STATE OF MICHIGAN

STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

In the matter of:	File Nos.:	GW1810162 and MP 01 2007
The Petitions of the Keweenaw Bay Indian Community, Huron Mountain Club, National Wildlife Federation, and Yellow Dog Watershed Environmental Preserve, Inc., on permits issued to Kennecott Eagle Minerals Company. /	Part:	31, Groundwater Discharge 632, Nonferrous Metallic Mineral Mining
	Agency:	Department of Environmental Quality
	Case Type:	Water Bureau and Office of Geological Survey

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

HEARING - VOLUME NO. VI

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Monday, May 5, 2008, 8:30 a.m.

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Lansing, Michigan

Monday, May 5, 2008 - 8:32 a.m.

JUDGE PATTERSON: Are we ready to --

MR. DYKEMA: We are ready, your Honor. Petitioners call Dr. Paul Adamus.

JUDGE PATTERSON: Okay.

MR. LEWIS: Could I have just a minute, your Honor?

JUDGE PATTERSON: Yeah; sure.

MR. DYKEMA: Dr. Adamus.

REPORTER: Do you solemnly swear or affirm the testimony you're about to give will be the whole truth?

DR. ADAMUS: I do.

PAUL R. ADAMUS, Ph.D.

having been called by Petitioners and sworn:

DIRECT EXAMINATION

BY MR. DYKEMA:

Q Dr. Adamus, would you please state your full name and spell your last name for the record?

A Paul Raymond Adamus. My last name is spelled A-d-a-m-u-s.

Q And, Dr. Adamus, where do you live?

A I live in Corvallis, Oregon.

Q Your address there?

A 6028 Northwest Burgundy Drive, Corvallis.

Q Where are you currently employed?

A I currently have two employments. One is -- I have my own consulting firm, Adamus Resource Assessment, Incorporated. And I also am affiliated with Oregon State University with an appointment as courtesy professor there.

Q Will you please summarize for the court your post-secondary education?

A My bachelor's degree is in wildlife science from the University of Maine. My master of science degree is from University of Utah in biology. And my Ph.D. is in wildlife science from Oregon State University.

Q What was the subject matter of your dissertation?

A The subject matter was the use of wetland and riparian habitats in the Willamette Valley, Oregon, during the winter.

Q The use of those habitats by what kinds of organisms?

A Oh, by birds.

Q And what was your first time -- your first full-time job in wetland science?

A In 1975, I began working for the Center for Natural Areas, which was affiliated with the Smithsonian Institution with offices in Washington, D.C., Los Angeles and Maine. And I was employed at their office in Maine.

Q And what work did you do with the Center for Natural Areas?

A I was employed as a scientist for them. And I worked on a variety of projects, one of which, for example, was a study

of a power line right-of-way that crossed all the northern New England states. And during the course of that project, I visited over a hundred wetlands, many of them bogs and fens, which are two very common types of wetlands in northern New England.

Q And did you do wetland surveys?

A Yes. I did do somewhat in surveys. And in 1980, I was the -- I began as the principal investigator of a major project for the Federal Highway Administration. And that project involved developing a rating system for wetlands for the entire United States. Federal Highway had selected Center for Natural Areas and myself to do that project. And I worked at it for about two years. And the culmination was a report -- a systematic method for scoring wetlands for assessing them based on their functions and values.

Q Does that scoring system have a name?

A Well, at the time, it was called the Federal Highway Method. But subsequently it went through a rigorous peer review by about 30 scientists -- wetland scientists from all over the United States. And following that peer review, the U.S. Army Corps of Engineers which, as you know, is the major agency that is responsible for wetlands regulation -- the Corps of Engineers decided to adopt that method after some additional revisions. And they published that in 1987 under the name WET. It stands for Wetland Evaluation Technique.

Q And have other regulatory authorities in the United States adopted or endorsed the Wetland Evaluation Technique that you developed over these years?
A Yes. A number of states have developed their own regional modifications of it. An example would be Minnesota, which in the mid 1980's used WET. And I met with them several times. And they developed a version for Minnesota.
Q How long were you with the Center for Natural Areas?
A I was with the Center until approximately 1983.
Q Where did you go then?
A At that time, I did a brief stint with the Maine Department of Energy. And then I went to work for a private consulting firm by the name of EcoAnalysts.
Q And did you do wetlands research for EcoAnalysts?
A Yes, I did. One of the projects that I did with EcoAnalysts, I was principal investigator for was a survey of wetlands in southwestern Maine rating them for their functions and values. And for that, we developed a regional version of WET or at that time it was still the Federal Highway Method, and we applied that rating system to well over 100 wetlands in southern New England -- southern Maine.
Q How long were you with EcoAnalysts, Inc.?
A I was with Ecoanalysts until 1986.
Q What did you do then?
A In 1986, I was approached by the City and borough of Juneau,

Alaska, which is in terms of land area one of the largest boroughs and cities or municipalities in the United States. And Juneau, Alaska, has enormous numbers of wetlands. And they asked me to assess their wetlands. They gave me a sole source contract to assess their wetlands and the functions and values of those wetlands. And I did so. And that was subsequently incorporated into one of the first wetland management plans for any municipality in the United States. I believe it was the second one ever done.

Q Are the wetlands that you surveyed for the borough of Juneau similar to wetland networks in the Yellow Dog Plain?

A They have many similarities, yes. They're both in glaciated regions. And we looked specifically at some precipitation-driven wetlands, which were bogs, and also at a large number of groundwater-driven wetlands, which wetland ecologists often -- they often call fens. And in the course of looking at many bogs and fens, I was partnered with an eminent hydrologist, Dr. Donald Siegel, from Syracuse University. And Don and I installed piezometers around these -- around and in these bogs and fens and monitored the groundwater levels, looked at the groundwater chemistry and, you know, became very familiar with situations that are somewhat analogous to the Yellow Dog Plain.

Q Do you consider yourself an expert in groundwater hydrology?

A I do not. I call myself a wetland scientist. And to be a

wetland scientist one has to be familiar with a lot of topics ranging from water chemistry to hydrology to biology. But I don't consider myself a master in any of those and particular in groundwater hydrology. I often consult with other experts. But I do have, I feel, a good working knowledge of the subject.

Q Do you have to have a good working knowledge of the subject to analyze wetland function?

A Yes. You don't have to have, you know, the equivalent of a Ph.D., but you do have to have a good working knowledge of groundwater hydrology.

Q You mentioned earlier Adamus Resource Assessment, Inc. When did you create that company?

A Well, I created it initially in 1986. But after completing the study for Juneau, Alaska, I had a very attractive offer to work in the Environmental Protection Agency's; that is, EPA's; National Wetlands Research Program, which is headquartered in Corvallis, Oregon. And I was hired onto their program not directly by EPA but through their contractor. That's very much how they operate at that particular lab. Because of the paperwork and difficulties of hiring through the federal system, they have their contractor hire scientists. And I continued working there for ten years, from 1987 to 1997.

Q And during those years, you were operating primarily as a

contractor to the United States EPA?

A That's correct; yes.

Q Can you describe for us some of the major contracts and projects that you undertook as a contractor for EPA relating to wetlands survey analysis and science?

A Okay. At the time, they were beginning to discuss the development of water quality criteria for wetlands, water quality standards for wetlands. And I organized and led a national workshop of scientists on that topic. I also worked on cumulative impacts. EPA had an initiative to develop methods for assessing cumulative impacts at a regional or landscape scale. And I worked to -- I was one of several people involved in the development of a standardized protocol which was published under the title "Synoptic Method of Assessing the Cumulative Impacts of Wetlands." It's approximately the title. And that was, you know, a major effort. I also analyzed through statistical analysis, regression and so on, the role of wetlands on a watershed basis in parts of Illinois. And I prepared a major literature review on the subject of impacts to wetlands for the entire United States.

Q What is the range of impacts that you were surveying?

A Well, we considered a broad array, myself and the person that I was working with on this. We considered all the taxonomic routes, so we considered wetland plants, wetland

algae, wetland birds, wetland amphibians, you know, the full taxonomic range. We had a chapter on each of those taxonomic groups. And within each chapter we talked about -- we had about a dozen major types of impacts. So one type was the effects of groundwater -- or the effects of water level drawdown on that group, the effects of toxic chemicals on that group, the effects of habitat fragmentation on that group and so on. So it was a very comprehensive survey that, I believe, involved close to a thousand publications in the peer-reviewed literature that we reviewed -- that I read personally and then extracted that information in this major report that's almost 200 pages in length.

Q Does the United States EPA still rely upon or recommend that report?

A They do encourage its use. It's certainly -- it's not a requirement. But they have it on their official website in the wetlands division. And they -- they do consider it a very good piece of work by virtue of the fact that they actually asked me ten years later to come back and update that report, which I did under contract to them.

Q And when did you do that?

A I did that in 2001 it was published. And I worked on it then with the help of one of my graduate students.

Q You said your contract work with EPA took you through 1997.

Where did you go then?
A At that time, I decided -- well, I had two possibilities. One, I was interested in restarting my consulting firm, Adamus Resource Assessment, which I had shelved. I had been required to shelve that during the ten years that I worked at EPA. So I wanted to restart that. And I also had an invitation to become a faculty research assistant at Oregon State University during -- that was not a full-time thing. But I did do that. So I began that dual employment path, which I currently maintain now.
Q Does your affiliation with Oregon State University hold out the prospect of tenure?
A I have considered that possibility, but I have voluntarily chosen not to pursue tenure because it would restrict me from doing the outside projects with my consulting firm to the degree that I do them right now. And frankly that's what I enjoy most is taking the science and applying it to real-world situations.
Q And whom do you teach or instruct at Oregon State?
A Well, currently I have three graduate students that I supervise. And I have supervised others in their theses and so on in the past. And I serve on faculty committees at the university. And I, you know, participate in university work. I do have -- I have had opportunities to teach university courses. But frankly I've been too busy. I do

enjoy teaching. But what I've been doing in terms of teaching is through my firm, ARA, I've been teaching not college students so much but other professionals. I provide -- or I train in about three or four courses per year. I've been doing this for the last ten years approximately -- training other wetland professionals. These are people from the Army Corps of Engineers, from EPA, from state agencies and from consultants. And I should note that I've been a trainer or a teacher of wetland assessments since the mid 1980's when the Army Corps of Engineers asked me to train district Corps of Engineer staff in wetland assessment in various workshops around the United States. And the only time I kind of took a break from that was during the ten years that I worked at EPA.

Q And when you leave Lansing this afternoon, where are you headed?

A I'm headed to Houston, Texas, because I'm going to be training wetland professionals there the rest of this week.

Q Approximately how many times in your career has the Corps of Engineers or the United States Environmental Protection Agency or state departmental agencies asked you to train people how to survey, analyze and understand wetland function?

A Oh, I would say probably a couple dozen times, yeah. It's numerous.

Q During the last ten years when you have the dual careers as university instructor and your private company, have you been asked by the National Park Service to do any wetland survey work?

A Yes. They have involved me in two projects. One is a few years ago they asked me to do a comprehensive assessment of the health of wetlands in two of the western national parks; Crater Lake National Park and Lassen Volcanic National Park. And this was a grant through the -- or an agreement through Oregon State University. And myself and a grad student of mine and some seasonal hires went out and we were on the ground during the summer visiting -- well, in the case of Lassen, it was about 80 wetlands and, in the case of Crater Lake, it was about 60 wetlands. And we spent a whole date in each of those wetlands and looked at indicators of their health and condition and possible stressors.

Q And which was that park?

A Lassen Volcanic National Park and also Crater Lake National Park. And another project I did for the National Park Service, I was asked to help them. They have put together a compendium of all the assessment methods not just for wetlands but for terrestrial ecosystems as well, so hundreds of rapid assessment methods. This was an effort that was completed about a year ago. It's now on their website. One can input the name of any state and wetland type and come

out with a list of methods that are available for that. And I helped them prepare that.

Q Does the United States EPA have plans for -- in the near future for a new national wetland survey initiative?

A Yes. Just to preface that for just a second, for the last few decades the U.S. Fish and Wildlife Service has been -- every ten years they implement a national status in trends for wetlands where they measure the gain and loss in wetland acreage throughout the United States or some of the regions of the United States. Well, their next assessment is coming up in the year 2010, you know, just a couple of years from now. And they have asked -- or they have partnered this time for the first time ever with the EPA. And not only are they going to assess whether we're gaining or losing acres of wetlands, but in 2011, EPA is implementing a nationwide statistical survey to assess the condition of wetlands; are they healthy, are they degraded, what percentage of the wetlands are in good condition or poor condition. And they're stratifying it by region and state and wetland type and a whole bunch of things. And they have -- EPA has started to meet with scientists and with state agency people both academics and state government people.

Q And have you been asked to help with that?

A Yes. I was invited to their first meeting about two months ago in Portland, Oregon. They will be having a series of

other meetings over the coming years which they've indicated they very much want me to participate in. But the goal of these meetings is to come up with indicators and a statistical design that we feel is the best possible for assessing the condition of wetlands and the impacts to wetlands in the United States.

Q You talked about your work with the borough of Juneau. Have you been asked by other municipalities or counties to develop wetland policies?

A I have. Kennebunk, Maine, back in the 1980's asked me to help develop their wetlands ordinance. Corvallis, Oregon, where I live, I contributed to their natural features inventory. And most recently over the past three years the largest county in Puget Sound, Washington, Island County, has contracted with me a sole source basis to work with them in their critical areas program to develop and update their critical areas ordinances and specifically the ordinance dealing with wetlands. And the State of Washington has a legal requirement enacted by their legislature about 15 years ago that municipalities and other local entities must use best available science in their wetland -- their wetland regulations. And the legislature and the agencies have spelled out very clearly what they mean by "best available science." So in my work with Island County, I've been very diligent in following their definition of "best available

science." And one of the three reports that I've prepared for them focuses specifically on best available science for wetlands and wetland functions and wetland buffers. And that report went through a rigorous external peer review. And subsequently just a month ago the state agencies in Washington issued a letter saying that they were extremely pleased with the work that I had done in Island County, that they saw it as pioneering work and they felt it was cutting-edge. And they totally approved of the county's and my work.

Q Have you done any wetland science work in Michigan?

A I have. It has been somewhat limited. But last summer I taught a course to wetland professionals at the Kellogg Biological Station which is in southern Michigan near Kalamazoo. And, you know, as I say, it was other wetland professionals, many of them from Michigan here. And it was focused specifically on wetland assessment. And we went around -- spent several days in the field visiting wetlands including some that were groundwater fed. And we -- you know, I taught wetland principles and we analyzed the situations. More recently I've been a partner on a contract with the Michigan Department of Transportation. Even though I'm out in Oregon, they wanted to include my expertise for prioritizing wetlands. The state of Michigan is in the process of developing a method they call MiRAM, Michigan

Rapid Assessment Method. And they were -- the myocardial infarction DEQ was interacting with the Michigan DOT and trying to develop certain components of the MIRAM method. And through this contract, I was tasked specifically with developing the wildlife habitat component. And as part of that, I developed models which predict -- or will predict the occurrence of every wetland-dependent mammal and bird and amphibian and reptile in Michigan including animals in the project area.

Q By "the project area," you're referring to the Eagle Mine project?

A Yes.

Q Dr. Adamus, how many total papers and reports have you authored on the subject of wetland science?

A It's over a hundred. Well, it's over a hundred publications total. The majority of those have been on wetland science.

Q And how many peer-reviewed papers have you published?

A I'd say at least a third of those have been peer-reviewed, maybe more than half.

MR. DYKEMA: Can I have slide number 1?

Q While we're waiting, Doctor, have you ever testified before on wetland science?

A Yes, I have, not in a courtroom proceeding but to the U.S. Congress. I've been invited twice to testify on wetlands.

Q Doctor, now, we've got up on the screen now -- well, Doctor,

tell us what we're looking at in the screen?

A We're looking at the two major points, which I wish to make today and which I will make through the evidence provided, one being that the wetlands at the mine site and those that are outside the mine site to some distance are exceptionally sensitive important to the degree that I can tell that from the data provided. And secondly that, not only are they sensitive and important, but they also will be degraded or, in some cases, lost entirely as a result of the mine activities.

