1 59:24 60:23 61:5 62:16,23 64:10,12,18 77:6 80:6 81:13 87:3,5 88:17 91:12 94:21 96:3,23
ones 36:11 51:18 62:9 72:22 85:22
one-and-a-half 64:10,12
one-time 21:23 21:24
only 19:2 21:17 24:22 26:18 27:5 28:9,15 42:13 55:20 57:14,23 58:1 61:15,17 65:16 67:4,12 69:15 69:18 72:17 73:9 78:4,5 82:7 88:21
on-site 27:5
open 45:24 46:6 46:10,13 77:5 77:7
open-cooling 62:16
operate 67:7 68:2 81:12 85:13,23
operated 86:6
operates 17:7
operating 65:18 67:8,8,12,24 75:1 85:21 88:21 91:15
operation 16:8 54:20 55:4 58:2 64:18 71:16
operational 13:21 46:5,11 46:11 55:9
operations 53:7
opinion 15:22 30:5 35:11 73:15 85:20 87:9,23
opposed 25:6
optimize 57:6
option 45:8 72:18 73:18,19 74:2 82:7,18 93:10 96:9
options 25:6,7 72:21 82:13 91:2,7 93:2 96:6
order 23:12 58:22 72:1 82:8
organic 49:23 50:6,14,22 54:5 83:15 85:15,17,22 88:3 89:12
organics 25:24 26:1,6 27:4 28:12 44:23 45:5 73:21 83:18,19 84:2
organisms 54:1 56:22 87:5
osmosis 53:9
other 5:11 8:5,7 9:15 11:14 12:5,10 13:12 22:6 25:6 28:16 30:16 33:11 36:9,15 43:22 51:6 57:15 59:19 60:23 68:1 69:19 70:16 73:4,18 78:17 79:3 81:6 82:13 87:3,15 89:1,6,11,17 89:24 90:3,8 91:8,11 93:4 95:2
others 6:22 38:20 89:2,4
ought 42:20 95:21
ourselves 33:13
out 6:18 8:13 20:12 22:8 27:13,16 28:1 30:10 36:1 37:24 49:12 58:8 60:10,11 61:9 62:22 63:7 68:6 74:1 75:13 82:12 86:3 93:5 96:20
Outfall 85:13
over 5:11 14:14 15:3 19:17 25:17 27:13 49:13,21 55:17 56:24 60:15 67:16 82:2 88:7,8
overall 20:2 39:18 95:19 96:21
overflow 26:24 27:1 72:4
overlapping 45:18
overlook 49:10
over-chlorinat... 73:21
over-chlorinat... 26:5
oxidant 83:14
oxidants 83:15
oxidation 73:7 93:18
oxidizing 83:12
oxygen 11:8 25:1 30:4,14 30:17,17 31:2 31:5,10 36:10 36:11 38:18 42:16 47:12 77:9 79:24 80:1,2,6,7,9,13 80:20,23 81:3 81:10,15,21 82:8,10,12
ozone 72:23 73:8,15 83:14
O&M 71:2,18 74:5 82:21 83:4 84:17
o'clock 98:10

P

padding 74:12
page 3:2 15:11 15:18 24:14,20 30:1 37:2,8 38:13,17,17,18 38:20 45:7 47:17 56:5 57:11 59:14 70:22 71:4 76:2 79:20 85:5 95:17
pages 10:9 38:18 72:13
pampering 57:4
paper 61:24
paragraph 95:18
paragraphs 15:20
parameters 11:11,13 12:9 14:13
parentheticals 71:4
part 12:16 41:14 43:10,19 47:10 69:8 72:5 77:9
partially 28:11 59:22
participated 11:19
particular 28:22 49:24 51:9 79:2 93:9
particularly 20:4 21:19 39:11 46:12
partly 9:3
partners 13:13
Parts 1:6
pass 83:19
passing 69:4
past 55:2
penetrate 73:2
people 63:10 85:1
per 34:22,24 35:2 57:20 59:1,3 68:6 71:2 78:5,6,8 78:10 80:20 81:1,11,19 84:18,23 85:3 96:15
percent 29:20 54:2,5 57:24 58:8 63:24 64:1,3,3 65:10 65:10,12 67:18 67:21,21 71:21 72:23 80:19,19 80:24 81:14,15
performance 46:4,9 54:22 67:15
period 14:8,16 15:6 16:3 17:1 17:4,8 18:7 19:9,17,19 21:18,21,22 22:1 65:8 66:2 67:2,4,5,15,16 67:22
periods 16:24 19:16 31:21,24 32:4,5
permit 14:5,12 14:18,20,24