Q Of the hundred or so papers and reports that you have published, how many directly bear on the assessment of the importance and sensitivity of wetlands or on the degradation and destruction of wetlands?

A Oh, I would say more than half of them. That has been a major focus throughout my 30-year career.

MR. DYKEMA: Your Honor, I'll ask that Dr. Adamus be permitted to testify as an expert in wetland science.

MR. PREDKO: Your Honor, Intervenor would just state that Michigan law does not require that the expert be tendered, nor does it require that parties stipulate that the expert is an expert, nor does it require the Court to affirm that the expert is an expert. And we would therefore reserve foundational objections for cross-examination.

MR. REICHEL: We have no objection.

MR. DYKEMA: Thank you.

Q Dr. Adamus, can you summarize for the Court what you looked at and reviewed in preparing the opinions that you intend to offer?

A I've looked -- first of all, I looked at the project documents, the environmental impact assessment and its appendices, particularly those that were focused on wetlands. I read the entire assessment document. I read the wetland delineation report. And I read the reports that dealt with wetland hydrology and groundwater hydrology generally. And also besides the reports, I did my own literature review on wetlands of Michigan and impacts to wetlands from groundwater extraction, groundwater draw-down, just to update my knowledge and to make sure that I was totally on target with my opinions on things.

Q How many papers did you review?

A Oh, it was probably close to 60 or 80. And I also consulted with some of my colleagues. For example, one of the pretty eminent wetland hydrologist who did some of the Seminole work back in the early 1970's here in the Midwest was Dr. Richard Nevitski. And Dick and I have been friends for a long time. We used to work at EPA together. He was formerly the head of the USGS in Illinois. And I conferred with him about this project and also with a number of wetland experts, local experts from Michigan here, and

certainly with the hydrologist and other people on our team here.

Q Did you have the opportunity to review existing wetlands inventories as they reflect information on the Upper Peninsula of Michigan?

A Yes, I did. I looked at the maps from the National Wetland Inventory and from the Michigan DEQ and, of course, the project documents.

Q And did you review materials that have been prepared by other experts that have testified or will testify for the Petitioners in this case?

A Yes. I reviewed hydrologic reports by a couple of firms, GEO Matrix and there was another GEO-something report that I reviewed.

Q And have you reviewed deposition maps that have been created by a firm called Conestoga-Rovers & Associates?

A Yes, I have.

Q Dr. Adamus, are wetlands important?

A Yes. I believe they are. And I believed that even before I got involved with wetlands as a career.

Q Why? Why are they important?

A Wetlands are important because the various types of habitats on the landscape, you know, things like, you know, forest, farmland, desert, mountain, you know, the different habitat types on the landscape. Wetlands have the highest

function -- the highest level of function for a number of functions, one being biological diversity. The number of species that -- of plants and animals that is dependent on wetlands to sustain them is, you know, generally higher than most other habitat types. Wetlands as a whole tend to be very productive, and they have a major role in the hydrology of the landscape. So scientists commonly categorize the importance of wetlands in three categories; their hydrologic benefits, their water quality benefits and their biological or biodiversity benefits.

Q And do wetlands support migratory birds and megafauna?

A Oh, yeah, certainly. There's thousands of -- or at least hundreds of species here in Michigan that are very important for which wetlands are extremely important.

Q What are the hydrologic functions of a wetland?

A Well, depending on the wetland type, its position in the landscape and a host of other variables, wetlands can be very important in regulating the flow of downstream rivers. You know, that is reducing flood peaks and sustaining low flows during the late summer so that rivers don't dry up. And they can -- wetlands also can influence the exchange between surface water and groundwater.

Q Do wetlands have an effect on water quality?

A Yeah, very definitely. Wetlands are among the most important systems on the landscape for removing nitrogen or

nitrate from surface waters. And nitrate is a non-point source pollutant; in high quantities, that is. And wetlands also are effective depending again on type and setting and other factors -- are very effective for removing a variety of other substances. However I want to point out that wetlands, although they have a reputation as being filters for pollution, they're like your garbage disposal. You can only put so much into a wetland when it begins to choke, and it begins to get degraded and then it doesn't function -- it doesn't provide that function anymore of processing waste. So there are definite limits.

Q Do wetlands store mercury?

A They do. Methylmercury -- mercury in the methylmercury form is important in wetlands. And in some cases the organic matter from wetlands interacts with mercury and mercury can be mobilized, which makes it available to the food chain.

MR. DYKEMA: Next slide.

Q Dr. Adamus, we're now looking at a slide that you prepared, which is a quote from a work by Drs. Tilton and Schwegler?

A Yes.

Q What are Drs. Tilton and Schwegler saying here, and do you agree with them?

A Yeah. What they're saying here is they're focusing specifically on wetlands in this region, the Great Lakes region. And I don't mean just along the shore of the Great

Lakes but inland wetlands as well. And they're saying that these wetlands have extraordinary functions, that they're very important. They produce organic matter. They support large, you know, numbers of invertebrates, birds. And they're very important in mineral cycling. And they mention that the alteration of these wetland habitats can alter regional patterns of mineral cycling and can cause an increase in nutrient loading and pollutant loading to other surface waters.

Q And about six lines down in this quotation from the Tilton and Schwegler paper, the authors state, "Wetlands are the most important habitat for wildlife in the Great Lakes Region." I've read only part of that sentence. Do you agree with that statement?

A I do.

Q Doctor, maybe I've gotten ahead of myself already. Let's get back to the beginning. What is a wetland?

A Well, a wetland is an area that -- it has -- by the legal definition used by the Corps of Engineers, which is the regulatory agency, a wetland has to have three things. It has to have a predominance of hydrophytic plants; that is, plants that are adapted to live in soils that are -- remain saturated for a substantial part of the growing season. Secondly it has to have what's called hydric soils. These are soils which are saturated for long enough periods that

they develop distinctive chemical characteristics, chemical reduction. And they have unique geomorphic or geochemical cycles. And thirdly besides vegetation and soils, a wetland has to have certain hydrologic characteristics -- hydrologic indicators that are spelled out in the Corps of Engineers 1987 delineation manual as well as the wetland delineation manual that Michigan DEQ has which is very similar to the Corps of Engineers manual.

Q Is there a rule of thumb as to how deep a wetland much be wet for a prolonged period in order to satisfy the definition?

A Yeah. There is a guideline that says that generally the upper 12 -- the 12 inches from the ground surface down that there has to be saturation during some of the year in that area for the area to be called a wetland. Now, a lot of people, you know, when they think of wetlands, they think of areas that, you know, have shallow water in them during a lot of the year and, you know, we see the pictures on TV with thousands of ducks flying into, you know, these nice marshy, ponded areas. But in actuality, wetlands -- the legal definition encompasses many areas that never see a drop of surface water that, at all times, the water is below the ground surface. But it has to be within that 12-inch zone during the -- part of the growing season for it to be considered a wetland.

Q Doctor, we put up Adamus demonstrative Exhibit 3, which you prepared for us or provided. And I would like you to use this, if it's helpful to you, to explain how it is wetlands get their water.

Q Okay. This is a -- this cross-sectional diagram is not, of course, specific to the project area. It's kind of a generic conceptual diagram. But those areas that you see labeled as "oases" are essentially wetlands. And, you know, the rainfall or the snow, as it falls into the higher parts of the landscape in the forests and so on, it infiltrates down into the water as recharge. And it recharges -- it can recharges in two ways. One is kind of in this shallow zone here which is called local groundwater movement. And here it just kind of pops up, you know, maybe a few hundred feet maybe a mile or two downslope. But we also have regional patterns of, you know, infiltration and movement of groundwater as it travels downgradient here. In this pathway, it can flow for considerable distances.

Very often wetlands occur at faults. So what you see here, this kind of geological fault, when the groundwater hits this fault or some other very impermeable layer which is at less than 180 degree angle -- you know, if there's something that -- 90 degree angle or so, the groundwater is forced up through pressure to come to the surface and you often get wetlands. And what I'm trying to

show here is the interaction with two types of wetlands, one which according to the Brinston classification would be a groundwater slope wetland, which would be something like this (indicating).

Q And there you're pointing to the oasis in the middle of the page?

A Yes. And this is more like just a gradual seepage of shallow water that's moved laterally. But in the case of this wetland down here, this would be called a -- well, either a sloped wetland or perhaps a depressional wetland where we have regional movement of water coming up vertically -- a very vertical component to this flow. And we have both types, which I'll go into in a minute. We have both types in the Yellow Dog Plain area.

Q What are the key determinants of how a wetland functions?

A Well, the three things that I mentioned that define a wetland also define how it functions. You know, its hydrology, its water quality and the plants and animals live there. But ultimately it really boils down to the hydrology.

Q And what are the key variables or parameters for the hydrology?

A The key variables are the duration of either flooding; that is, surface water on the land surface -- visible water on the land surface; or the duration of saturation in that

upper 12 inches. So it's the duration, the frequency with which that occurs. Does the saturation only happen once a year or is it intermittent, and what are the time sequences between those saturation events and the magnitude of the saturation? Is it -- does it cover a large area or is it focused? And one other key thing is the seasonality of the saturation. If the soils are saturated only during the wintertime, that's going to have a different effect on the functions of the wetland as opposed to if it's saturated during the late summer or early summer or the growing season.

MR. DYKEMA: Okay. Next slide.

Q Doctor, we're now looking at demonstrative number 4, which is a paper that you and others authored. What is the relevance of this to what you just were saying?

A Well, this illustrates my point about the idea that water level or soil saturation level -- water table level. Just on the order of a few centimeters can shape the composition and richness of the plant community in wetlands. And I have cited a whole bunch of references there. This, by the way, is that first literature review that EPA asked me to do back in 1990. Excuse me. This was the ten-year update of that. But my point here is that water level fluctuation and the level of the water table in wetlands is extremely important in determining, number one, whether we have a wetland area

at all and, number two, what is the quality of that wetland and what are its functions.

Q And does the scientific literature support the notion that a change of only a couple of centimeters can radically alter wetland function?

A It does. There are numerous references in the literature that demonstrate that.

Q Are there different kinds of wetlands?

A Yeah, there are. And the environmental assessment document has noted two or three of these. They kind of lump them into two categories, precipitation-driven wetlands and groundwater-discharge -- or groundwater discharge-driven wetlands. Those are two broad categories. But there are much finer distinctions that can and should be made, I believe.

Q And have you prepared a demonstrative that summarizes the key features of the different kinds of wetlands?

A Yes, I have.

Q Doctor, we're now looking at Adamus demonstrative number 5. Is this a table you prepared?

A Yes, I have.

Q Can you please quickly lead us through it?

A Yes. These -- here the main water sources for wetlands in the Yellow Dog Plain area. These first two are precipitation-driven systems for the most part. And these

two are more groundwater. But if you can imagine a gradient, these being the most precipitation-driven, these the most groundwater-driven --

Q In the first case looking at the surface water and, in the latter case, the deep groundwater?

A Yes. Right; yeah. Because many wetlands are a combination of multiple sources. You know, they don't break neatly into totally precipitation-driven or totally groundwater-driven. They have different components. But as a conceptualization, this is what we're dealing with. And for the layperson, most bogs and poor swamps and depressions in the Upper Peninsula fit into this category surface water; whereas, those that are driven by groundwater are commonly at least among wetland scientists called fens. And you're going to hear this word a bit more in my testimony. But we're dealing with, you know, in some cases, fens that are along the river, in some cases, ones that are further apart. But the distinction is that, in these surface water driven wetlands, these bogs and so on, most of the water comes from rain and local runoff, and it percolates down -- vertical direction is down. These tend to be very acidic types of wetlands, pH sometimes between 4 and 5. Temperature tends to be basically whatever the air temperature is. They're relatively dynamic in terms of their temperature and, in some cases, water level -- water quality fluctuations.

Bogs, of course, have a very thick organic layer. Not all bogs do, but many bogs have, you know, a thick layer. And their plant diversity tends to be relatively low. You know, some of the species that occur in them may be important, but the numbers of plants is low. And likewise animal diversity tends to be low. They tend to be vulnerable to contaminants, especially metals because they're poorly buffered systems. And on the other hand, their threat of being dried up from groundwater loss is really not a major concern, I don't believe. The impact statement that correctly noted that many of these bogs in the project area, the surface water wetlands, are high enough and separated enough, they believe, from the groundwater table that a drop in the groundwater table, if it occurs, is not going to impact these. However, they also note the presence of these fens or what they call the groundwater-supported wetlands in the project area.

Q And how does the fen or groundwater supported wetland compare with the surface water wetland?

A Well, it's much more vulnerable to the loss of groundwater, you know, because it is supported by groundwater discharge. Any change in the level of the ground -- the water table is going to very definitely impact these, not only impact where the water level is in that 12 inches that defines a wetland but also affect the quality of these wetlands, their

chemistry.

Q What is the water chemistry of a fen compared with a bog?

A All right. In these groundwater-driven fens, the water is much less acidic. It -- because it's coming up from the ground and it carries more calcium and a higher alkalinity. And the temperature tends to be more stable on a year-around basis. And actually shows -- by "more stable," I mean it doesn't -- it doesn't -- the temperature is not the same as the air temperature. But during the winter, these groundwater-fed areas tend to be warmer than the surrounding air. And during the summertime, they tend to be cooler.

Q What's the typical plant diversity in the groundwater-fed wetland or fen?

A Oh, these groundwater-fed wetlands or fens tend as a whole to be much more diverse. They support a higher diversity of plants. And the plants which they do support often tend to be some of the rarer types.

Q Does the greater diversity of plant life have, in turn, a greater diversity of dependent animal life?

A That's often the case, yes. And if I might add to that, the areas that are groundwater-fed also tend to remain open later in the fall; that is, they don't get iced over as quickly. And in the spring in some cases, they may lose their ice cover sooner in the spring. And this has very important implications for wildlife that, when everything

else is frozen on the landscape, they can hone in on these areas, wildlife coming from considerable distances.

Q Now, based on your review of the applicable wetland inventory materials and everything else that you've looked at in this case, how would you characterize the area surrounding the mine site in terms of wetland richness?

A Looking at the maps, this area has got exceptional density of wetlands; that is, the acres of wetland per acres of the landscape. The contractor for Kennecott has mapped out 26 wetlands just in the vicinity of the mine site. And it's a substantial wetland complex.

MR. DYKEMA: Can I have the next slide, please?

Q Dr. Adamus, what -- over what area did Kennecott's contractors conduct their wetland survey?

A Well, unfortunately, they only conducted their survey within the bounds of the property. Now, we do have maps from National Wetland Inventory and Michigan DEQ, which supposedly portray wetlands. But most wetland professionals know those maps have a lot of limitations, because they're mostly not ground truth. So, you know, we -- I think we really don't know for sure outside this area the full extent of wetlands that may be there.

Q We're now looking at slide number 6. What is this? What does slide number 6 show?

A This shows the wetlands that have been mapped by Kennecott

and their contractor, and it has numbers, so you can see there's 26 of them. Some of them they have, you know, lumped into one huge complex like this, and others they have dispersed throughout.

Q Could you determine from reviewing the reports submitted by Kennecott and its contractors whether their wetlands survey was performed in a though and accurate manner?

A I was not able to full determine that. They -- their contractor performed surveys of wetlands in the project area twice, once in summer of 2004, I understand, and then they were called back to reassess some of the wetlands in November of 2006. And of course, every wetland scientists knows that November is a bad time to be looking at vegetation and other determinants of wetlands. They did provide in the project documents the original field sheets for the latter effort, for the November effort. But I could not find anything in terms of the original field sheets for the majority of their effort that was done in the summer of 2004, so I have a difficult assessing whether it was a good job.

Q Because you -- to do that you need to look at the field sheets?

A I would.

Q Did Kennecott analyze the water chemistry and so on of the wetlands that they identified in order to determine which

ones are fens?

A Of the 26 wetlands that they mapped, they only did the diagnostic studies on one of those 26 wetlands and, by "diagnostic studies," I mean they instrumented it with piezometers to measure groundwater levels, and they looked at the water chemistry at different levels below the surface.

Q And those are the standard ways to determine whether a wetland is in fact a fen.