20:20 21:12,13 43:10,11 65:20 65:20 66:16,17 77:18 78:17,17
permits 14:16 77:23 78:1,14 79:14 89:21,23 90:10
peroxide 72:23 73:8,15 82:7 82:14,19,23 83:5,6,13,18 83:22
perseverance 91:13
personal 90:8
personally 61:23
petroleum 50:23
PH 55:21 74:16 82:17
phone 36:24 88:23
phosphorous 28:12
phrased 25:2
phrases 83:9
physical 50:5
pipe 15:23 36:16 44:18 67:3,5 72:21 77:22 78:3,4,5,6,10
pipes 64:20
piping 71:11
place 19:3 39:23 40:5 42:16 87:20
places 27:16
Plaines 1:5 4:5 14:10 18:2,21 45:10,11 77:23 79:13
plant 12:18,22 25:14,18 26:7 27:3,6,8,20 28:6,13 29:2,3 29:5 37:3 43:20 52:20 53:6,16,23 54:5 57:13 60:15 61:1 62:8 69:4 71:1 72:4 76:9 81:9 83:20 86:2 87:7,14,21 88:11,13,16,22 90:20,21 91:16 91:18,18
plants 49:19 54:6 61:11 79:5 85:15,17 85:22 86:18 88:9 89:1,17
plant's 27:17 53:21 55:10
plastic 50:14
plastics 89:13
plays 81:6
please 5:9,10,13 13:16,22 24:13 47:18,23 85:15
plugged 61:2 62:18
point 18:2 20:6 20:8,10,16 22:9,21 23:6 23:23 32:18 36:3,4 37:13 57:1 67:12 69:24 72:8 73:16 78:11 97:9
pointing 49:12
points 25:19
Policy 5:3
polishing 88:6
Pollution 1:1,11 2:5 97:20
pond 58:2 92:16 93:12
ponds 59:16 62:12 92:24 93:9
pool 30:4 31:12 31:17 34:12,21 70:7,9 77:12 84:15
population 37:20 38:3 84:24 91:23 92:2
position 40:20 40:22 41:3 42:4,8 83:17
positions 41:8,9
possibility 27:22 44:22
possible 22:14 55:20 77:15 82:3
post 94:10
potential 23:5 45:3 60:9 79:23 82:10 83:22 84:12
potentially 53:14 70:15
pounds 85:3 96:15
power 46:20,21 47:2,5,8 60:21
practical 96:4 96:16
practices 85:24 88:12,19
pre 71:10
precise 26:5
preconceived 5:15
predict 83:17
predicts 36:1
preexisted 95:3
preferably 82:1
prepared 8:14 32:20 41:22
preparing 13:17 13:23
PRESENT 2:1
presented 9:16 12:2 66:2
presiding 4:9
pressure 81:6
presume 78:20
presuming 78:21
presumption 23:22
pretty 28:17 29:7 30:7 78:11
pre-comments 41:14
pre-filed 4:23 6:15 7:5,10,13 7:14 8:10 10:11 11:6 37:2 45:7 47:17 63:7
pre-filing 7:18
pre-treated 53:10
primarily 49:22 75:1,4 83:4 84:22
principal 13:24
principles 56:12
prior 19:23 29:7 52:13 56:8 76:14 86:1
probably 28:21 54:5 62:16 67:18,21 72:23 74:20 75:8,9 75:10
problem 27:11 60:6,8
problems 26:2 46:11 55:3 60:6 62:1
procedures 51:7
proceed 4:24
proceeding 4:3 19:20 23:3 32:21 33:1,7,9 34:8 49:7
proceedings 1:9 99:9,11
process 17:15,16 28:11 52:18,23 52:23 53:3,21 53:22 55:11 56:7 61:6 88:13,16 92:6 92:7 96:18 97:17
processability 81:11
processed 26:17 72:6
processes 50:4 57:16 62:7 98:2
processing 26:20
product 53:5 63:17,17 88:18 96:15
production 53:4 53:15 55:16 57:17 63:18 87:13
products 53:4 55:17 63:16 89:2
profile 19:18
Progressive 10:8
project 14:1
projecting 14:4
proof 73:17
proper 53:21 85:23
properly 86:5,5 86:22
proposal 39:7 42:21 95:21
propose 8:14
proposed 1:6 4:6 14:3 17:1 17:14 19:19,23 20:1 23:11,12 23:16,18 24:16 31:13,17,22 32:1 34:7,9,12 38:8,24 40:23 41:2 44:13,16 44:17 45:4 58:23 72:1,2 77:14 84:13 85:12 95:11
proposing 47:12
propylene 58:15
protect 51:1
Protection 2:7 2:11 3:3 11:2
provide 22:13 24:13 33:24

75:23 93:23
provided 8:8,12 9:14 10:10 14:3 24:22 25:2 29:20 32:13,15 33:23 49:9 71:13 75:9 93:22
prudent 15:21 65:2
public 1:12 4:16 37:24 51:23 52:2
published 10:8
pump 83:4
pumps 39:16 58:6 74:15,16
purely 49:21
purpose 4:17 56:15 66:24
push 20:2
put 18:5 25:21 27:17 28:6 32:18 33:18 35:23 48:8 60:14 61:8,9 64:16 65:4,9 67:19 73:14,22 80:23 81:3 82:13 90:17 93:12
putting 58:16 60:1,20 84:7
p.m 98:13
P.O 2:8

Q

qualifies 49:16
quality 1:4 4:4 14:7,9,15 15:3 17:14 18:24 19:6,22,24 20:2,8,9,17 21:16 34:7 38:8 39:1 40:24 41:2 45:3 49:20 50:2,20,21 51:7,13,22 68:19,21 69:5 69:13 76:5 77:16 83:11 84:14,19 88:9 93:2 95:11,12 95:22,22 97:17 98:1
quality-based 50:17,24 92:3
quantified 39:9
question 5:6 8:10,12,15 9:4 9:13 11:6 12:1 12:5,17 13:2 13:16,22 15:17 18:5 20:14,21 20:23 21:1 22:4 24:13,18 25:2 30:1 34:3 36:12 37:10,15 39:4,20 40:8 40:10,13,14 41:5,12 42:3,7 42:23 45:20,23 45:24 46:18 47:11 48:1 49:17 51:5 53:19 55:7 56:4 57:11 58:21 62:3,8 63:10 65:14 66:21 67:6 68:13 70:19,20 71:24 72:12 73:24 74:1 75:5 76:2,6,15 77:9 79:19 82:6,19 83:8 84:11,11 85:10 89:10,14 91:3 92:12 94:22 95:7,16,17 97:2
QUESTIONI... 11:1 49:3
questions 4:24 5:2,7,10,12,13 5:23 6:21,23 8:10 9:4,12 10:22 11:4,14 41:23,24 48:12 49:2,8,10,11 49:15 52:14 56:4 57:18,21 63:8 71:23 72:17 84:10 91:5 98:8
quickly 60:10
quite 55:24 68:4 71:11 72:20 74:23 75:3 82:11
quotations 9:15
quote 40:4 95:23
quotes 12:15 24:21