A Those are the most commonly used ways. There is a new technique, which I consider closer to the cutting edge, us of stable isotopes, but they did not use that.

Q You say they only analyzed one of the 26 wetlands they identified?

A That's right, yes.

Q Did they give any reason for why they only analyzed one of 26?

A Well, they -- I don't know if they said this or if I just assumed it, but it's the wetland that's closest to the actual mine site.

Q From your review of the report and supporting materials that Kennecott supplied to the Department of Environmental Quality, does it appear to you or can you form an opinion as to whether it is likely that there are other groundwater-supported wetlands among the 26 that Kennecott

identified on its own property?
A I think there's a high likelihood of it. There are, you know, many -- the topography of this site -- although I don't have detailed topographic maps those this site, the topography generally suggests that there may be groundwater discharge wetlands and fens elsewhere on the site. And I was able to review the plant lists collected by their consultants and other people and, from the plant lists for these other wetlands in the vicinity, I was able to note that a number of the plants were what many botanists consider to be fen-indicator plants; that is, plants that may occasionally occur in bogs and other wetland types but can more occur in fens. So I cannot say definitively, but I have a strong suspicion that other wetlands there are groundwater fed.
Q Did the botanical survey supplied by Kennecott have a photo of a fen?
A Yes, it did. So -- and this was not the wetland that they instrumented and studied. But there was another wetland. I can't remember the number which they said in the -- underneath the photo. They said specifically, "This is a groundwater discharge area."
Q Do you see wetland number 2- -- well, are there -- let me start over again. Are there geological features here that suggest to you the identity of another fen among the

wetlands on Kennecott's own property?

A Yes, there are. As I recall looking at the geologic maps, there are a couple of parallel faults which border this wetland here (indicating). And of course it's chalked off, because they didn't want to study this area here, but I'm sure this is a wetland too.

Q You're looking at number 26?

A 26, yes. And the fact that this is bordered on both sides by geologic faults -- I've seen wetlands in other situations in glaciated terrain where those are groundwater discharge situations.

Q Is this part of the country known to be rich in wetlands?

A Northern Michigan does have, yes, a fairly large number of wetlands.

MR. DYKEMA: Let me go back to slide number 1. That's the second in the deck.

Q Dr. Adamus, I'd like to return your first opinion, "The wetlands at the mine site and those outside it (but likely affected by the mining operations), are exceptionally sensitive and important."

A Uh-huh (affirmative).

Q Is that your opinion?

A Yes, it is.

Q I'd like to talk to you about important of the wetlands in the area.

A Uh-huh (affirmative).
Q Why are they important, in your expert opinion?
A They're important for several reasons. One is they're in the -- many of these wetlands are in the headwaters of the Salmon Trout River. And headwater wetlands generally tend to be very important.
MR. DYKEMA: Can I have slide 9?
Q This is an exhibit that's already been admitted. It's the Part 632 Exhibit Number 11, slide 26. It's been identified as a depiction of the Salmon Trout River Watershed. Does this illustrate your point, Dr. Adamus, about the importance of the headwater wetland?
A Yes, it does. It shows very dramatically the situation, you know, this (indicating) being the mining site and this being the Salmon Trout River that goes into Lake Superior.
MR. PREDKO: Counsel, is that red circle that's on the left-hand bottom side part of that exhibit as admitted?
MR. DYKEMA: I will have to check that, Chris. I believe so, because I had this taken out of the exhibits that had been used. But I will confirm that.
MR. PREDKO: Okay. Thank you.
MR. DYKEMA: Slide 10, next one. And I will confirm the red circle in this one as well, this one being the Part 632 Exhibit 11, slide number 26.
Q Now, is the mine site actually at the headwaters of the

Yellow Dog River?

A No, it's not actually at the headwaters, but it's very near it. And we also know that groundwater doesn't necessarily follow the boundaries of watersheds; that groundwater dynamics can spill over from one watershed to another.

MR. DYKEMA: The next slide, please.

Q Dr. Adamus, you prepared for us here in slide number 11 a quotation from a publication of the North Carolina Division of Water Quality dated 2006. What does this say?

A This quotation is -- illustrates the important of headwater wetlands, which is something which is widely known to wetland scientists; that it's important, when considering wetlands functions and values, that one consider the landscape perspective. And when a person does so, headwater position is very important, because these headwater wetlands are like regulators on the landscape. They influence everything that happens further down. And, you know, this is highlighted there in the last sentence that, "Maintaining the ecological integrity of these headwater wetland systems it's necessary to protect the quality of the entire downstream watershed."

Q Do you agree with that; --

A I do.

Q -- that, maintaining the ecological integrity of headwater wetland systems is necessary to protect the quality of the

entire downstream watershed?

A I do believe that headwater wetlands have a disproportionate effect on the quality of downstream areas.

Q And we're discussing your first opinion, which has to do with the importance and sensitivity of the wetlands in and around this mine site.

A Yeah.

Q And I asked you why they're important, and your first answer was that it's because they're headwater wetlands.

A Yeah.

Q They're directly in the headwaters of the Salmon Trout and close to the origin of the Yellow Dog. Now, what else makes them important?

A There's two other factors. One is that the ones that are -- that have a strong vertical component of groundwater discharging at the surface and also have certain types of vegetation, those wetlands would be called fens by wetland scientists. And fens, as a type of wetland, are widely recognized as being quite important.

Q And why are they important?

A Well, they're important for some of the reasons that were given in that table that we showed earlier; that they support a large diversity of plants and animals. Their environment is more stable in terms of groundwater, and they -- they're -- they influence a wider area than, say, a

bog.

Q As distinguished from other wetland types, are fens more or less common?

A Well, for the United States as a whole, fens are a rare type, northern Michigan not so much so. But even though they're not rare necessarily in northern Michigan, they do -- they are outstanding in the functions that they provide.

MR. DYKEMA: Can I have slide 12?

Q We're not looking at your demonstrative number 12, Dr. Adamus, a paper published by Bedford and Godwin. What is it these authors say here?

A Well, Dr. Bedford from Cornell University is an authority on fens, and she is pointing out the importance of fens. This is in a professional journal she published this paper. And she's pointing out the importance of fens and the way that they contribute to the integrity of the nation's waters, and she especially mentions fens in headwater positions as being important, because they influence the flows and temperatures of the water further downstream and in lakes, you know, like Lake Superior. So --

Q Well, dwelling on that for a moment, she refers to the water entering out nation's streams and lakes.

A Uh-huh (affirmative).

Q But where do the Yellow Dog and Salmon Trout Rivers outflow?

A Well, they outflow into Lake Superior, and not every wetland -- I should qualify, not every wetland has a surface water connection, but many of them do.

Q She also states that -- referring to fens -- United States fens that, "Their plant species diversity is unequaled among wetland ecosystems and high relative to all other U.S. ecosystems." Do you agree with that?

A I would say that, yeah, depending on how one classifies wetlands. They're certainly very near the cream of the crop.

Q She also notes at the end, "Fens expand the range of many regionally rare and endangered species." Based on your lifetime of studying wetlands, do you agree with that?

A Yes, I do. Potentially they can support many species. And we know from the project area that there are likely to be at least a dozen or so state-listed or federally-listed species that depend on these wetlands or are very much associated with these wetlands. And yet the surveys I read of the site were woefully inadequate to determine the presence of many of these species.

Q Dwelling for just another minute or two on the issue of the importance of the wetlands that are potentially impacted by the Eagle mean, is there a standardized measure of plant diversity and quality at wetlands?

A Yeah. One of the money common measures that's used and

which is likely to be used by EPA in their national assessment in 2011 is the FQI or floristic quality index. And the contractors for Kennecott did compute the FQI's for a number of areas in the project area and --

Q What does the FQI -- what is the floristic quality index designed to reflect?

A Well, it reflects two things. One, it is the number of plant species. Do you have a high diversity? And the other being, are the species that you have in your area exceptionally important or uncommon? So that on a scale of, let's say, 1 to 10, a 10 would be a species that occurs nowhere else in Michigan except this one wetland perhaps, and a species that's a 1 would be a species that occurs in every other wetland in Michigan, you know, so to speak.

Q Does the scoring of the floristic quality index also reflect the pristineness of the wetland environment at issue?

A That is the interpretation that has been put on the FQI by state agencies here in Michigan.

Q Does the calculation of the floristic quality index also reflect in any way the extent to which the wetland understudy has been compromised by the invasion of exotic species of plants?

A Oh, yeah, very definitely. When a wetland is invaded by weeds, nonnative plants, the FQI score drops. It gets very low.

MR. DYKEMA: Can we have slide number 7?

Q You've prepared a demonstrative here. Where are these quotes from in slide number 7?

A These are from a document that is the standard document here in Michigan for the floristic quality index, and it's -- the author, I believe, was under contract or was employed by the Michigan Natural Features Inventory, I believe.

Q And what do the quotes tell us about how to interpret FQI scores?

A Well, it says FQI that's in the 50's 9:47:51were higher. You know, those kinds of areas are extremely rare in Michigan. And areas with an FQI higher than 35 have species that have a lot of conservatism, meaning they don't occur many other places, and richness that really makes them important from a statewide perspective.

MR. DYKEMA: Can we have the next slide?

Q We're now looking at your slide number 8, Dr. Adamus. Can you please explain to the Court what we're looking at?

A We're looking at the impact assessment, this table 3.2 that is reported in the attachment C-3, Appendix F of the impact statement. And these are the FQI's that were calculated for the project area by the consultant. And we see that habitat area F, which includes a wetland here (indicating), has an exceptional FQI, you know. Extremely, rare, remember, is any score 50 or above, and we've got that.

Q Now, in courtesy to my learned colleague, let's be clear that the arrows on this slide were not on the original of the environmental impact assessment?
A Correct.
Q You put those there yourself?
A Correct; yes.
Q Please continue.
A And in this E-1, which is a bog area, it's certainly over 35. It's up here at 42. And this area here, area B, this wetland, which is a complex of bog and possibly fen near the stream, is up 42 or 43. So these are -- you know, there's some really important wetlands here.
Q Now, what's the difference between the two columns of scores, and what's the significance of that difference?
A Well, the FQI is commonly calculated both with and without including the native species component. What this is telling us is that --
Q Excuse me. Did you mean to say "with and without the exotics"?
A Yeah; yeah. I'm sorry. And -- yeah. What it's telling us is that, you know, because the score doesn't change much, there's very few weedy or exotic species in these wetlands. These wetlands are in really good shape. And even the areas that are right where the mining operation is going to be, this -- which is these areas here (indicating) --

Q C-1 and C-2?
A Yeah, if my memory serves me. Even those areas are not degraded by lots of weeds and things. They've been logged in the past and everything else, but they're not a trashed ecosystem. They're --
Q So those two areas the scores for native plants and all plants are identical; am I right?
A Yeah; yeah, that's right; yeah.
Q Okay. And does that tell us that there are no exotics -- no exotics were found there at all?
A Apparently. That would be my interpretation, yeah.
Q In any of these areas is there a significant difference between the native plant FQI and the all-plant FQI?
A None that I would consider to be significant.
Q What, if anything, do these numbers tell you about the pristineness of the area generally or the --
A It tells me that, yeah, there -- you know, it tells me that the wetland areas here (indicating) are quite important, the upland forest less so. But even the upland forest is -- you know, it doesn't have a lot of nonnative species, so it's pretty good.

MR. DYKEMA: Your Honor, I'm a natural breaking point, if this is a good time to take a few minutes.

JUDGE PATTERSON: Yes, let's do that.

(Off the record)

Q Dr. Adamus, I'd now like to turn to your second major opinion, and that is that, "A large number of wetlands and their functions will be lost or degraded by the mine and associated infrastructure." What are the ways in which the mine and its operation will cause the loss of or damage to area wetlands?

A Well, the most obvious way is by lowering the water table in the wetlands, which, if it doesn't kill the wetlands entirely, will certainly alter them and degrade them in a number of ways. Secondly, the chance of water quality degradation to the wetlands is a consideration.

Q And what are the ways in which water quality could be degraded?

A Well, one is based on the -- well, one would be the dust from the mining operations, which contains metals. If you review the report, I believe it was CRA report and their maps showing dust deposition. That's a potential problem. Another is acid mine drainage. Several years ago I studied acid mine drainage in another system in California. I studied the impacts on vegetation in birds and amphibians, and I know that things don't always work out the way you design them and that acid mine drainage can be an issue. And a third thing is that just the surface water that currently may be flowing to some of these wetlands, that surface water runoff is going to be diverted into treatment

facilities. And I understand the need for this; that, you know, you don't want to have contaminated surface water rolling downhill into these wetlands. But if you're depriving these wetlands of that surface water, that is going to further exacerbate the drop in the groundwater, the water table beneath the wetlands.

Q Have you prepared a demonstrative exhibit that summarizes your view of likely and potential harms to the wetlands in the area?

A Yes, it --

MR. DYKEMA: Can we have slide 13?

Q Please describe what you have prepared in your slide number 13.

A Yes. Here again I have the major types of wetlands that are in the project area across the top row here. And here on this access vertically are the impacts that I just spoke about: the groundwater drawdown, surface water diversion, airborne contamination and acid mine drainage.

Q Let's focus first on the first row, groundwater drawdown. Please summarize for the Court your opinions as to the likelihood of destruction or impairment of the different wetland types resulting from groundwater drawdown.

A Well, the -- from groundwater drawdown the greatest impact is going to be on these fens, these groundwater-supported wetlands. And the least impact would be on the bogs that

are fed mostly by direct precipitation or surface runoff. And to that extent, the -- I think the environmental assessment gets it right, but they don't adequately assess how major this impact is, and I'll get to that later.

Q What is the likely impact of groundwater drawdown on the river overflow wetlands?

A It's an intermediate impact, I would say, because these river overflow wetlands; that is, ones that are right on the margin of the Salmon Trout River; appear to be fed both by a combination of groundwater and surface water runoff.

Q Did Kennecott's environmental impact assessment on supporting materials predict that the operation of the mine would result in a lowering of the water table in the area of the local wetlands?

A Yeah. They predicted near the actual operations area that the wetland closest to that would suffer perhaps a 6-inch or half-foot drop in the water table. Well, I should say they predicted the water table would drop by that much.

Q What happens to wetland water levels if the underlying water table drops?

A Almost in all cases -- not all cases but most cases the wetland water table drops when the groundwater table drops.

MR. DYKEMA: Give me slide 14.

Q We're now looking at Adamus slide number 14. Doctor, what are we looking at?

A Well, in the environmental impact assessment, Kennecott has noted the numbers of the three wetland types, the way they label them, in the project area. And they said that there could -- they're not saying there will be, cut they said I'd of worst case, if there was a half-foot drawdown, this is the acres of wetlands that would be within that drawdown area. They go on to say that these precipitation ones would not be affected. The groundwater-supported ones -- well, I'll get to that in a minute -- and the stream-supported ones likely might have some impacts.

Q What is the likely impact of a half-foot drawdown on groundwater-supported wetlands?

A It can be a very major impact. And if I might at this point sketch here -- is this appropriate?

Q Sure, please. Do you have a Magic Marker there you can write with?

A Yes; yes. Okay.

(Witness draws diagram)

A If we can imagine a wetland here in the project area --

Q You'll need to try to stand off to the side so Judge Patterson can admire your artwork.

A Okay. Not an artist. But here's plants growing in the wetland, and they have roots that extend down into the subsurface area. Now, here's, let's say, the 12-inch line below the surface. And many of these wetlands in the

project area appear to lack surface water for any long period of time. Their water seems to be mostly below the surface. They're saturated in this area. So this is your 12-inch wetland zone approximately.

Q And that 12-inch root zone is what's critical for the very definition of a wetland?

A Exactly; yes. And then, you know, at some depth here's the groundwater level right now. Now, naturally -- actually, 12 inches might be, you know, more like here. Now, naturally right now the contractors for Kennecott have measured a 6-inch fluctuation -- natural fluctuation they call it -- in this zone here. So let's say we have a 6-inch drawdown here just because of, you know, it being summer or, you know, the time of year. They're predicting that this water table worst case is going to drop down another, you know, half a foot, 6 inches. And I believe that, when this does do so, because this area in here is saturated, that there will be a drop -- you know, if there's a 6-inch drop here, there could be a 6-inch drop or something close to it here, which puts us right at the margin of whether this is going to be a wetland anymore. And this assumes that their projections of a half a foot are accurate. And, you know, I think we may hear some other testimony later. And also the -- some of the reports I read by independent consultants challenged that indeed the drawdown may be quite a bit greater. So

there's no margin of safety here. This is -- you're pushing the margin of whether this is going to exist as a wetland anymore.