R

R 1:11 2:20 99:7
radiation 22:7 64:8
rainy 69:21
raise 5:8
range 15:15 54:7,9,10,11 54:19,20 55:9 56:1 65:13 81:12
ranges 11:10 55:13
Rao 2:3 4:13 22:19 23:17,21 23:24 24:2,6 24:10 27:22 28:4
rapidly 50:18
rate 29:17
rather 7:14 8:13 26:24 27:18 28:5 91:3
rationale 14:3 36:14 66:17 78:12
raw 83:21
reached 42:18
reaction 56:23
read 4:23 6:17 37:4 46:2 55:7 59:11 70:21 84:16
reading 59:12 76:20
real 58:18 61:13 82:10
realize 16:17
realized 49:13
really 18:4 22:1 24:19 25:17 27:12 39:10 43:22 49:15 60:10 61:4,16 64:21 65:4,6 70:8 73:8 83:16
reason 56:1 58:19 74:10 91:21
reasonableness 95:19
reasons 31:16 74:7 77:19
RECEIVED 3:8
receiving 21:8 30:21,22 51:1 69:12 70:2 87:6
recent 78:1,1
recess 48:23
Reclamation 5:4 52:6
recognize 71:3
record 5:12,14 7:3,8 22:24 32:11,16 33:13 33:14,16,18,21 37:6 38:21 41:14,22 52:9 52:11,22 59:4 94:12
recycle 50:5
redesignation 44:14
reduce 73:1
reduction 16:9 59:16 63:15
refer 24:14 32:9 37:11 97:10
reference 76:8
referenced 26:15
references 30:10
referred 85:21 86:21
referring 13:4 14:12 15:19 29:14 45:11,19 52:5 76:3 83:10 85:16 95:24
refineries 49:23 50:23
regarding 74:1
Region 51:19
regulations 23:18 51:12,18 58:23 87:10 95:3
regulators 87:12
regulatory 56:15 85:19 86:16 88:1 97:20
reiterate 24:17
related 11:7 31:6 51:15 93:5
relates 24:20
relationship 50:23
relative 74:9
relatively 82:22 91:2,7
relevant 50:10 90:18
reliance 33:19
remains 80:14
remark 52:4
remarks 7:13,15 7:16,19
remedy 40:3
remember 32:3 75:9 97:12
remind 59:12
remove 56:7
removed 57:14 58:22 59:1
renewal 43:10 43:11

repeat 46:7,8
rephrase 20:13 40:13 91:4
rephrased 89:10
report 6:19 7:9 7:20,20 8:23 9:3 14:14 15:10 32:3 37:1 38:10 42:18 46:3 49:17 52:16 71:4 79:20
reported 2:20 16:15 99:8
reporter 1:13 5:11 94:12 99:7,19
reports 16:16 31:20 32:10,14 33:8,22,23
represent 5:10 23:2 49:6 94:1
represented 51:24
representing 6:5 48:10 51:24
represents 14:15 59:3
requested 13:3
require 48:15,16 82:17 87:2
required 14:24 38:7 48:6,11 48:18 56:7 57:16 96:13
requirement 82:1,15
requirements 11:10 14:6 24:24 25:1 46:14
requires 40:3
residential 26:23,23 84:24
residual 27:2 28:14 75:10
residues 53:5
resin 53:9
resources 56:13 57:16 58:19 89:15
respect 14:5 24:15 34:5 43:8,22 45:1,3 57:18,21 70:20 71:6 73:23 74:3 76:8,18 76:19 77:3 83:10 93:7 95:9
respects 87:21
respiration 31:7
respond 6:22,23
responding 55:21
response 8:9,15 9:3,11,14 19:7 41:12 44:24 49:9 50:2
responsible 13:19
responsive 24:18
rest 58:9
restricted 54:12
restrictive 95:13
restroom 27:18
result 93:3
results 14:9,11 14:15 15:4 72:7
retained 11:17
retrofitting 94:23
reuse 50:5
reverse 53:9
review 51:13 72:13 84:12
revise 76:6
revised 8:23 59:7
re-aeration 22:8 31:7
rid 39:11
rider 65:20
right 4:12,13 7:4 7:11 10:21 32:3 37:14 40:9 48:4 59:8 63:12 64:17 68:20,24 69:7 69:11,15 76:17 76:20 77:5,8 84:9 89:4 94:10 96:3
river 1:6 4:5 14:10 16:20 17:24 18:22 20:12 31:5,8 36:4 44:11,13 44:17 45:10,11 82:12 89:15
road 43:20
Robert 4:20
Robin 3:2 4:18 6:6 7:5 8:11 42:1 85:19 86:15 87:9,16 87:17
robustness 54:23
role 13:17,23,24
roll 81:6
Room 1:14 5:18
routed 93:11
RO8-09 4:7
rudimentary 26:21
Ruhane 52:5
rule 66:18 92:8
rulemaking 1:4 5:22 49:7 51:7 51:11,15,16 92:7
rulemakings 51:10
rules 14:3,4 51:18 72:2 92:8
run 79:12
running 39:16 39:16 68:4 71:20 91:19
R08-09 1:4