Q So what's the degree of risk posed by the combination of the 6-inch drawdown that Kennecott acknowledges as possible and the 6-inch normal water table variability that Kennecott recognizes?

A Well, what's going to happen is that this zone of variability here (indicating) is going to shift down so that, you know, if -- their 6-inch -- the 6-inch drop that they predict in the water table is kind of an annual mean. But during the year this water table is going to fluctuate up and down -- you know, if it operates the same way it does now, will be fluctuating up and down in and out of this area that's defined as wetland.

Q Thank you, Doctor. Dr. Adamus, in general, do small drops in the water level of a wetland -- a groundwater-supported wetland, --

A Uh-huh (affirmative).

Q -- have significant impacts on wetland function?

A Yes, they do.

Q What kinds of impacts do you see from even small drops in water level?

A Even if a particular wetland is not lost entirely, if there's still enough moisture to sustain it, we see a

dramatic change in the species composition of plants and animals that use that wetland.

Q Is there a change in the chemical functioning of a fen from even small drops in water level?

A Yes. As you drop the water level and you have less and less groundwater discharging on the surface, you may have in some cases more and more surface runoff coming to the wetland, and that tends to acidify it.

Q What happens to the organic matter in a fen if the water level is dropped even by a small amount?

A Well, if the water level drops, the organic matter which has built up in that wetland, in some cases over many centuries, if that organic matter is exposed to the air for long periods of time, it will begin to decay rapidly. And if the wetland has a surface water connection to other receiving waters, then those receiving waters will have -- experience this outflux of organic matter from the dried-out wetland.

Q Do you know if the organic matter in the wetlands in this area store toxins?

A I don't know directly, but I do know that organic sediments generally do hold especially acidic ones. So they tend to serve as reservoirs for a lot of toxins.

Q And if organic matter in a wetland dries out as a result of even a small drawdown in the water level, what will happy to those toxins?

A Those toxins, if there's a surface water connection, could be flushed into downstream areas like the Salmon Trout.
Q Does Kennecott's environmental impact assessment consider that possibility?
A I did not notice anything to that effect.
Q From even a small loss of water level in a fen, what happens to the oxygen in the water?
A Well, in the sediments, you know, if you have a lot of decomposition occurring from this organic matter which is built up, you have what's called redox reactions, r-e-d-o-x, become intense, and you can have a mobilization of some contaminants.

MR. DYKEMA: Can I have slide 15?

Q Dr. Adamus, we're now looking at your slide 15, which features two quotes, one from the Natural Features Inventory of Michigan and the other paper by Doctors McGee and Kentula. What do these tell us?
A Well, they tell us that, you know, just a half-foot bounce in the water level really is a big deal for a wetland. It might not seem like much to many of us, and certainly wetlands do fluctuate a lot naturally. But when you artificially induce a change in that water level of just that tiny amount, it has major effects on plants and other organisms. In the first case, they highlight the sensitivity of fens in -- as far as, you know, their -- the

effects they can have on water chemistry and so on. And in the second case, they say that, if you change even to a minor degree the average water level throughout the year, like, only 10 centimeters, or that change the variability plus or minus 2 centimeters in terms of the mean annual difference in the water level, you know, 2 centimeters is a whole lot less than the 6 that they're projecting. But this can promote a shift in assemblages which is -- that are, you know, native and cause weeds to come into your wetland -- to exotic species come into your wetland if it's -- if it occurs over a long period of time.

Q Does Kennecott acknowledge or try to analyze or predict the extent of damage that could result from a 6-inch water table drawdown?

A Well, they really hedge things. They say that -- they don't say that, if it occurs -- they -- but they said that -- they don't say it will occur, but they say that, if it occurs, there could be a change in the composition of the plant community in the wetland.

Q Are you familiar with the concept of capillary action?

A Yes, I am.

MR. DYKEMA: Can I have slide 16?

Q With respect to the effect of water table drawdown on groundwater-fed wetlands, what does Kennecott say about capillary action in their environmental impact assessment?

A Well, they said we really don't have to worry about these wetlands because, if the groundwater drops by half a foot, that doesn't automatically translate to the wetland water level dropping half a foot. But in many, many cases, the majority of cases that I'm aware, there is a very close correspondence to the two. Capillary action is kind of like the wick that you find in a burning, you know, kerosene-fed lantern. It's where the moisture can actually move vertically up from the groundwater -- move vertically upward into, let's say, a wetland or stream higher up. But for that to occur, you have to have -- the intervening sediment or soil has to be fairly fine material.

Q And is it your understanding that the environment of the wetlands in this area -- that it's safe to assume that those conditions are present?

A I -- it's difficult, because they don't provide detailed data on the sediment underneath these wetlands. But knowing what I know about the region, it's a sandy region, and I would say it's extremely unlikely that the capillary action is going to occur. So, you know, their argument that, "Well, even if the water table drops, it's not a big deal, because we have capillary action," that's not likely. And they also mention a 4-foot rise attributable -- you know, capillary action being able to act over a 4-foot vertical height. And, boy, I've never seen situations where it's

been that extreme. That's unusual.

MR. DYKEMA: If you'd go back to slide 13.

Q Now, going back, Dr. Adamus, to your slide 13 where you summarize the likely and potential destruction and impairment of wetlands, we're still looking at the impact of groundwater drawdown on the groundwater supported wetlands or the fens?

A Yes.

Q And we've been talking about the impact of even a small drawdown, between a couple centimeters or the six inches that Kennecott predicts in one of their scenarios, now I'd like to talk about the effect of a major drawdown of the water table. Have you reviewed a groundwater study performed for the petitioner by a firm called Geomatrix?

A I have.

MR. DYKEMA: For the record, that study is Exhibit 3 to the comments filed by the National Wildlife Federation in October of 2007. Can we have Table -- can we go to that exhibit, please, the Geomatrix study? Excuse me. Appendix 6 to Exhibit 3 to the National Wildlife Federation comments of October 2007.

Q Is this the Geomatrix study that you reviewed?

A It is.

MR. DYKEMA: Okay. Can you take us, Jan, to Table 4? That's good.

Q Dr. Adamus, we're now looking at Table 4 to the Geomatrix report. Can you please summarize what this table shows?
A Well, here they're contrasting the modeling results from the Geomatrix study with the modeling results from the Fletcher Driscoll study, which was used in the environmental assessment by Kennecott. And in the -- under two different scenarios -- one being 75-gallon per minute inflow to the mine, the other 250 -- the impact statement predicts, you know, a drawdown anywhere from .12 feet to .95 depending on the scenario --
Q That's the maximum drawdown projected?
A That's the maximum drawdown right near the mine. Geomatrix right near the mine predicts the drawdown of anywhere between three feet and twelve feet. And you know, even if the truth is somewhere halfway between, we're looking at a very clear loss of groundwater-fed wetlands in that area.
Q What is -- let's focus on the Geomatrix projection of the three-foot drawdown under the scenario Kennecott projects; namely, 75 gallons per minute water flowing into the mine. What in your expert opinion is the likely effect on area fens of a three-foot drawdown of the water table?
A Well, --

MR. PREDKO: I'm going to object to -- sorry, Doctor. I must object to foundation as to the amount of gallons flowing into the mine. There's been no testimony as

to that.

MR. DYKEMA: This will be connected up later, your Honor. The Geomatrix study will be offered by a groundwater expert who will explain the assumptions of the basis for this analysis. Dr. Adamus is simply assuming the correctness of the various outputs and offering his expert opinion on the effect of those projections on the wetlands in the area.

JUDGE PATTERSON: I'll overrule.

A So right in the vicinity of the mine it would mean a total loss of those wetlands. Now, extending out away from the mine Kennecott projects that the area that would be affected would not extend very far. By "affected" I mean more than half a foot. On the other hand, Geomatrix; their study is predicting that areas as far as a mile radius of the mine site could be affected by at least a half-foot drawdown in the water levels.

Q Okay. Now, focusing again on the first row, the 75-gallon per minute inflow assumption, Geomatrix projects an area about 4800 feet by 5400 feet in which the water table will go down by more than half a foot?

A Yes.

Q Okay. And we've talked about the impacts of -- on those wetlands of a drawdown of half a foot?

A Yes.

Q But I'm sorry I missed your answer about the three-foot drawdown. What will be the effect on groundwater-supported wetlands by a three-foot drop in the water table?
A We would -- it would anhiliate those wetlands closest to the project site.
Q What would be the result of that on the organic materials in those wetlands?
A Well, they -- you know, where those wetlands are connected to the Salmon Trout that organic matter would move out of those wetlands and that would include, you know, things like, you know, potentially mercury and several metals, toxic metals.
Q What would be the impact on wetland-dependent plants and animals?
A Well, you lose the wetland and they totally disappear, you know, from that particular wetland.
Q If the wetland subsequently is rehydrated, does a fen type wetland come back?
A It's very uncertain; the whole science of wetland restoration is very uncertain. There have been many failures where people have tried to take areas that once were wetland and restore them. And where those wetlands were driven by surface precipitation the success rate is better, but where those wetlands were historically fed by groundwater it becomes very difficult to restore them to

your -- their natural state because, you know, depending on how long the water table has been down you've lost that organic matter through decomposition. So it's not the same wetland that comes back.

Q How long has the organic matter in the wetlands in this part of the Upper Peninsula of Michigan been accumulating?

A Oh, for centuries.

Q Now, does Kennecott acknowledge that if there's a half-foot drawdown of the water table with the result that groundwater-fed wetlands are deprived of a substantial amount of their groundwater, does Kennecott acknowledge that the impacts you've described will result?

A No, they -- you know, again, they kind of hedge themselves and they don't say whether, you know, really they will or they won't. What they say is that there's a possibility -- not a definite thing, but a possibility that at least two factors could compensate: one being the capillary action that I talked about earlier and I hopefully have disproved; the second is they say that, well, if we lose groundwater as the source of the water in these wetlands, it's not a problem because surface water that presently flows -- you know, runoff that currently goes into these wetlands and just kind of flows out of them because the space is already occupied by groundwater -- they say that the surface water runoff will compensate so there really won't be a drop in

the wetland water level; that the surface water runoff is just going to make up for whatever groundwater water you lose.

Q Let's assume for a moment that Kennecott is right to this extent; that groundwater taken away from these fens as a result of mine operations will be replaced by surface water. Let's assume that's true. Will that eliminate any impairment of wetland function?

A Oh, definitely. As I illustrated much earlier, the plant diversity in fens is much richer than bogs and other sources of runoff-fed wetlands that would replace them. So you would have a net loss of biodiversity and the animals that -- the wetland-dependent animals that are associated with it. And you would also have a chemical change. Chemically it would not be the same wetland as what you had when it was a groundwater-discharge wetland.

Q My question to you was whether the replacement of groundwater with surface water would eliminate any impairment of wetland function. I gather your answer is it wouldn't, because the impairments would happen?

A Right. Yeah, impairments would happen.

Q Okay. What would happen to the acidity of the wetland's water if it's -- if groundwater is replaced by surface water?

A They become more acid.

Q And the plant community; what would happen to that?
A It would shift from, as I say, being a very rich community with many species that don't occur in other wetland types with high FQI to a wetland that's got low FQI and were mundane species.

MR. DYKEMA: Can I have slide 17, please?

(Pause in dialogue)

Q Does Kennecott acknowledge that if groundwater is replaced by surface water at a fen the wetland will be transformed from one thing to something else?
A Yeah, they do kind of indirectly mention that. You know, they -- first they talk about those compensating factors that I just mentioned: the capillary and the surface runoff. But then they go on to say that in the event that these natural mitigating factors don't happen -- you know, that they're not as effective at minimizing impacts -- then they say there would be a shift in the wetland plant communities from species that are more saturation tolerant to species that are less tolerant of saturated conditions. And that's euphemistically saying that these aren't going to be wetlands anymore; that you're going to have instead of a predominance of wetland species you'll have a predominance of upland species; you will have lost one of the three indicators that federal agencies use to define wetlands.

And then at the very end of this section they, you

know, kind of acknowledge it; they say, "The former wetlands would remain vegetated." Well, big deal; they remain vegetated. That's not hard to do, that -- they're highlighting that indeed there is a probability or a possibility that we're dealing with former wetlands, not wetlands that are going to continue.

Q And this language that you've excerpted on your slide 17 is from page 37 of the Environmental Impact Assessment?

A Yes.

Q You mentioned earlier that one of the impacts to wetlands in the immediate area of the facility would be Kennecott's control of surface water runoff on its own acreage?

A Yes.

Q Do you recall that?

A Yes.

Q What effect, if any, could that have on Kennecott's prediction that if the water table is drawn down groundwater-deprived wetlands will be resupplied by surface water?

A I think it really casts severe doubt on that prediction, because, you know, on the one hand they're saying that surface water is going to compensate for the loss of groundwater, but then in other parts of the impact statement they say they're going to take that surface water runoff and they're going to funnel it far away from where the wetlands

are on the site; they're going to funnel it to a place where it can be treated. And it's not clear from the maps and so on that they provided that any of that surface water runoff that currently feeds the wetlands is going to come back into those wetlands, so the wetlands, you know, could dry up.

Q You mentioned a moment ago that this area is generally fairly sandy, the Yellow Dog Plains are sandy?

A Yes.

Q What relevance does that have, if any, to Kennecott's prediction that wetlands that are deprived of groundwater will have -- will be compensated by surface water?

A It makes it very unlikely, because of the sandy terrain there. Although there's a lot of precipitation certainly in excess of the evaporation, that precipitation -- a lot of that precipitation doesn't travel very far over land. It quickly sinks into the ground as recharge.

Q If groundwater sources at fens are replaced by surface water, what effect will that have on the temperature regime of the fen?

A It would certainly create a hotter environment if the area persists as a wetland it -- you know, as I say, it won't be the same wetland in terms of chemistry, biology or water temperature and that will translate some impacts for wildlife and other organisms and functions.

Q But if Kennecott is right and in effect fens are transformed

into bogs because groundwater is replaced with surface water, what effect, if any, would that have on the vulnerability of the wetland to drought?

A It would make these wetlands more susceptible, because currently -- groundwater is a much more reliable source to wetlands; there's less fluctuation. But when wetlands become dependent on the rainfall and the surface water running off the land, then, you know, you have a few years of drought and the chances of them failing to continue as wetlands. So I think it's quite severe.

Q Dr. Adamus, if Kennecott had approached you back in 2004 or whatever and it said, "Dr. Adamus, we need you to analyze a question. We project that the water table is going to be drawn down in the area of some groundwater-fed wetlands. We want to know whether it's reasonable for us to assure the Department of Environmental Quality that those wetlands will not have a net water loss because the groundwater will be replaced by surface water." Dr. Adamus, how would you have gone about answering that question?

A I would have calculated a water budget for all the wetlands that are likely to be affected. Now, in the impact assessment they do mention a water budget; you know, they lay out the formula for it, you know, the inputs and outputs of water to a wetland to determine how much water is in the wetland, but they don't actually show that they've run the

calculations using that water budget; certainly not for any number of the 26 wetlands at the site.

Q In trying to project whether groundwater will be replaced by surface water at a fen, is the creation and -- of the water budget standard practice?

A In projects of this size I have found it to be standard practice, yes.

Q If you didn't do a water budget or if Kennecott when it gave you this assignment said for whatever reason, "We don't believe in water budgets," what else could you have done to try to answer their question?

A Well, there's a variety of tracer techniques; as I mentioned, one that's at the cutting edge right now is the use of stabilize isotopes to determine the relative proportions of groundwater and surface water. And I would have actually measured the inputs of precipitation and evapotranspiration too.

Q Did Kennecott do that for any of the 26 wetlands that they identified on their own acreage?

A No, they didn't.

Q Did they do that for any wetlands off of their own acreage?

A No, they did not.

Q Again, returning to my hypothetical, that Kennecott came to you in 2004 and said, "Dr. Adamus, we want to know whether it's reasonable for us to assure the DEQ that this

groundwater will be replaced by surface water." Could you have tried to tackle that issue just by looking at topographical maps?

A Certainly not the ones at the scale that they had -- that have been provided to us, which are very poor scale topographic maps. If I had what I'm more accustomed to -- that is, topographic maps with contours of less than a foot -- those kind of maps for the entire site would give me a lot more information and a lot more confidence in what I'm able to say.

MR. DYKEMA: Could I have slide 18, please?

Q We're looking at an excerpt that you prepared in slide 18, Dr. Adamus, which is taken from page 38 of the Environmental Impact Assessment and I'd like you to share with the Court what Kennecott said here and I'd like you to comment on it.

A Well, they're saying even if worst case happens and these areas do cease to become wetlands, maybe it's not a big deal because with reclamation there would be a corresponding reversal in the plant communities, you know, favoring hydrophytic species, implying that these areas could return to being wetlands. But as I noted earlier, I believe this is unlikely; one, because you've volatilized the organic matter; and two, you've established different pathways of water coming into the wetland. And probably a third reason is, you know, depending on what the quality of the water is

that they reclaim these wetlands with; that can affect the quality of the --

Q If a fen is restored because the water table bounces back and the water level returns after having spent several years desiccated, how will the biological diversity and hydraulic functions of the wetland compare before and after mining?

A Well, without that organic layer my sense is that the diversity of plants would be much less and that the organic layer is -- that it really affects a lot of things in a wetland.

MR. DYKEMA: Could we go back to slide 13?

Q Dr. Adamus, we're back at slide 13, which is your overview of the likely and potential destruction or impairment of wetland types. Please share with the Court your expert opinions as to the likely effects of surface water diversion.

A Surface water diversion will affect most dramatically the wetlands, the bogs and so on that are dependent on it right now. You know, if surface water is diverted for treatment and doesn't come back to those wetlands -- well, they don't right now have a groundwater discharge source, so we would essentially dry up those. But surface water diversion would have less effect on groundwater-fed wetlands, the fens, assuming minimal loss of the water table.

Q You also have a row here in your slide 13 on airborne

contamination?
A Yes.
Q And is your concern about airborne contamination based on your review of the study that was performed by Conestoga Rovers Associates?
A Yes, it was. Yes.
Q Now, and that analysis produced deposition maps that show the metal and sulfur laden particulates that will settle on the landscape as a result of mining operations?
A Yeah.
Q Why is that a concern to you as a lover of wetlands?
A Well, I know that many wetland-dependent animals and plants are highly sensitive to toxics. Amphibians are especially. You know, frogs have thin skins and very sensitive moist skins and they're extremely sensitive to heavy metals and that really concerns me. Plus the fact that we've got a very acid environment and, you know, in an acid environment many of these animals and plants are already under a whole lot of stress, so you're just adding another stress. I might add that, you know, if we lose these animals from a local wetland, they can't just pick up and go somewhere else and everything is fine and dandy. Typically with animal populations, as a wildlife ecologist I know that the available spaces for animals to occupy when they move out of a destroyed area they -- when they move into other areas

they generally fail to breed successfully, so that in the long term there's a net loss in population. You may -- the individual animal may survive for a while by moving to another wetland, but the population as a whole declines.

Q Could particulate deposition in wetlands surrounding the project site have an effect on water clarity?

A It could theoretically. I don't have the -- all the data necessary to draw a definitive conclusion on that, but I would say that anytime you put levels of dust into the air above background levels and that dust gets into the streams and wetlands it reduces water clarity and as a result you begin to lose the aquatic plants and aquatic invertebrates and so on that live underneath the water.

Q Your final row in slide 13 refers to acid mine drainage. If this mine, the Eagle Mine -- well, first, is acid mine drainage a term and a phenomenon with which you are familiar?

A Yes, I am. As I mentioned earlier, I studied one of the largest superfund sites in the state of California, the Iron Mountain Mine near Redding, and that mine which was shut down many years ago still continues to export large amounts of contaminated water to downslope areas.

Q But you do not hold yourself out as an expert in acid mine drainage or the underlying sciences, do you?

A Correct; correct.

Q Okay. If this mine causes acid mine drainage, does that cause you concern about the health and function of the wetlands surrounding this site?
A Absolutely. Although, you know, to some degree in some of these wetlands the species' already adapted to some levels of acidity -- certainly in bogs they are -- the extent, you know, of adding this additional stressor onto these wetlands, additional acidity I think will cause a widespread loss of wetland-dependent plants and animals.
Q Have you reviewed --
MR. DYKEMA: Let's go to a cover slide.
Q Dr. Adamus, have you reviewed the wetlands-related conditions that the Department of Environmental Quality included in their mining permit?
A Yes, I have.
Q In your expert opinion are those conditions likely to be effective to prevent the destruction or impairment of wetlands as a result of the construction and operation of this mine?
A No, they will not be effective. I think they're well intentioned; that the DEQ wanted to have some monitoring that showed they were at least aware of the potential here, but they fall far short of what's necessary. And frankly, I don't think any sort of realistic monitoring is going to -- for the problems that could result of groundwater drawdown.

And specifically what I mean is in the discussion of monitoring DEQ says that these wetland water levels will be monitored once a month. Now, sounds good. And if they notice a decline in the water level, you know, cease operations or do something to, you know, cease it, that problem. And if they notice that decline occurring for more than, you know, a certain period of time they'll require Kennecott to do weekly monitoring of the water levels in these wetlands.

Well, this is -- to me this is meaningless, because when you're probing underground with piezometers and tunnels and shafts and all that, you can interrupt the groundwater/surface water connections in a matter of seconds or minutes or hours. And if you're only monitoring it -- you know, checking once every week or once every month, the damage is already done by the time it occurs. So you'll be there three weeks later and the groundwater/surface water connections have already been ruined. So I don't see that monitoring is going to adequately address this problem.

Q Dr. Adamus, based on your more than 30 years of experience studying wetlands and their functions, and based on your review of the facts in this case, is it your opinion to a reasonable degree of scientific certainty that the development and operation of the Kennecott will cause the destruction of wetlands?

A It is. I definitely believe it is.
Q And how certain are you?
A I am certainly more than 50 percent certain, and in the areas closest to the mine more than 80 percent certain that wetland loss will occur. And a hundred percent certain that some of the wetlands will be degraded in terms of their quality and their basic character will be changed.
Q Is it your expert opinion that wetlands will be degraded or destroyed even extending beyond Kennecott's own acreage?
A I believe so. And again, I am not a groundwater hydrologist; I'm taking as truth the Geomatrix report. And I think that, you know, based on the Geomatrix report I would say certainly outside the property boundaries wetlands will be degraded. And even setting aside the Geomatrix report just by Kennecott's own predictions I predict that wetlands within the project area will be severely degraded.

MR. DYKEMA: Your Honor, may I take one moment?

JUDGE PATTERSON: Sure.

(Pause in dialogue)

MR. DYKEMA: Your Honor, by stipulation I offer Dr. Adamus's CV, which is Exhibit 131. And I also offer for demonstrative purposes the slides that Dr. Adamus has testified to today, identified as Exhibit 142. And I apologize for not having copies of those handy. There was photocopier glitch this morning, but I'll have a set of them

available for the Court and all parties within a matter of moments.

MR. PREDKO: Your Honor, we have no objection to the CV. We've stipulated to that.

JUDGE PATTERSON: Right.

MR. PREDKO: To the rest of the demonstratives there are many things in those demonstratives -- again, this is beginning to be pattern that we're not in the original exhibits; that there are portions of different studies set forth in those exhibits that should not come in for their substance. They're clearly hearsay and should not be admitted.

MR. DYKEMA: I'm not offering them for their substance, your Honor. I'm offering them purely for demonstrative purposes so that Dr. Adamus's testimony -- so the transcript will make sense; so that the reader of the transcript will know what it was he was referring to.

JUDGE PATTERSON: I think for that limited purpose it's admissible.

(Petitioner's Exhibits 632-131 and 632-142 received)

MR. DYKEMA: Thank you. Tender the witness. Thank you, Doctor.

MR. PREDKO: Dr. Adamus, my name is Chris Predko; I represent Kennecott in this matter.

CROSS-EXAMINATION

BY MR. PREDKO:

Q Now, you didn't do your own hydrology assessment of the site; correct?

A That's correct.

Q Did you visit the site?

A I did.

Q And how long was that visit?

A It lasted two days -- well, no, one day.

Q And how many hours did you spend at the site?

A Probably about six hours I would guess.

Q And when you were at the site I assume that you observed the wetland types there at the site?

A Yes, I did.

(Pause in dialogue)

Q Okay. Doctor, I put up on the screen here what is part of Intervenor 243. And this is a photograph of the wetlands near the orebody. Do you recognize this area as one that you looked at?

A Yes. I believe I walked right through there.

Q Not all the way through there?

A No.

Q And as far as the types of wetlands we see here -- of course, we have the open water which is part of the Salmon Trout River; correct?

A Right.
Q And then along the edge there we have emerging wetlands?
A Uh-huh (affirmative).
Q And those plants there I understand are sedges; correct?
A I can't tell from the photo for sure.
Q Well, did you see sedges out there when you were there?
A I did.
Q Okay. And behind the sedges right here (indicating) in this area here and along here we have what they call scrub brush wetland?
A Yes, scrub-shrub wetland.
Q Scrub-shrub?
A Uh-huh (affirmative).
Q Okay. Thank you. And then behind that they have forested wetlands; correct?
A Correct.
Q Okay. And then the types of species -- plant species that you saw in each of those -- in the forested wetland you see populated by balsam firs? Do you see some of those, or did you see some of those?
A Yeah, I can't recall from memory, and just trying to identify off a photo I don't want to risk that.
Q Okay. Do you have any reason to disagree with me that that's one of the species out there?
A It could well be; I don't know.

Q Black spruce?
A Certainly I saw black spruce there, I remember.
Q Tamarack?
A I remember seeing tamarack there.
Q See one in that picture also?
A I do; that yellow tree there.
Q All right. And as far as the scrub-shrub, leather leaf?
A Yes, I saw some out there I believe.
Q Michigan holly?
A I don't remember if I did or not.
Q And we've already talked about the sedges?
A Right.
Q Okay. Now, in that forested wetland that's in the background, I understand that that's a shaded area; correct?
A Yeah.
Q Okay. And the ground is covered with sphagnum moss?
A In places, yes.
Q Okay. You saw that while you were there?
A Some, yes.
Q Okay. How about the areas surrounding the wetland; did you get a chance to look at those?
A Not in as much detail as I wanted. You know, of the 26 wetlands or so on the site I think I saw perhaps two or three, so I don't have a comprehensive knowledge of them all.

Q Okay. I'm showing you now what is part of the wetland delineation similar to one of the exhibits that Mr. Dykema asked you about. And you've seen this document before?
A Yes.
Q Okay. Now, you said you only visited two of the three -- or two or three wetland sites while you were there. Which two or three?
A Oh, I can't recall exactly. I know certainly number 6 and probably some of the ones up near the road there, 7 or 4 or 5. But I don't know exactly.
Q Okay. Well, how far did you walk while you were there?
A You know, maybe a half mile total during the day. I relied to a large extent on the reports of Kennecott and its contractor.
Q Okay. You didn't venture down to Area 26 down there?
A No. Well, I may have; I don't recall.
Q All right. Now, what you saw of the surrounding area -- and let's take one that you did actually visit. Let's take number 6 here.
A Yeah.
Q Now, what you saw of the surrounding area, vegetation around -- in that surrounding area was intact?
A No, it had been logged at some time in the past, so it was fairly open canopy in a lot of places.
Q Open canopy, but I'm talking about ground vegetation.

A Yeah, the ground vegetation was, you know, a mix of shrub species, of bare areas in some cases.
Q Okay. How about the soils in that area?
A I did not look at the soils.
Q Okay. Any reason to disagree that they area organic soils?
A They may or may not be; I would lay my odds that they are just knowing that they're in that region.
Q And you testified that those organic soils have been building up for -- I can't remember the term --
A Yeah, for centuries.
Q Centuries. Okay.
A Yes. And that's -- if you're asking for a definitive evidence? No, I can't say that I examined them myself, but based on your reports, Kennecott's reports and my knowledge of wetlands I would expect that they would be organic soils.
Q Odds are that they are organic?
A Oh, yes. Yes.
Q And again, talking about the surrounding area of wetland number 6, one of those that you did visit, --
A Yeah.
Q -- what is topography like right in that area?
A It's sloping. It's sloping. If I've got my orientation right, I believe it's sloping down towards the Salmon Trout there from the road down in that direction.
Q Okay. And there's -- maybe it would help if I didn't point

on there and try to use the laser. Hopefully I didn't point it at myself. Right here (indicating) in this area here?

A Yeah.

Q And I understand there's a little bit of a slope there?

A Uh-huh (affirmative).

Q And the slope, as I understand it, is about 30 feet over 300 feet?

A Uh-huh (affirmative).

Q Is that consistent with what you remember?

A That sounds about right, yes. And I know there are wetlands in patches, so -- through there on the slope.

Q Now, factors that would affect the type of wetland that forms. Would you agree that soil condition is one of those factors?

A Uh-huh (affirmative).

Q Precipitation and climate another factor?

A Uh-huh (affirmative).

JUDGE PATTERSON: You have to say "yes" or "no."

A Yes. Sorry.

Q Vegetation another factor?

A Yes.

Q And hydrology another factor?

A Yes. And I would also add animals. By Michigan statute if an area lacks vegetation, if you have wetland-dependent animals that may be considered an indicator as well.

Q Okay. And that does remind me. You've been talking about the federal standard for wetlands through much of your testimony?
A Yes.
Q And three factors are needed for the federal standard; correct?
A Right.
Q Okay. And you understand the Michigan standard is a little bit different?
A I do understand that and I understand that Michigan has a responsibility for the Section 404, the Clean Water Act as applied in Michigan, yes.
Q Okay. And you understand that instead of the three factors Michigan only requires two factors be present to identify an area as a wetland; correct?
A I believe so.
Q Okay. Two factors: vegetation and hydric soils?
A Correct.
Q Okay. When you were reviewing the -- well, let's take the one that you reviewed, the area 6, which is closest to the orebody, and the orebody in this picture is that represented by the gold right there (indicating)?
A Uh-huh (affirmative).
Q Now, you would agree with me that all of the wetland surrounding that area flow towards the river; correct?

A That's what I remember, yes.
Q Okay. And I think it's pretty clear when you're in the area -- in the emergent areas that that's happening. When you get up into the forested areas the water is not traveling above ground but, rather, is traveling below the surface and towards to the river; correct?
A That's correct; yes.
Q Now, on area 6 again; what would you say the width of the wetland is from one end to the other?
A I don't recall. You know, it could easily be gotten off the scale of the map.
Q Yeah. Well, I'm not -- it's not a memory quiz here either. I need Mr. Lewis's pocket scale that he keeps with him. There's the scale.
A It looks like maybe 300 feet, 200 feet.
Q Thank you. So about two and three-quarters, about 1500 feet; measuring end to end I get about two. So it looks to me somewhere in the range of a thousand feet?
A Okay.
Q Is that -- any reason to disagree with that?
A That's probably fine, yeah.
Q Okay. Now, Dr. Adamus, are you familiar with the hydro period for wetlands around the orebody?
A Only from what I read from the project documents and the hydro period seems to indicate that except for the ones that

are along the river that most of these wetlands are already on the dry end of the wetlands; they're kind of marginal whether they're wetlands. I mean, they are definitely wetlands, but they're not covered with water all the time like a lot of wetlands are.

Q No standing water; again, this idea of the water moving below the surface?

A Right; right; yeah.

Q How, when you did your assessment of the wetlands did you investigate the climate and precipitation that exists in this area?

A No, I didn't. I assumed that that was not my burden to -- you know, legally or scientifically to undertake that.

Q Okay. Well, you just told me that's one of the factors that you used to determine the type of wetland that you have though; correct?

A In a general sense, yes.