S

S 3:7
safety 13:10 16:6 17:8,8 63:11,19,20
sag 36:5,13,18
sags 36:1
salt 43:4,20 44:24 80:3,3,4 80:5,6,8,13,14 80:14,15,15
same 9:1 14:20 46:10 51:2 74:6,14 89:11 91:8 93:1
sample 78:7
samples 72:6,10
sampling 72:7
Sanitary 53:10
sat 91:12
saturate 79:22
saturation 80:19 80:24
saw 31:24 46:2
saying 21:10,15 31:24 47:4 61:8,22 66:24 78:12 92:21 93:13
says 42:18 69:18
schedules 14:19
scope 14:1 23:13 90:6
scum 64:20
scums 73:12
searched 32:16
seasonality 43:19
seasons 31:22
second 8:22 16:5 39:8 86:8 95:18
secondary 95:10
secondary-con... 90:23
Secondly 25:11 81:19
section 56:4 76:3 84:10 85:10
sediment 31:2,2
see 18:9 23:14 23:15 75:11 77:24 97:18 98:4
seeing 8:18 9:7 9:22 10:15 43:12 55:18
seemed 60:19
seems 91:7
seen 66:16 77:17
segment 16:20 35:8
segregating 29:23
selecting 11:11
selection 13:19 63:19
sending 60:14
sense 47:14
sensitive 54:24
sent 27:2,5,9 29:6
separate 6:18 60:22 61:6
septic 25:7,10,20 25:21 26:16,16 26:19,21,23 27:23 28:24 29:18 53:10 72:4,5
series 48:9
serpentine 92:24 93:8,14,20,21
serve 4:3
served 13:18 50:15
service 27:23
services 13:14
sessions 51:23
set 14:20 38:10 38:14 63:22 99:13
sets 87:5
setting 16:20
settling 55:2
seven 59:14 62:7
seven-day 32:7 34:22 35:1 78:9
several 4:17

13:3 62:24
sewer 27:1 53:6
sewers 52:2,3
sheet 79:17
sheets 66:17
shiver 61:20
shocking 54:13
shocks 55:1
short 48:23
shorter 83:23 84:3
shorthand 1:13 99:7,9,19
show 48:5
showed 43:21
showing 59:2 88:17
shown 43:16 48:17
shows 15:15 26:11 43:18 88:19
Shundar 2:4 4:11
side 31:4 52:17
sides 60:15 82:16
significant 47:18,19,23 95:20
significantly 76:14
similar 18:6 19:7 26:23 51:14 70:18 73:24 80:3,6 92:21
Similarly 80:11
Simon 6:7
simple 17:21 19:13 21:9
simply 6:23 8:14 9:2
since 50:21
single 6:19 78:10
sink 31:3
sinks 30:16,19 30:23 35:21
36:2,10
sit 60:4
site 12:21 28:6 29:6 51:10,14 51:15,15 91:14 91:16 92:8 97:23
sitting 27:14
situation 25:23 49:24 92:21
skip 51:4 52:12
sky 73:9
slew 14:13
sludge 37:18 50:6 53:12,13 53:17 54:4 68:1 73:5 86:6 86:22 87:1,2,4 87:14 94:7,10 94:17
sludges 53:18
sludge/solids 38:1
small 17:24 19:24 44:22
smaller 18:9 95:19 96:10,11 96:14,14,20 97:2,5
smooth 86:3
soap 51:24
soaps 55:19
sodium 75:11,16
solar 64:8
solely 5:1
solicited 12:15
solid 47:18,19 74:19 76:5,14 84:21 96:8
solids 37:19
solubilize 80:12
solubilizing 80:5
solude 80:3,12
solve 26:2
some 6:20 8:5,24 9:13 10:10 11:14 16:19 17:15 18:10 21:4 23:18
26:21 27:13 28:21 29:8 30:19 31:8 32:18 36:4 41:8,13 43:9 43:14 44:7 47:2 51:10,18 57:15 58:17 63:9,10 64:21 68:22 71:4 72:15,16 73:7 73:13 83:5,8 87:21 91:11 93:4,4,15,22 93:23
someone 21:20
someplace 32:24
something 39:14 40:11 48:8 56:14 58:15 60:1
sometimes 21:11 37:20 38:3
somewhat 97:5
somewhere 28:3 54:11 58:12 75:17
sophisticated 87:1,6
sophistication 87:8
sorry 36:10 47:24 51:5 54:15 83:1,2 91:3 95:10
sort 26:20 30:10 30:15,18 50:18 73:8 88:8,21 97:15
sound 91:19
source 25:9,14 25:15 27:15 28:15 72:19 85:24 86:18,19 88:11,20
sources 16:10 22:6 25:15 29:5 30:17 31:4,4,5 35:22
36:2,8,9 45:9 69:19 70:1
South 2:12
SOX 85:1
speak 5:10,11 33:12 34:19 52:17 61:9
special 61:18
specializing 13:13
species 45:2
specific 14:22 15:1 31:23 51:10,14,15,15 78:14 91:14,17 92:8 96:9,20 97:23
specifically 11:7 24:20 25:2 33:2
specifics 15:6
spell 10:6
spending 74:10
spills 65:23,24
spoke 51:23 78:18
spray 60:4,20 62:13
sprayer 60:4,14 60:18
spread 27:13,16 72:4
spreading 62:14
spring 25:13
Springfield 2:8
square 76:9 84:20
SS 99:2
stability 54:23
stable 55:20
staff 4:14 5:14
standard 19:6 19:24 21:17 22:10 24:15 31:13,18 32:20 35:15 44:18 65:16 66:2,20 69:6,14 72:2 73:18 76:20
77:16 87:5 89:7 97:3,4,4,6
standards 1:4 4:4 15:23 17:14 19:1 20:1,3,9,17 23:12 24:9 31:22 32:1 34:5,7,8,9,12 34:13,21 35:3 35:6 36:15 38:8 39:1 40:24 41:2 44:14,15,16 45:4 49:20 50:3 51:7,13 51:22,23 66:11 68:19 69:3 71:10 77:4 82:8 84:14 86:14 88:10 90:20,22,23 94:24 95:1,11 95:12,13,22 97:17 98:2
standpoint 57:8
start 6:14 30:15 48:22 64:2 98:11
started 13:12 43:5 50:12 96:2
starting 15:15
starts 52:17
start-up 71:16
state 1:13,14 5:9 30:2,8 45:8 47:17 51:9 56:5 57:11 85:9 95:18 99:1,8
stated 85:4
statement 24:20 31:16 36:20 42:18 56:11 79:20
station 46:24 47:2,4
statistical 66:14

67:13
statistics 64:6
stay 54:18 82:18
staying 73:23
steam 91:24
steel 49:23
stenographic 99:12
step 63:7
Stepan 2:14 4:19 6:5,8 8:9 8:11,13 11:16 11:17,21 12:19 16:17,18,21 17:3,4,23 18:2 18:5 19:10,11 19:17,23 20:9 20:18 21:19 22:3,20 23:16 23:17 29:20 35:3 36:18,22 38:7 42:2,10 43:2,5,9 44:3,6 45:20 46:12,20 47:2,2,5 52:19 53:2 55:15 62:8 63:16 67:1,1 69:4 71:24 72:3 80:17 81:8 84:13 85:13 86:6 87:1,20 88:4,15,21,24 88:24 89:1,12 89:15 90:21
Stepan's 17:15 17:15,18 18:1 18:18,21 19:24 20:8,11,12,16 25:14 26:12 40:20,21 42:4 53:23 58:22 79:21
Stephanie 2:9 11:3
stick 61:1
sticking 60:19
still 16:5 17:15 18:7 58:16 69:5 83:9 92:8
stops 80:5
storage 74:17
store 53:18
storm 28:19,23 29:6
stormwater 53:14,14
straight 18:7
streams 53:1
street 1:14 2:16 5:18
stricter 90:24
strike 45:23 47:11,16
stringent 77:14 95:10,11
studied 89:23
studies 30:9
study 11:16,20 13:17,23 15:4 30:7,14 37:16 52:14
stuff 41:13 57:2 68:1 80:21
subject 43:12 89:12 90:22,22 90:23
submitted 33:10
subsequent 75:23
substantial 82:15
substantially 90:24
substantiated 85:21
sudden 15:1 84:4
sufficient 90:11
suite 93:1
sulfate 44:21 45:4 84:19
summarizing 7:19
summary 32:6 41:23 87:19
summer 45:21 54:20 55:23
supervised 13:3
supervising 13:20
supervision 13:7
supplement 62:13 85:19
supplied 47:5
suppliers 12:20
support 10:11 50:17 51:14 71:13 97:22,23
sure 6:3 7:23 14:1 29:8 39:24 44:12 51:1 61:14 64:13 87:18 91:23 92:13 94:20
surface 59:18 60:7 63:1
Survey 30:9
Susan 2:17 33:4 49:6
suspect 32:23
sustained 67:14
swear 6:2
swing 56:2
swore 41:15
sworn 6:11,13 41:7,12,18 42:7
synthetic 50:15 89:13
system 1:5 4:5 17:19,24 25:9 26:4 53:24 54:24 55:3,5 56:18 57:5 60:2,3 66:7 67:10,10 72:5 76:22,24 81:3 87:6 91:19,20 94:7,10
systems 10:6 19:12 26:16,16 26:17 28:24 49:19 57:3 67:23 68:18 72:4 87:3
system's 82:3

T

T 3:7
table 9:3
tables 9:14 24:21
take 17:22 23:13 30:16 48:21 51:8 55:1,7 57:1,6 58:7 60:24 61:8,9 66:6,15 67:13 70:6 98:10
taken 1:11 48:17 60:11 76:10 99:12
taking 14:3 17:18 44:1 55:8 97:15
talk 89:9 92:14
talked 23:19 53:10 76:13
talking 37:12 40:6 66:4,5 67:9 69:9 70:7 77:11 92:15 95:2
talks 39:20
tank 25:21 26:23 27:23 60:20,20 72:9 81:22 83:3 87:2
tanks 25:8,10 26:19,21 29:18 53:11 59:18 60:12,13 62:4 62:5 63:1 72:21 74:15 76:23
Tanner 2:3 4:9
task 11:20 44:12 47:10 66:24
team 11:22,23 12:19 38:5
technical 4:14 13:18 14:2 35:16 50:17 57:7 85:18 98:4
technically 95:20
technological 50:3
technologies 11:13 17:6 38:22,24 40:23 59:19,20 62:7 72:13 85:14,23 96:20 97:19,23
technologies/p... 59:15
technology 10:8 13:19 38:7 63:14 70:23 76:10 77:3 86:5,13 88:3 93:6 96:4,5,12 96:17,22
technology-ba... 50:19,24
tell 50:9 52:24
temperature 10:5 11:7 12:9 12:12,14 15:5 15:7,23 16:1,8 16:24,24 17:3 17:3,7,20,23 18:6 19:18 21:19 22:10 23:7,20 24:24 30:22 38:16,17 39:11 42:15 46:16 48:7 53:20 54:14,21 54:22 55:3,9 55:21 56:1,17 56:19 57:4 59:16 61:5,16 61:20 62:1,7 62:20 64:5 65:11 66:2,23 67:20 68:3 69:20 70:1,18 79:21 80:11,11 81:4 91:10,14 92:9
temperatures