MR. DYKEMA: Objection; misstates testimony. He said that the types of wetlands depend on where the water comes from. That isn't -- doesn't require reference to local climatological data, which is the premise for the question.

MR. PREDKO: Well, Counsel, with all due respect, I asked Dr. Adamus earlier what factors would affect the type of wetland that forms and he told me precipitation and

climate do so.
Q Correct, Doctor?
A Right. And on a regional basis they affect, you know, what the majority of wetland type will be in a region, but you're talking something site specific and site specifically one would -- to get beyond just talking probabilities one would need to take that -- you know, more detailed analysis.
Q And precipitation and climate can determine the hydrology of the wetland?
A Yeah.
Q Okay. So it's an important factor?
A It is. Not the only one, but yes.
Q Now, would you have any reason to disagree with me -- I know you didn't investigate this, but would you have any reason to disagree with me if I told you that in this particular area in the Upper Peninsula they have an average of 35 inches of rain annually and 176 inches of snow from October through April?
A I would not disagree with that. And I was aware of that when I considered the report.
Q And are you also aware that this particular area because of the precipitation and climate conditions -- that the wetlands experience periods of drought or dryness?
A Uh-huh (affirmative).
Q And it's -- I mean, all wetlands experience some periods of

dryness?
A Yes; yes.
Q Are you aware that these wetlands experience dryness to the effect that the water level will drop three feet below the surface at times?
A At times. We're not talking, you know, for a ten-year stretch, but for shorter periods of time, yes.
Q Every season?
A Yeah.
Q Okay. And that can vary from year to year too?
A Yeah; certainly.
Q It's not always going to drop three feet during the dry season; it may drop three and a half feet; it may drop two and a half feet; correct?
A Right. But on a long-term average the water table tends to be within 12 inches of the surface.
Q Well, the water table -- the water tends to be within 12 inches of the surface at five percent of the growing period; correct?
A That's correct; yes.
Q Okay. All right. You're not talking about -- I mean, that's all you need for hydric soils; right?
A Yeah. Under the state of Michigan that's true, yes.
Q And you talked a little bit about precipitation-dominated wetlands and groundwater-dominated wetlands. Again, you

didn't conduct your own hydraulic assessment of the area; right?

A I did not.

Q Did you know that -- from what you've seen that some of the wetland areas on this site are precipitation dominated; correct?

A I would imagine so, yes. Based on the information in Kennecott's documents I would say there's a very high probability of that.

Q And I think you've already testified -- and there's no dispute here today that precipitation-dominated wetlands are much less affected, if at all, by drops in the groundwater table; correct?

A That's correct.

Q Now, are you aware that on this map that we have up here, which is part of the wetland delineation performed by Kennecott and is part of the Environment Impact Assessment which has been admitted already -- are you aware in area 6 that there exists many areas of wetland that are dominated by precipitation?

A Well, yeah, because Kennecott says as much in the Wetland Hydrology Report. They point out that many of these sloping wetlands here are precipitation driven, whereas groundwater-driven wetlands were in this part. But, you know, the -- I'm a little bit wary of those conclusions, because the

number of piezometers and the number of samples and the density within the wetland was not, I feel, sufficient to provide a high resolution as to which wetlands -- even in that one wetland -- which areas of that were high, were precipitation driven and groundwater driven. And then that doesn't account for the other 25 wetlands which were not even studied at all.

Q You're a little bit wary of the characterization?

A Yeah.

Q However, you didn't conduct any assessment at all, did you, Doctor?

A I didn't consider it my responsibility to.

Q Okay. And it's not your responsibility -- you don't have anything here today with you that would disprove Kennecott's characterization of those wetlands as precipitation dominated, do you?

A That's correct; I have nothing to dispute that characterization, nor the characterization that they would be unaffected by a drop in the groundwater level. However, they will be significantly impacted by other activities at the mining operation as I noted. And if I might add, I also found it odd that Kennecott did not characterize which proportion of the wetlands on its site were precipitation driven as opposed to groundwater driven. They only studied that one wetland, number 6, and they kind of divided it in

half, some of it being precip driven and the other groundwater driven.

Q Now, Doctor, is -- are the application materials that -- the only materials that you've reviewed in this case?

A The application materials, their appendices, and the reports that were submitted as, you know, evidence, as exhibits. I can't think of anything else other than what I mentioned earlier.

Q In your short visit to the site, did you get an opportunity to look at the animal population that's on the site?

A In a casual way, but that wasn't -- I was not tasked with, you know, recording animals. I did notice a bald eagle flying over the site.

Q A fly over?

A A fly over, yes. And it was low enough that I considered it was probably not a migrant but -- yeah. And I heard numerous birds that I identified.

Q You didn't see any bald eagle nests in the area, did you?

A No, I did not; but I was not searching for them either.

Q Now, the -- well, did you look at the Environmental Impact Assessment to look at what kinds of wildlife are in and around, for example, area 6?

A Yeah, I couldn't recall from memory which species were in which wetland, but I do -- I did look at the list of species that occurred in the project area and I noticed at least 15

of about 54 species that were reported by your consultants -- you know, at least 15 of them are what I would call wetland-dependent species. And also in that list are many species that are listed by the State of Michigan as particularly sensitive.

Q Okay. See any threatened or endangered species?

A No. I did not -- I did not even bother looking for them. My focus was on wetlands.

Q Now, are you generally familiar with -- and I know you didn't explore all of the areas on the site, but are you generally familiar with the surrounding areas, the surrounding counties, the types of land that is located in those counties?

A I've driven through them. I've looked at aerial imagery. When I was working on that assessment method that I told you earlier and I built models for all the wildlife species in Michigan, I considered the distribution of those species in the area surrounding the project.

Q Okay. And you'd agree with me the areas surrounding this wetland that we're talking about here are all fairly natural areas; correct?

A Well, depends on how you define "natural." But certainly I'm aware of areas such as the tract that's owned by the Huron Mountain Club that's on the Salmon Trout River further downslope that is I understand to be one of the most

pristine forested areas left.
Q We're getting a little bit off scope here, Doctor. I'm talking about the areas directly surrounding this wetland that's up on the screen here.
A Yeah.
Q Do you see that?
A Yes. Oh, the areas surrounding that wetland have had some disturbance in the past from logging and from fire probably.
Q They're primarily natural areas? There's no cities up there, are there, Doctor?
A Correct. They're natural.
Q Okay. And all of those areas are, in this picture, connected to the Salmon Trout River; correct?
A I don't know that as a fact, you know. Again, lacking fine scale topography maps of the sort that should have been done, I can't really say whether there's a surface connection or not.
Q All right. Now, up here on the plot map, and did you look at these types of maps?
A Yes, I did.
Q Okay. And this particular map is one of Marquette County. And the area of the wetland that we're talking about here is right here (indicating); would you agree with that, Doctor?
A Yes.
Q Okay. And you would agree that this area of wetland here is

just a small portion of an extension of this larger wetland that I'm circling; correct?

A That's correct. Although that large area that you've circled with Yellow Dog flows in an opposite direction.

Q But they're connected, aren't they?

A They are connected, yes.

Q Okay. And they're all surrounded by fairly natural areas?

A Yeah.

Q Now, you talked a little bit about a base of invasive species?

A Correct.

Q Okay. It's my understanding that invasive species have the opportunity to come in to a wetland when the native plants are either weakened or dying; correct?

A Correct; yes.

Q Okay. Now, going back to this area six that you took a look at, I assume that you took a look at area six at the request of your client, Huron Mountain Club; is that correct?

A That's correct. I was contacted, I believe, by the National Wildlife Federation.

Q Okay. One of the Petitioners?

A Yes.

Q Okay. And your understanding that you were focusing in on area six was because that's the area closest to the orebody and where the most amount of water drawdown if any will

occur; correct?

MR. DYKEMA: Your Honor, may I just caution the witness not to disclose any attorney-client confidences? The premise for this was a communication with counsel.

Q Oh, please don't tell me the contents of discussions with your lawyers. I don't want to know about those discussions. I want to know why you were there.

A Just to, you know, get a sense of what the site was like, what the terrain was like in that area.

Q And your understanding was when you were at area six was that that was the area that would be affected by the most drawdown; correct?

A You know, again, I can't remember all the areas that I went to. I didn't take a lot of detailed notes when I was there. So I can't say for certain, you know, where on your particular map there I was at any given point in time.

Q Well, I'm not asking where in particular you were, Doctor. I'm asking you in general. You told us that you looked at area six.

A Yeah, parts of it.

Q And that that was the area that I showed you the picture of?

A Yes.

Q And you recognized that?

A Yes; yes.

Q Okay. I'm asking you whether the reason that you were

looking at area six was because that's where the most drawdown would occur, as you understood it?

A I have always understood that the most drawdown would occur near the mine site. But when I was walking on the ground out there looking at that wetland, I wasn't -- I didn't have that thought in my mind.

Q Now, I can't remember which demonstrative exhibit it was that was put up on the screen, because I wasn't yet provided with copies.

MR. PREDKO: thank you, Counsel.

MR. DYKEMA: Your Honor, if I may approach?

JUDGE PATTERSON: Sure, please do. Thank you.

Q And there was a -- no need to put it up, but they had from your "Indicators from Monitoring Biological Integrity of Inland Freshwater Wetlands," from that survey, they had a quote up there that said, "Topographic variation on the order of a few centimeters can shape the composition and enrichments of the plant community." And you're talking about differences in a few centimeters?

A Uh-huh (affirmative).

Q Okay. Now, you also know that differences exist among plant species with regard to their ability to resist drought and flooding; correct?

A Yes.

Q Some species are much more tolerant of drought, for

instance; correct?

A Yeah. And generally those are not wetland species.

Q Okay. Now, let's talk about some of the species that are in this area six, again, one of the areas that you took a look at. And are you familiar, Doctor, with a document that we've identified -- or I'm identifying now in this proceeding as Intervenor 264? It's a document by the United States Department of Interior Fish and Wildlife Service, "Wetland Plants of the State of Michigan."

A I may have seen it once or twice, but it's not something that I'm real familiar with.

Q Okay. You're familiar, though, that the Fish and Wildlife Service characterizes the wetland plants and whether they can be tolerant of wet and dry areas; correct?

A Yes. And they assign labels, facultative, obligate and so on to those species, not just in that publication but the same information is contained online and other sources. And I referred to that.

Q Okay. Sounds like you're very familiar with it, then?

A Yes.

Q Okay. Let's talk about some of the species that you saw again. And it's in this (indicating) area right there.

Q Now, the tamarack that we see there, --

A Yeah.

Q -- that's a facultative wetland plant, isn't it?

A Uh-huh (affirmative).

JUDGE PATTERSON: Is that "yes" or "no"?

A I believe so, just from memory. I would have to consult that list to be sure.

Q Okay. As a facultative wetland plant, that means that it can survive in drier areas; correct?

A It can.

Q In fact, what it means is that although 67 to 99 percent of the time it's found in wetlands, --

A Yes.

Q -- the other percentage of the times it can actually be found in upland areas?

A That's correct; yes.

Q How about red maples?

A You know, again, I would have to consult the list as to what it's labeled as. But let me add that many of the species on the species list that you cite from the project area are not facultative species like the large --

Q Doctor, I didn't ask you that question. Okay?

A Thank you.

Q The red maple, what's the --

A I don't know.

Q Okay. Do you have any reason to disagree that that's a facultative species?

A That sounds about right.

Q Okay. And facultative means it's only sometimes found in wetlands; right?
A That's correct.
Q Okay. 34 to 66 percent found in wetlands; the percent found in upland areas, dry areas?
A Yes; understood.
Q Correct?
A Yes.
Q Trembling aspen, did you see any of those when you were on the site?
A I think I vaguely recall that, yeah.
Q That's also a facultative plant, --
A Okay.
Q -- also tolerant of dry conditions; correct?
A Yes.
Q Balsam firs?
A Yeah, I would imagine those are facultative.
Q Okay. And in fact, they're facultative wetland, but that means they can also survive in dry conditions; correct?
A That's correct; yes.
Q Northern white cedar?
A I would guess that that's probably facultative wet.
Q And you write on also can survive in upland areas; correct?
A Correct. It can survive in upland area, yes, on --
Q Well, it's found in upland areas; right?

A Yes; yes.
Q Okay. How about some of the scrub-shrub? Michigan holly, any idea what that's classified as?
A It probably can survive in upland areas, but I don't know exactly what its classification is. And, you know, there's 54 species on that list. And we could go through them -- I hope we don't go through them one at a time, but I --
Q Doctor, and I don't mean to cut you off, but, you know, I'm asking questions and I'm trying to get answers to my questions. Okay?
A All right.
Q We're not going to go through every one of those. And my point was to go through some of the dominant --
A Yes.
Q -- species of plants that are located here in these wetlands. Okay?
A Yes.
Q Okay. And you just testified that the ones that we've gone through can survive in upland areas as well as wetland areas; correct?
A That's correct. And they're routinely used to delineate wetlands.
Q Now, in fact, some wetland plants, in fact, some of the wetland plants that you saw here, can benefit from periods of drought, can't they?

A Some, yes.
Q Black spruce is one of those, isn't it?
A Uh-huh (affirmative).
Q I'm sorry, Doctor?
A Yes, I imagine that to be so. Although, if you have prolonged drought, it increases the risk of fire and you can have your whole stand burned over easily.
Q Okay. But black spruce is a species that can actually thrive because of some drawdown in water; correct?
A I fin don't kind of leading. I don't know exactly what the case is with black spruce.
Q Okay. How about sphagnum moss?
A Sphagnum moss depending on the species of sphagnum generally tends not to occur in uplands, but it can survive periods of drought.
Q Okay. And in periods of drought, that species will actually thrive?
A It will for a time.
Q Okay. Sedges, sedges can benefit from periods of drought, can't they?
A There are hundreds of species of sedges, and over a dozen in the project area. It's a very species-specific thing.
Q Well, thank you. Sedges can benefit from drought, can't they?
A Some.

Q Now, you talked about the fact that these wetlands are located around the headwaters of the Salmon Trout River?
A Correct.
Q And you talked about the effect that water level fluctuations would have on those and something to the effect that its headwater areas are more important and we have to look out for those; right?
A Correct.
Q Okay. Now, you understand on -- in this area, in fact, in the area upstream of the orebody, that there are beaver dams, natural phenomena that are affecting the water levels in the areas of the headwaters; correct?
A I do, yes.
Q Okay. And these natural phenomena can cause water level fluctuations, can't they?
A They can to some degree, although beaver dams specifically tend to moderate the flow of downstream areas. You get a higher base flow in a lot of cases where you have a beaver dam up above.
Q Okay. Well, and the area up above, though, the water level would be increased during the period of time that that --
A Yeah. And, you know, maybe within 30 feet above the beaver dam it would increase in a very small area.
Q Well, and we're kind of talking over each other, and that may be partly my fault, Doctor. And if you would just -- if

you would wait 'til I ask my question and I'm done with that, I will wait until you give your answer. Okay?

A Okay.

Q Thank you. And it makes it easier for the court reporter, too. Now, would you disagree that natural phenomenon such as a beaver dam could cause water fluctuations, you know, one to two feet?

A It would increase the water by two feet. I mean, it would -- it would raise the water level by two feet, but it's not going to drop the watertable by two feet except when the dam blows out.

Q Right. And when the dam blows out, then that area that was raised two feet then would drop back down two feet?

A Yes.

Q Okay. And some wildlife experts consider that kind of drop in elevation good for wildlife, don't they?

A For limited periods of time. As a chronic disturbance, no, but as an occasional disturbance it's beneficial to wetland productivity.

Q Now, you talk a lot about what you called fens in the area. Now, would you agree with me that all of these what you called fens that the river is an important source of water for these fens?

A Some of them, you know. Of all the wetlands that you have mapped there, the ones closest to the river there I would

imagine I believe to be a mixture of groundwater discharge, i.e., fen, and the product of the river naturally rising, you know, during snow melt in the spring and also a third factor being the surface runoff. So those wetlands along the river I believe have varying components of those three water sources.

Q Okay. And so the answer to my question of whether the river is a source for those fens is "yes"; correct?

A One of three sources, yes.

Q And again, your belief on -- well, you don't have a belief onto the percentage of, you know, how much water is coming from each source, do you?

A I don't.