16:15,21 18:11 23:10 45:21 58:13 69:24
temperature's 80:18
ten 22:11
ten-minute 48:21
term 39:21 40:8 40:10 46:16 78:1 86:23
terms 21:7 52:13 91:1,6 97:24 98:1
tertiary 86:23
tested 73:11
testified 51:6,9 57:19
testifiers 5:1
testify 6:20 49:16
testifying 4:19 6:7,9 50:11
testimony 4:16 4:17,22,23 5:23 6:15 7:5 7:10,13,17,20 10:12 13:6 37:3 41:10 42:1,2 45:7 47:17 48:8 49:14 56:5 57:12,22 59:14 63:10 70:22 72:13 77:2 85:10 87:19 90:6 92:19 95:17,24
testing 45:1 73:16 84:1
text 32:14 33:23
thank 5:24 7:21 7:23 8:6 10:19 18:14 20:5 34:2 39:3 42:24 48:20 52:8 55:6 57:10 59:10 75:24 90:15 94:19 95:5 98:7
Thanks 5:23 24:10
their 6:14 9:3 14:12,15,16,18 15:3 23:5 32:6 43:10,11,13 45:16 47:2 51:13,16 53:17 72:6 79:14 86:1,22 87:7 88:15,19 89:20 91:2 92:1 93:2 94:6,10 96:19 98:5
themselves 57:16
thermal 17:18 18:18 19:12 20:19 21:4,5,7 22:5 56:3 66:22 69:13 74:1,7 77:4 91:14,17 92:4 92:23
thing 28:1,8,8 58:1 64:5,18 64:22 69:1 84:16 91:8
things 20:11 22:5 25:16 30:16 49:13 59:24 68:23 69:19 73:9 77:6 80:6 81:13
think 9:12 15:6 15:19 20:7 21:5,7 22:2 24:11 27:10 30:1 33:8,14 33:15,21 37:17 38:19 39:4,9 40:1,14 41:4,4 41:6,7,8,9,10 41:21 42:6,17 42:21,23 45:20 51:4 52:13 53:8 55:6,12 55:17 59:11 62:2 63:10,11 64:8 70:19 72:15,19 76:13 77:9 84:16 85:20 86:23 90:18 91:10 96:1
thinking 41:19
Thirdly 60:12
Thomas 2:2,13 4:12
thoroughly 95:21
thou 78:7
though 37:10 64:19
thought 32:21
thousand 18:21
three 37:4,12 38:15 51:23 61:11 63:12,19 63:21,21 64:15 64:24 65:5,7,7 65:12 67:16 68:9 71:14 72:21 78:7 81:18,24 82:1 84:10
three-degree 15:24 16:6
threw 37:24
through 28:20 29:6 33:9 47:13 48:13 52:24 57:16 58:6 60:2 64:20 70:12 83:19 92:6,7 92:20 93:19 96:4,18
throughout 55:11 72:4 81:24
throw 80:14,15
thrown 50:13 96:2
time 5:11 12:24 14:8 15:6 16:24 19:16,17 23:2,2 24:2 31:14,21 32:5 34:23 35:2 51:2 61:2 63:18 64:3 68:2,4,5 87:11 88:7,8
times 39:14 54:18 62:24 70:11 71:14 78:7 91:12
Tipsord 1:10 2:2 4:1,2 5:24 6:10 6:14,24 7:4,11 7:21 8:4,16 9:5 9:17 10:13,21 15:12 17:10 18:14 22:23 24:11 29:13 32:9 33:3,17 34:2,10,18 37:8,21 40:11 41:6,11,19 42:6,10 43:1 46:7,15 47:7 48:21 49:1 59:9 75:24 89:9 90:7,15 94:14,19 97:9 98:9
titled 7:10 8:9 10:5
today 4:8,16 5:23 6:5 55:19
together 17:23 25:18
toilets 26:18,19
Tom 6:4 11:23
tomorrow 5:17
tons 39:2 57:20 85:1,2,2
tool 44:1
top 15:8 58:10 60:4 65:10 79:19
total 29:21 43:23 75:15 84:12
touched 39:8
towards 15:16
tower 47:13 53:8 62:16,19 70:24 71:21 77:6 94:16
towers 46:1,5,9 46:10,13 59:17 62:15 64:23 77:7 93:1 94:1 94:6,9
toxicity 45:1,5
toxics 50:17
trail 37:22
trailed 46:15
transcribed 99:12
transcript 1:9 99:11
transfer 39:13 39:15 58:5
transferring 39:12 57:14 58:10
translate 69:3
transport 64:21
treat 42:5,15 53:16
treated 18:12 27:2,3 28:12 28:13 53:17 79:21,22
treating 88:12 88:14,15
treatment 17:6 18:12 25:18 26:7 27:3,6,8 27:20 28:6,7 28:13 29:2,3,5 29:7 49:18,19 50:5 52:20 53:2,6,21,22 53:24 55:4,10 56:7 57:13 59:18,21 68:17 76:10,22 81:8 81:9 85:14,16 86:2 87:21,22

91:19,20 92:1 92:17 93:19 94:2,17 96:20
tremendous 73:5 81:20
triangle 48:19
tried 32:16
trouble 45:21
true 42:11 99:10
truly 61:4
try 6:17 8:13 25:8,10,19 49:8 73:14 90:17
trying 17:20 40:9 52:1 56:17 64:15 86:17 91:5
TSS 55:3
turn 5:7
Twait 43:11 44:6
twice 49:13 74:22
two 6:16 13:12 22:5 25:7 31:22 37:3,12 49:15 60:8 62:23 63:15 64:15 71:14 77:19 78:1,13 81:11,13,18,22 81:23,23 82:1 83:14 87:3,5
two-degree 61:17
two-sludge 87:4
two-stage 87:3 88:5
type 19:9 36:21 40:5 49:19 68:17
types 35:24 52:18
typical 68:8
Typically 21:5 35:19

U

UAA 40:2 41:1
Uh-huh 18:16 72:11
ultimate 31:1,1 69:3
unable 32:17,22
unbearable 81:20
uncertainties 16:7
uncertainty 17:5 64:10,17
under 13:6 14:16 23:17 34:8 84:10 88:4 89:8,11
understand 30:24 32:19 43:22 57:10 61:7 65:14,15 66:4,9 79:1 83:8 86:17 87:18,19
understanding 14:23 30:13,15 31:9 34:11 50:20 68:7
unexchanged 53:9
unfortunately 17:20 18:4 39:13
unit 88:13,16,17 92:1
units 9:1
universe 96:21
unknown 84:8
unless 56:15 89:22
unquote 95:23
until 5:7 98:13
upgrade 96:19
Upper 30:3 31:12,16 34:12 34:21 70:7 77:12 84:14
upsets 55:1 65:24 66:1
upstream 16:10 18:24 19:5,10 23:4 37:4 45:8 69:19
usage 37:19 38:2 74:20 75:13,14 76:6 84:20,22
use 15:22,24 16:6 21:13 34:13,23 39:15 40:10,16 43:20 44:14,20 53:24 58:14 62:4 63:4 65:6 73:7 76:5,8 78:13 81:24 84:13 94:4,6,16 95:9
used 12:9,12,15 18:15 23:2 38:3 40:8 46:17 60:23 63:11 67:12 73:4 97:3
uses 95:22
using 15:21 39:21 40:16 58:5,11,14,19 65:15 72:23 75:11 81:23 83:16,24
usually 58:11 67:16 81:17
utilities 46:20,24 47:6
utility 53:6
utilization 38:2
UV 72:24 73:2 73:12

V

vacuum 51:3
variable 55:18
variables 22:13
variance 92:7,19
variances 97:24
variation 66:7
varies 63:17
various 52:18 53:4
vary 70:8
vast 12:11
velocity 64:20
vendor 71:10
vendors 12:16 64:15
verbally 8:14
versus 90:21 94:24
very 19:24 25:19 25:19,22 26:5 26:5,23 30:23 54:17 55:4,22 56:6 72:24 73:3,9,10,20 74:15 80:13 83:13 87:1,6,8 98:7
viable 92:2
viewed 93:9
violation 21:16
visit 12:22
visits 12:21
volatile 50:6
volt 58:7
volume 10:9 62:13
volumetric 18:3

W

W 2:13
Wacker 2:12
wait 5:7,8
want 20:13 26:10 33:19,20 55:19 70:19 75:19 83:9
wanted 6:17 97:13
wanting 56:1
warm 16:5 18:13 45:9 92:22
warmer 16:3 46:14
warming 17:15
Washington 2:16
wash-downs 53:4
wasn't 47:10 74:12 78:8 79:16 93:20 94:20
waste 26:17,17 26:18 28:16 47:18,19 53:1 76:5,14 81:22 83:21 84:21 96:8
wastewater 12:7 13:13 18:11 29:1,3,5,7,23 46:12 49:18,22 52:18,19,19,24 53:2,3,11,20 53:21,22 54:2 55:10,10 57:13 58:22 59:19,21 60:8 63:17 68:17 72:1,6 73:2 80:17,21 81:8 85:11 86:1 87:21 88:13,16 91:20 92:1 97:16
wastewaters 18:13 53:7 61:19 86:3,3
water 1:4,5 4:3 5:4 10:8 16:2 17:14,14 18:24 19:5,10,22,23 20:2,8,9,12,17 21:8,16 25:22 28:19,23 29:6 30:4,8,12,21 30:22 34:7 35:8,13,14,15 35:20,23 38:8 39:1 40:23 41:2 49:20 50:2,5,15,17 50:20,21,24 51:6,13,22 52:6 54:4 60:14 63:6 68:19 69:4,5 69:12,13 70:2 73:3,21 77:16 80:1,2,2,5,7,8 80:9,10,11,12

80:14,15 81:5 81:14,15 82:4 84:14 88:9 92:3 95:11,11 95:22,22 97:17 97:24
waters 51:1 69:22 89:18 90:2,9,13
watershed 69:21 69:23 77:24 78:14
watersheds 36:1
Waterway 1:5 4:5
way 11:15 17:7 26:3 28:9 34:16 58:12 60:5 62:24 63:4 65:21 69:13 75:11
ways 93:1
website 32:23
week 78:7
welcome 5:21 49:12
well 6:9 7:10 15:14 21:24 24:5 25:6 32:2 33:12 34:17 35:16 36:10,10 39:9 41:9 42:13 50:12 54:17 61:13 62:18 63:9 66:7 70:4,14 72:3 73:3,20 74:9 78:23 85:14 89:24 91:10 94:13 96:21
well-designed 87:13
well-managed 87:13 91:20
well-operated 87:14
went 25:1 92:6 92:20 96:3,18
were 6:12,16,21 7:15 11:17 12:20 13:5 15:23 16:23 19:2,5 23:10 27:10 29:14 31:21,24 32:4 32:5,17,19,22 36:14 37:15,23 41:12,13 44:17 45:19 46:23 47:4,12 48:14 48:16 52:1,4 60:13 62:9,10 63:3 66:21 68:15 69:9,22 69:24 72:7,10 79:6,14 81:4 82:13 83:9,20 83:21,21,21 84:2 87:15,20 90:21 91:16 92:10,15 93:6 97:13
weren't 32:6 90:22 92:4 95:15
wet 46:16 61:16 69:21
we'll 4:19 6:2,14 6:15,24 8:17 9:6,20,22 10:14 39:5 41:21 48:22 49:1 64:2 75:22 98:11,11
we're 14:11 16:3 24:11,13 29:7 30:1 35:9 43:2 44:2 48:20 54:13 57:2 58:10,11,13,16 58:17,19 63:20 64:11,12 65:1 66:4,5 67:1,4 70:7 77:10 81:1,14 82:11 83:16,16 84:7
we've 9:14 28:13 42:18 58:24 60:11,22,23 61:3,4,5,11,20 62:23 63:24 64:19 67:2 73:6 76:13 84:4 92:22
WHEREOF 99:13
while 55:7 59:11
whole 45:1,5
wildlife 28:20
Williams 2:9,15 7:7,22 18:15 18:17 20:6,13 20:16,22 21:2 21:10,15,23 22:2,15,18 33:15 37:6 39:19 40:1,9 40:14 41:21 42:8,13,23 65:6,14 66:4 92:12,14 93:13 93:17,22,24 94:4,8,21 95:5
windshield 73:14
winter 20:4 21:20 45:21 54:21 55:24
wintertime 43:21 92:1
wipers 73:14
Wisconsin 51:16 51:18
witness 41:17 51:20 99:13
witnesses 4:18 4:18 6:1,7,11 6:12 8:11 40:19 41:5,24
wondering 28:20
worded 78:7,8,9
words 30:16 36:9 59:19 79:3
work 13:4,6 23:2 33:20 54:6,17 61:13 62:5 68:17 73:1,15
worked 50:23
working 19:2 49:18 65:11 96:2
works 61:1
worksheets 75:8 75:16
world 43:20 54:6 62:1
worldwide 72:22
worried 25:22
worth 73:6
wouldn't 20:9 39:17 44:13 62:5
writer 20:20 21:12,13
written 10:6
wrong 40:16
wrote 61:24
WW 52:23