Q Because you didn't do that analysis; right?

A That requires detailed hydrologic studies.

Q Now, you said something along the liens of you thought that the area would be habitat for a dozen or so threatened or endangered species?

A I said species that are considered -- I believe I said species that are listed by the State of Michigan as sensitive or threatened or endangered or rare. That was my intent to state it in those terms.

Q Okay. Thank you. Now, did you see any threatened or endangered or rare plants?

A No, I did not. I was not looking for them.

Q Did you see any threatened or endangered or rare insects or invertebrates?
A I was -- I did not. I was not looking for them.
Q Did you see any rare, threatened or endangered fish?
A I did not. I was not looking for them.
Q Did you see any rare, threatened or endangered amphibians or reptiles?
A I did not. I was not looking for them.
Q And other than the flyover from the eagle, did you see any rare, threatened or endangered birds?
A I did not. And it doesn't surprise me, because I was only there for a few hours.
Q Now, Dr. Adamus, you've done some work, I understand, with MDOT with regard to Michigan wetlands; correct?
A That's correct; yes.
Q And so I think you would know that in the State of Michigan that there are millions of acres of wetlands?
A Yes.
Q And I received from in this case from Petitioner's counsel a very large exhibit that was called Wetland Background. Are you familiar at all with Exhibit Number 115 -- Petitioner's Exhibit 115?
A I believe so, yes.
Q Is that something that you put together?
A I believe I put a major part of it if not all of it

together.

Q Okay. It's something that you relied on in coming to your opinions?

A It's something that I used as a resource, yes.

(Counsel reviews documents)

MR. PREDKO: I apologize. I have way too much stuff in front of me.

MR. DYKEMA: I can help.

Q Well, while I'm still looking for what I'm looking for, Doctor, I did want to ask you, you had talked about your experience in putting together rapid assessment tools for wetlands?

A Yes.

Q The synoptic method; correct?

A Yeah.

Q The wet method?

A Yes.

Q And I do understand that you've got experience with the HTM method, too?

A Yes.

Q Okay. And you talked about Maine, Oregon, Minnesota, Alaska, Washington?

A Yes.

Q Now, there is not a rapid assessment model for the Upper Peninsula of Michigan, is there?

A None have been legally adopted, but Michigan DEQ is working on a method which will cover the entire state, including the Upper Peninsula. And I've used that method in Michigan.
Q Okay. And they've not finished that, have they?
A That's my understanding. It's a work in progress.
Q My understanding is is that that's a pretty daunting task to put one of those methods or assessment tools together; correct?
A It does take some effort, especially if you haven't done it before.
Q I really wanted to ask you some questions about one of the exhibits.

JUDGE PATTERSON: Can I suggest something? It's almost noon. If we break for lunch and then --

MR. PREDKO: Judge, that will be perfect.

JUDGE PATTERSON: -- that will give you time to find it.

MR. DYKEMA: Your Honor, I'm afraid Dr. Adamus is very tightly constrained. He had hoped to testify Friday.

JUDGE PATTERSON: Right.

MR. DYKEMA: But we need to get him to Detroit Metro Airport to catch a 2:30, 2:45 flight. So if we can finish now, I'd be very --

JUDGE PATTERSON: Okay. I hadn't thought about that. Want to take a quick five-minute break?

MR. PREDKO: Can we, please, Judge?
JUDGE PATTERSON: Sure.
MR. PREDKO: Thank you.
(Off the record)
JUDGE PATTERSON: Find it?
MR. PREDKO: I did, Your Honor. Thank you.
JUDGE PATTERSON: Okay. Good.

Q Dr. Adamus, I did find the exhibits that I was looking for. And you had testified that you had looked at a plot map such as this that I have on Marquette County?
A Yes; yes.
Q And so you're aware that there are other wetlands directly connected to the one that's at the site; correct?
A According to the map, yes.
Q You know of no reason to disbelieve what's on the map?
A Well, sometimes connections are so small that they're not shown on maps. But the major connections would be shown on a map.
Q And if somebody, an expert for Kennecott, were to say that these were all connected, you have no reason to disbelieve that, would you?
A Those particular wetlands there, you're correct.
Q Okay. And I assume that you're also aware of -- and this is kind of, you know, a little bit backing out a little bit more and you'll see the Marquette County wetland on the

right-hand side and then you see other wetlands in the area of Baraga County; correct?

A Yes.

Q And you were aware that there are other wetlands in the area there, too?

A Certainly. And that doesn't diminish the value of these wetlands, but there are other wetlands in the area.

Q Okay. And we were talking a little bit about threatened, endangered or rare species. And the Michigan Natural Features actually rates the types of wetlands also, don't they?

A They -- I wouldn't use the word "rate." They categorize them, yes.

Q Okay. Categorize them as rare or endangered? I know that's not the terminology that they use. And we'll get to that.

A There's different levels of rarity that they use, yes.

Q Yes. And I'm going to put up on the screen here, this is Petitioner's Exhibit 632-115-69. So this was something I think that you may have put together for your counsel. The writing on here is mine. Now, would you agree that on this page in terms of the wetlands at the site the ones that we have at the site are the ones underlined?

A I would agree that some of the ones on the site are indeed bogs in that a few of them on the site may be emergent marsh. But I would tend to think more likely that those

groundwater discharge ones are in the category on the right there of poor fens and possibly northern fen. And the surface water ones that are not bogs would be probably poor conifer swamp or rich conifer swamp or rich tamarack swamp.

Q Okay. And for the ones that I've underlined at least, the bog, I mean, which you agree is there?

A Uh-huh (affirmative).

Q Okay. And the S4, that first is a state rank?

A Yes.

Q And the second column is a global rank?

A Yes.

Q And the S4 means that bogs in the State of Michigan are secure?

A Yes.

Q Okay. And globally G3 to G5 means -- do you know what that means, Doctor?

A I'm sorry. Repeat your question.

Q Well, the global rank there that's underlined --

A Oh, G3 to G5, yeah. It means that globally bogs are not something that's threatened to a large degree.

Q Okay. All right. And then for the emergent marsh, again, state we have a secure ranking; correct?

A Right.

Q And then the GU I understand is unrankable?

A Yeah; yeah. I don't believe that emergent marsh is a large

component; that is, emergent marsh as defined by the MNFI, not by the National Wetland Inventory, but as defined by the MNFI, I don't believe emergent marsh is a large component of the wetlands on your site.

Q But they're there?

A Yeah, I believe so.

Q Okay. And you had talked about a poor conifer swamp?

A Uh-huh (affirmative).

Q And again, statewide secure; correct?

A Correct; yes.

Q And the global classification is apparently secure?

A Yes.

Q Okay. And rich conifer swamp it's got an S3 classification?

A Yes.

Q Which is relatively secure, isn't it?

A Yes.

Q Okay. And then, again, the G4 globally, those are globally apparently secure?

A Yes.

Q Now, do you agree, Doctor, that in coming to your conclusions about this particular area that's at the site that it was important for you to consider the relative sensitivity of that site?

A Yes. I routinely do that when I assess wetlands.

Q And you did that here, didn't you?

A Yes.
Q Okay. Now, the factors that you would use in assessing what makes some wetlands more sensitive -- and these are your factors, aren't they?
A Yes.
Q And that's from a presentation that you've given; correct?
A That's correct.
Q Okay. Now, the factors that you would consider are those that are on the screen; right?
A Right.
Q And the first set of factors are factors within the wetland; correct?
A Correct.
Q And the first factor is that, "An outlet is lacking where you have long water residence time, 'isolated' wetlands"; right?
A Correct; yes.
Q Here in this particular site we don't have outlets lacking, do we?
A I don't know that for a fact, because I didn't visit every wetland. I would have to verify that on the ground. But I would -- based on the maps that you have provided, I would agree with your contention that most of them are connected.
Q And that factor would lead you to believe that this wetland is less sensitive; correct?

A Well, that's one of many factors. But if, you know -- ipso facto; correct; yes.
Q And we talked about the width of this particular wetland, which spans at the area of the orebody 1,000 feet; correct?
MR. DYKEMA: We're talking about wetland number six?
MR. PREDKO: Yes.
Q Do you remember that?
A Yes.
Q I mean, we're talking -- I want to talk about one that you looked at.
A Correct; yes.
Q And wetland number six is an important one in this case. Now, the width of that wetland is not narrow, is it?
A That's correct.
Q Okay. And so that factor would also lean in favor of less sensitive, wouldn't it?
A Yes; correct.
Q Now, "Soil organic content is low." You've already testified here today that the soil in the area organic content is high; correct?
A That's my understanding, yes.
Q And so that factor would also lean in favor of nonsensitive or less sensitive; correct?
A Correct.

Q "Animal communities consist of easily disturbed and/or non-generalist species," now, the animal communities that exist there are all fairly generalist species, aren't they, Doctor?
A Not all of them. Some are specialists.
Q The majority of the wildlife that exists in and around that wetland are generalist species, aren't they, Doctor?
A Based on your lists, I would say that's likely to be true.
Q Okay. And the plant communities -- and we've gone through this -- the plant communities that exist are for the most part generalists? In that area six -- let's take one that you've looked at -- the dominant plant species that we talked about can survive in both wet and dry conditions, can't they?
A That statement is correct. But your preceding statement I would say that the plant communities are predominantly not generalist species of plants in these wetlands, as indicated by the FQI, Floristic Quality Index. I would like to add a little context to this slide that you're showing.
Q Well, you can do -- well, you can do that.
A I feel it was taken out of context.
Q And your counsel will help you do that, I'm sure.
A Okay.
Q I'd like to ask you some more questions. But the question is to these -- the plant comments, again, the ones that are

dominant in area six can survive under the stressor that you focused on the, water drawdown, they can survive in wet and upland areas, can't they?

A Some of those species can.

Q The ones we talked about can; right?

A The ones we talked about can over some period of time, yes.

Q And in fact, some of those species thrive in dryer conditions; don't they?

A Some of those species do.

Q The next set of factors that you look at are factors in the contributing area; correct?

A Uh-huh; yes.

Q And the first one is, "Soils are erodible and have low chemical buffering capacity"; right?

A That's correct.

Q And you noticed while you were in the area that the area surrounding area six, for example, vegetation is fairly intact; right?

A Right. But the soils do appear to have, you know, from data that were provided, appear to have low chemical buffering capacity. They're mostly sandy soils. And erodible, they're on a slope of, you know, 30 feet over 100 feet or something like that, I think we said. That would indicate there's a potential for erosion.

Q Well, certainly, though, Doctor, if the plants, vegetation

is intact, the soil is going to be less erodible; correct?
A Less erodible, yes.
Q And you said sandy, you know, now we've switch turns. We had talked about organic soils previous to this. Now, you understand that in the area of the wetland and surrounding the wetland there is a deep layer of organic soil; correct?
A Well, the difference -- yes; that's correct. The organic is in the wetland. The sand is in the contributing area.
Q Now, the next one, the "Terrain is steep," and we've already gone over that. Again, you've got 30 feet over 300 feet. That's a 10 percent incline. That's not steep, is it, Doctor?
A It's moderately steep. Most wetlands are in terrain of less than five degree slope.
Q But in terms of determining whether this wetland is sensitive, that factor would not lean heavily in favor of sensitive, would it, Doctor?
A That's correct.
Q I know we're running short on time, or you are, Doctor, so I'm trying to make this quick. But let's look at the last one,

"Landscape Factors." "Wetland is not embedded within natural vegetation cover or water; that is, connectivity is low; sensitive because more vulnerable to invasion by weeds. Animals dispersing from wetland

are more vulnerable."

Now, this area is not -- or this area is embedded within natural vegetation, isn't it, Doctor?

A That's correct.

Q And all the areas around it are natural?

A That's right.

Q And so this factor would weigh heavily in favor of the area of being less sensitive; correct?

A Correct.

Q Now, and turn to your CV, Doctor. You were asked some questions about if Kennecott had called you up and wanted to hire you to do some things on this project. Do you remember those?

A I don't remember the exact questions, but I remember you prefacing them in that way.

Q Something to that effect. Well, in fact, according to your CV, your work is almost exclusively for nonprofit groups and government agencies, isn't it?

A That's correct.

Q Not for industry?

A I've done some for industry, but I'd say it just happens that most of my work is for government and a small amount for nonprofits.

Q Well, and in fact, according to the express language of your CV, it's almost exclusively that; right?

A I would say 95 percent, yes.
Q Now, Dr. Adamus, you understand that construction of the mine does not involve any sort of mowing or direct disturbance, no cutting of trees in the wetland area; correct?
A I understand that, yes.
Q And you understand that there will be no tilling or disturbance of the soil in the wetland area; right?
A That's correct.
Q They're not going to expose the soil, for instance; correct?
A Well, not directly. But if you drop the water level, it's going to expose areas that previously were under water.
Q And they're not going to do any burning, are they, Doctor?
A Not intentionally.
Q No burning is planned that you know of, is it; correct?
A That's correct.
Q And they're not going to be using any pesticides or fertilizer in the area; correct?
A Correct.
Q And those would be some of the common stresses that you would look for in assessing threats to wetlands; right?
A On a percentage basis for wetlands across the United States, yes.
Q Now, you understand, Doctor, that Kennecott and the Michigan Department of Environmental Quality have gone great lengths

to avoid the kinds of harms that you've talked about here today; do you understand that?

A That's your characterization. I don't feel they have.

Q Okay. Well, let's take, for instance, the type of mining that's going to be done here. This is going to be underground mining; correct?

A Correct.

Q All right. It's not going to be an open pit mine?

A Correct.

Q Okay. There's going to be no smeltering operation on site; correct?

A Correct.

Q No milling --

A Correct.

Q -- of the materials on site; correct?

A Uh-huh (affirmative).

Q All the kinds of things which I assume you've seen on other sites where you've seen this acid mine drainage; right?

A Correct.

Q And I understand that you've taken the time to read the permit that was issued; right?

A The parts of it that dealt with wetlands. I didn't read the entire thing.

Q Okay. Well, you understand that erosion control is required, don't you?

A Yes, I understand that.
Q And that fugitive dust in the area is going to be controlled; correct?
A I understand there will be attempts to control that. I'm not convinced that it will be controlled effectively.
Q Well, are you aware of any erosion control in the area right now?
A I'm not aware of any.
Q Okay. And you understand that obviously because you said so that that area has been heavily logged; correct?
A Correct.
Q And the road Triple A road that is in the area is a dirt road; right?
A Right.
Q Okay. And that, the logging and travel on that dirt road -- well, do you understand that that Triple A Road is a fairly well-traveled thoroughfare?
A At times, yes.
Q And you've got people going through there at all seasons of the year?
A Yes.
Q The residents taking a shortcut from Baraga County to Marquette using Triple A Road?
A Yes.
Q You've got hunters, blueberry pickers, a lot of people using

the road; right?
A Uh-huh; yes.
Q And use of the road in existing conditions has caused some sedimentation in the river?
A It's possible, yes.
Q Did you see the portion of the environmental impact assessment that talked about sedimentation that resulted from logging?
A I don't recall that part specifically.
Q Okay. But you would believe that that could be the case; right?
A Certainly.
Q And now as part of the mining permit, Kennecott is required to do numerous things to control erosion and fugitive dust. Now, one of the things that they're required to do is to water the roads?
A I understand that, yes.
Q And that's not being done right now?
A Uh-huh (affirmative).
Q Okay. And so that's going to control the dust from the roads?
A It will help.
Q You understand that trucks leaving the area -- well, let's get into some of the fugitive dust types of protections that the permit requires. Trucks leaving the mine have to be

washed before they leave the mine?
A Yes.
Q Which is going to help reduce the dust that they acquire while on the mine site; correct?
A Yes; yes. Dust is not a major concern of mine.
Q Well, I thought that was one of the things that you mentioned.
A It's one. It's one, but groundwater is a much more severe concern.
Q Now, and those trucks that are leaving that are loaded with the rock containing the ore, those have to be covered under the permit; correct?
A Yes.
Q And as far as the acid mine drainage, in your previous experience where you've been involved with mines that have had acid mine drainage, did those mines have lined areas to store the rock or the ore?
A It's been many years since that, but I do believe they did, yes.
Q Well, you understand that this --
A As a Superfund site, I think they were required to, you know, as the remediation.
Q After the fact?
A Yes, after the fact; yeah.
Q But not during mining operations?