X

X 3:1,7

Y

yeah 14:18 17:17 18:20 20:15 21:2 23:21 24:6 28:4,18 60:17 62:11 68:9,14 77:19 83:2 88:2 92:11 93:18
year 14:14,16,17 14:18,20,21,22 15:3 55:11 57:4,20 69:20 71:2,19 74:5 82:21 84:18,23 85:1,2,2,3 96:16
yearly 75:13,14
years 49:21 50:1 64:6 67:16
Yerachmiel 10:6
Y-e-r-a-c-h-m... 10:7

Z

zinc 44:8
zip 89:2,6
zone 15:21,22 16:2 20:10,18 20:23,24 23:17 24:3,7,9 45:8 45:12,13,15 66:13 69:10 70:15 78:22,23 79:4,10
zones 21:5,6,7 23:23 45:18 78:19

$

$1,300,000 71:2
$1,640,000 71:2
$1,771,000 74:5
$10 64:1
$3.436 84:17
$650,000 74:5

0

0.88 21:13
001 85:13
07 14:22
08 14:22
08/13/2009 8:3 8:21 9:10 10:3 10:18
09 14:22

1

1 11:6 15:15 18:3 29:15,16 48:13,14 49:17 52:15
1.1 21:14
1.3 71:19
1.64 71:8
1:00 98:11,13
10 3:12,13 13:16 24:14,20 29:20 56:2 62:9

72:13
100 63:24 64:3 80:19,19,24
100,000 29:19
1000 18:2
1021 2:7
103 54:8
11 3:3 9:14 13:22 30:1 38:17 47:17 70:19,20 76:2
117.8 84:23
12 14:8 71:24 79:20
12:00 98:10
120 48:14
129 85:1
13 1:15 15:17 38:18 72:12 98:13
130,000 39:2 57:20 85:1
14 9:13 24:13 38:20 85:5
15 26:15 30:1 54:7 56:2 72:3 76:2 95:17
1500 55:17
16 37:15 77:9
160 1:14
17 39:4 79:19 80:22
18 39:5
19 43:2 82:19
1900 2:16
19276 2:8
1977 10:9 64:9
1980s 13:11
1985 13:13
1987 13:14 50:13,22

2

2 15:15 51:5 84:21
2.6 84:18
20 67:18 81:15 83:8
20006 2:16
2004 31:19 32:3 33:9 78:1
2005 13:11,15 32:4 78:1
2006 14:22 15:9 15:16 31:19 32:4 33:9 48:14 69:22
2007 48:15 69:23
2008 11:18 12:23 15:9,16 43:6 72:6
2009 1:15 98:13 99:14
21 84:11
22 44:5 85:10
23 44:9 95:17
236 85:2
24 44:10 48:14
24.2 85:3
25 45:6 54:10
25,000 82:24
250,000 82:21
26 45:6
27 45:7
28 45:20
29 45:23

3

3 17:9 37:8 39:21,22 40:15 45:7 51:4 52:12 56:4 65:9,10,12
3,000 80:18
3,057 85:2
3.5 35:2
30 45:24 64:6 67:18 71:21
30-day 32:7 35:1 78:9
301 1:7 4:6
302 1:7 4:6
303 1:7 4:6
304 1:7 4:7
31 4:15 5:22
318 3:9 7:6,24 8:2 24:15,20 30:2 37:9 38:11 52:16 85:7
319 3:10 8:17,18 8:20 12:3
32 46:18
32,000 84:24
320 3:11 9:6,7,9 9:18 15:13 48:2 59:9,10
321 3:12 9:20,22 10:2 12:16 24:18
322 3:13 10:14 10:15,17 12:15
33 47:11
34 47:11
35 1:6 4:6 47:16 49:21 50:1 54:8,10 80:18
36 47:16
37 9:4 48:1
397 10:9

4

4 8:10,23 12:1 15:18 35:1 53:19 56:5 57:11 59:6,6,7 68:11
40 54:7,8
400 26:12 28:9 72:8
409 10:9
49 3:4

5

5 12:5 29:13 30:21 34:23 51:19 55:7 59:14 65:10,10 65:12 76:3 96:15
5.5 34:24
500 80:23
5700 76:8

6

6 12:17 34:22,22 56:4 64:2 78:5 78:6,8,10 84:10
6.6 80:20
60 54:19 65:11
600 14:8,11,15 15:4
60606 2:13
62 15:1
62794 2:8
65 54:11,17
650,000 82:21

7

7 57:11
7,000 84:20
70 54:17 65:12
71 2:12
75 54:17
77 48:16

8

8 3:9,10 13:2 38:18 58:21 60:20 70:22 71:4
80 58:8 72:23 81:14
80s 86:20
84-3565 99:21
85 54:12,15

9

9 3:11 10:9 38:18 46:24 47:2,4 59:11 62:3 72:13
9,000 84:24
9.2 81:1
9.4 68:5
9:00 1:15
90 54:5,12,16,19 65:11
90s 86:20
9031 5:18
95 54:11 55:2
96-10 32:21,22
98 55:2 67:21
99 54:2 57:24 64:1,3 67:21