A Right. No; no, not during.
Q Okay. And you understand that during mining operations Kennecott in its rock storage area is required to have a lined --
A Yes.
Q -- area to keep the ore in?
A Yes.
Q Okay. To prevent acid mine drainage from entering the environment; correct? That's the purpose?
A That's the purpose.
Q And they're required to have that area covered --
A Yes.
Q -- so that it won't be exposed to air and rain; right?
A Right.
Q They're required to monitor that area for sulfates?
A Yes.
Q And they're required to have a quality assurance, quality control program to make sure that all of those things are working?
A Yes.
Q Now, again, as to the dust, there will be no milling on site. There will be a crusher; you understand that?
A Yes.
Q And that crusher is going to be in an enclosed building; right?

A Yes.
Q Okay. And there's going to be a bag house; right?
A Yes.
Q And they're to inspect that bag house regularly; correct?
A I understand that, yeah.
Q And do you understand that when they transport the ore that in addition to having the trucks washed and covered that they are to monitor the roads and inspect the roads for spillage?
A Yes.
Q Now, you had talked about that the water was a big deal or a bigger deal than the dust?
A Uh-huh (affirmative).
Q Are you talking about water that will be vented back out?
A I'm talking about the water that is being deprived. I'm talking about wetlands that will be deprived of their water because of Kennecott's attempts to contain that water for treatment.
Q Okay. So you're talking about the water on the Kennecott site; right?
A That's correct.
Q You understand the Kennecott site is located away from the wetland; right?
A I understand that.
Q Now, as far as monitoring requirements, according to the

permit, you understand that outside of all of the catch basins they're to have monitors to detect leaks?

A I can't remember if I read that or not.

Q Okay. Do you understand that they're to monitor groundwater quality?

A Yeah, I do remember reading that.

Q You understand that they are to monitor the flow of water from mine dewatering?

A I do recall reading that. But, again, you know, by the time you catch something that's wrong, it's too late to fix.

Q Well, let me ask you this, Doctor: Have you ever seen a mine in your experience with these types of permit requirements?

A I have not, but I --

Q And so you don't know about the effectiveness of these types of requirements, because you've never seen it before; correct?

A Not in the context of mines, but I have seen instances where irreversible damage occurred to wetlands as a result of underground activities nearby and that that -- and that that damage occurred it is scheduled that is not compatible with the monitoring schedule proposed.

Q Back to the monitoring, Doctor, now, you understand that Kennecott is to monitor surface water in order to protect the fish and aquatic species; correct?

A Yes.
Q And that they are to monitor all the water pumped from the rock storage basin; correct?
A Uh-huh (affirmative).
Q Because they're monitoring sulfates and --
A Yes.
Q -- acidity?
A I recall that.
Q Okay. And all of that water will be pumped to a water treatment center?
A Yes.
Q And do you understand the ins and outs of the water treatment center?
A I don't. I understand that testimony will be presented at a later time on that.
Q Okay. But do you understand that by the time the water gets done in the water treatment center that it will be of drinking water quality under Michigan standards?
A I don't know that as a fact.
Q You understand that that's what's anticipated and required by the permit?
A Yes; yes. I think I do remember reading that.
Q And, now, do you understand -- and this relates to the wetlands -- is that Kennecott is required to monitor flora and fauna in the area of the mine site; correct?

A I don't recall reading that. But I'll accept that it's in there.
Q Now, do you recall reading that Kennecott is required to inspect the narrow leaf gentian plants --
A I do.
Q -- that exist on site?
A Yes.
Q And the narrow leaf gentian is a threatened plant?
A Yes.
Q Okay. And Kennecott has gone to great lengths to identify the population of narrow leaf gentian that exist near the project area; right?
A It has identified and mapped them.
Q Okay. And under the permit they are required to have no disturbance within 66 feet of any gentian plant; correct?
A That's correct.
Q And also under the permit Kennecott is required to monitor the water level within the wetland; correct?
A Correct; yes.
Q And when that water level falls below six inches of where it would be normally, they're required to take action, aren't they?
A Yes. They should go to weekly monitoring then, yes.
Q And you understand, as we've talked about this already, that fluctuations in water level in these wetlands vary

tremendously because of the hydrology and precipitation in the area; correct?

A Yes; yes. By "fluctuation," I mean in an up, you know -- up one year, down another year as opposed to a unidirectional drawdown over many years.

Q Well, certainly with respect to the precipitation dominated wetlands you'd agree with me that -- and I think you did -- that they can vary from two to three feet within a regular season; correct?

A That's correct.

Q Now, as far as toxicity and chemicals, Doctor, are you a toxicologist?

A I am not.

Q And so I take it you have no opinion, no expert opinion, on the amount of chemicals that may be emitted from the plant and the particular effects they may have on any species around the site or in the area; correct?

A I can only speak in terms of potential that, you know, there certainly is a potential within a mining operation for that sort of thing. But I don't feel qualified to speak to specifics.

Q And, Doctor, one of the first areas that I went over with you is that wetland types and the effects of stressors on wetlands will vary region to region; correct?

A Yes.

Q And that's because of those factors we talked about; soil, precipitation, climate, hydrology; correct?
A Yes.
Q And you testified here today that you did not do a hydrology assessment of the area; correct.
A Correct.
Q And your assessment of this wetland area was limited to a few hours of observation on one day; correct?
A Correct.

MR. PREDKO: Thank you, Doctor.

MR. REICHEL: Dr. Adamus, my name is Bob Reichel. I represent the Department of Environmental Quality. I have, I think, I hope, just a couple of questions.

CROSS-EXAMINATION

BY MR. REICHEL:
Q On direct examination, sir, you were asked some questions about your review of some aspects in the mining permit that's been issued here, --
A Yes.
Q -- and specifically as they relate to hydrologic monitoring; do you recall testifying to that?
A Uh-huh; yes.
Q I just want to make sure I understood your testimony. Is it your belief, sir, that the schedule provided in the permit for hydrologic monitoring of the site is limited to monthly

or possibly weekly monitoring?

A That's my understanding, yes.

MR. REICHEL: Would you please bring up Respondent's Exhibit 117 of the mining permit, and specifically the portion of the permit that is headed "Special Conditions," and then within that section of the permit page 17? I apologize for the delay, sir. Now, I'd note for the record I've just projected up here something that has the highlighting and that circle, sir, and not part of the original exhibit. I'm just doing this in the interest of expediency. Bear with me.

Q I'm going to direct your attention, sir, I'm going to represent to you that this is a page 17, showed at the bottom there, of the permit under Special Condition L, and specifically Special Condition L4, states,

"The permittee shall monitor groundwater and wetland elevations throughout the life of the mine and do watering operations and shall report the data to the MMU supervisor in a quarterly for the following" -- "for the following wells and piezometers." Directing your attention to condition 4a, it states that, "Daily measurements shall be taken by transducers placed in certain wells identified there."

Do you see that, sir?

A I do see that.

Q And then it goes on to talk -- in addition to that, it talks about monthly measurements and piezometers actually in the wetlands; correct?
A Yes.
MR. REICHEL: That's all I have.
MR. DYKEMA: Chris, can you put back up that sensitivity factor that you had on the screen?

REDIRECT EXAMINATION

BY MR. DYKEMA:
Q Dr. Adamus, we're looking at what looks to be a page from a PowerPoint presentation with the title "What Makes Some Wetlands More Sensitive"?
A Uh-huh (affirmative).
Q Mr. Reichel asked you some questions about this. Do you recognize this?
A Yes, I did.
Q What's it from?
A It's from a presentation -- well, I've given the presentation several times. But in every case, it was in the context of surface water runoff to wetlands from agricultural or urban development.
Q Do the factors identify here apply to the issues raised by the Eagle Mine? And if they apply at all, do they in any way weaken the conviction with which you hold the opinions you've expressed here today?

A Yeah. I don't feel that it weakens my conviction, because these were taken in the context of all wetland types throughout the United States, and in specific reference to agricultural and urban runoff. I do believe that these are the important factors in that context.

Q Counsel for Kennecott also asked you whether your assessment of the wetlands at issue in this case was limited to a few hours on a single day. Now, when I asked you early on what the basis for your opinions was, you didn't mention the fact that you'd visited this site. To what extent, Dr. Adamus, was your walking around and taking a look at the site of this proposed mine the basis for the opinions you've offered today?

A It was only a very minor part of my overall opinions.

Q Does the fact that the permit requires daily measurements in a few piezometers change your opinion at all as to the likelihood that wetlands in the area of this mine would be impaired or destroyed?

A It does not change that for two reasons: One is, if I recall the codes for those mines that are being -- for those wells that are being monitored daily, those wells are not in wetlands. Those are located in non-wetland areas. And secondly, as I indicated earlier, I believe there are instances when even daily measurement of water levels may not detect a severe and catastrophic drop in groundwater

level in a local area.

MR. DYKEMA: Thank you, Dr. Adamus. And, Your Honor, I thank the Court for indulging us in trying to get Mr. Adamus on his plane.

JUDGE PATTERSON: You're welcome.

MR. PREDKO: Just a few.

RECROSS-EXAMINATION

BY MR. PREDKO:

Q Dr. Adamus, those factors that are still up there, --

A Yes.

Q -- those factors would still apply generally to any wetland that you're going to assess, wouldn't they?

A I don't agree with that. As I indicated, they -- I feel they apply most definitely to wetlands subjected to agricultural and urban runoff.

Q You don't think that any of these factors are important here?

A Some of them may be, yes.

Q You certainly in evaluating any wetland would evaluate whether it had an outlet, wouldn't you?

A I would consider that, yes.

Q Okay. And you would certainly evaluate the size of the wetland, wouldn't you?

A Relative to the size of the project, yes.

Q And you would also -- we've covered this -- you would

evaluate the soil, because that determines what type of wetland and the effect stressors may have; correct?

A That's correct. I would -- I would consider all of these, but in the case of the mining project which could effect underground, you know -- the groundwater level, these would comprise perhaps 10 percent of my overall evaluation of that project in its sensitivity.

Q All of these, though, now you said you would consider; right?

A I would consider them, yeah.

MR. PREDKO: Okay. Your Honor, just I'd like to mark this one as a demonstrative exhibit. It would be 597 Intervenor and offer it into evidence.

MR. DYKEMA: No objection.

MR. REICHEL: No objection.

JUDGE PATTERSON: All right. No objection. It will be entered.

(Intervenor's Exhibit 597 received)

Q And, Doctor, you had talked with me before about this idea of surface water runoff being changed or interfered with because of the mine. And I put up on there what I believe is part of the mining application which shows the area of the wetlands here (indicating); right?

A Yes.

Q And also shows the proposed facility here? Okay?

A Yes.
Q All right. And this is what you're talking about is Kennecott is going to contain, according to the permit, all of the water that falls within the facility because they want to run that water through the water treatment center to ensure that none of the particulates or dust get out into the atmosphere?
A Correct.
Q Okay. And that's the effect on water runoff that you're talking about; right?
A Correct.
Q Okay. Now, Doctor, you have done no hydrology assessment of the area, have you?
A Correct.
Q All right. You have no idea, then, how much of the water that falls here ends up in these wetlands, do you?
A Correct. I would have expected that from Kennecott.
Q Okay. But you yourself --
A I have not done it.
Q -- have no idea about whether there's any runoff that comes from this area and goes into the wetlands; right?
MR. DYKEMA: Referring specifically to wetland number six?
MR. PREDKO: No. Referring to the wetlands here in this area.

MR. DYKEMA: But not the wetland immediately to the south of the facility?

A This wetland here, it's -- I see the possibility, but I would need to review topographic maps first.

Q And so, Doctor, today sitting here you don't have any way to give an opinion on how much runoff will be interrupted from any of the wetlands; correct?

A It raises a red flag for me, but I can't give you a definitive, "yes," how much runoff would be effected.

Q Because you haven't done the assessment; right?

A Correct.

MR. PREDKO: Thank you.

MR. REICHEL: I have nothing further. Thank you.

MR. DYKEMA: Nothing further, Your Honor. And again, thank you.

JUDGE PATTERSON: Thank you, Doctor. Break for lunch?

MR. PREDKO: I think so, Your Honor.

JUDGE PATTERSON: Okay. Let's come back at 1:00. It's almost -- or 2:00, I mean.

(Off the record)

JUDGE PATTERSON: Welcome back.

MR. HAYNES: Your Honor, before we get started with the next witness, Petitioners have several motions that we would like to raise based upon the testimony that

occurred last week.

JUDGE PATTERSON: Okay.

MR. HAYNES: And so let me give them to you as deliberately as I can. First Petitioners move for a peremptory denial of the permit, because it's clear from the testimony last week both from Mr. Parker and Dr. Bjornerud and Dr. Vitton and also from Dr. Blake that the DEQ did not have all of the core samples or core photos for this project to review as part of its review of the Part 632 permit. We think that lacking that data, it is impossible for the DEQ to have fulfilled its duty under Part 632 to properly review the permit. And for that reason, we think that the permit ought to be peremptorily denied.

Second, in the alternative, if this Tribunal does not peremptorily deny the Part 632 permit, we ask that the Tribunal -- that you bar Kennecott and the DEQ witnesses from testifying regarding rock mechanics to the extent that such testimony will rely on core -- cores or core samples or core photos that have not been disclosed to us. And from what we can count, that's about 101 cores. We heard testimony last week from Dr. Blake that he had reviewed three cores. And Mr. Reichel's disclosure on April 1st included photos from those three cores. And Mr. Reichel's disclosure in -- on April 1st included photos from those three cores. But those three cores were not made available

to us before April 1st to review unlike the other eight that our experts reviewed. So we think that it would be prejudicial to allow witnesses for either the Respondent or the Intervenor to testify regarding anything relating to those at least 101 cores without our having a chance to have reviewed them.

Third, because of these non-disclosures, we think that this Tribunal should infer that the data from those 101 cores ought to be -- we think that the Tribunal should rule that the data from those 101 cores having not been disclosed would support Petitioners' positions and should be held to be detrimental to the position of the Respondent and the Intervenor.

Fourth, we renew our request for discovery of the ability to look at the core -- look at the cores, examine them, pick them up, feel them and, to inject Parker's words, even taste them. We renew our motion for discovery to review the photos of all of those cores assuming that they exist. We renew our request to inspect the drillers' logs that we believe exist so that we can properly prepare for the testimony -- the expected testimony of the witnesses for Intervenor and for Respondent.

Fifth, we request -- following the scheduled witnesses for this week, we request an adjournment for a chance to carry out these inspections if this Tribunal would

so order of at least two weeks to allow our experts a chance to look at the photos, inspect the cores, inspect the drillers' logs.

And lastly, not by way of motion but way of clarification, Petitioners want to clarify that their stipulation to admit the mining application, the groundwater application -- excuse me -- the Part 632 application and the Part 31 applications and their supporting documents that our stipulation that those be admitted be -- is that they be admitted only for the purpose of showing that they were, in fact, submitted to the DEQ for its review and not for the substance that's contained in those documents. Thank you.

MR. WALLACE: May it please the Court, on behalf of Huron Mountain Club, let me just add to this and maybe make a friendly amendment to part of the motion. And I'll start with that. The problem we have and your Honor saw it repeatedly last week is that, after we were deprived of the opportunity to see these cores and the photos of these cores through FOIA and so forth and after your Honor ruled because of time constraints about discovery, the theme of cross-examination and the defense to our petition last week relied heavily on what our experts were unable to see. And so we ended up with an extremely tilted playing field as the hidden ball was the subject of what our own experts were unable to opine about. So not only did we lack the basis to

expand upon very strong opinions, but an enormous effort was made to undermine the opinions that were given based on some nearly 100 core samples that our experts were never allowed to see. And that was terribly unfair and is prejudicial to us.

So my friendly amendment is that, in the event that your Honor chooses not to peremptorily reverse and allow this process to go back to square one and be done properly, allow the MDEQ an opportunity to review the cores it's never seen so that the grant or denial of a permit the second time around is based on this extreme -- large abundant supply of highly relevant evidence, which both sides concede is relevant, us through our experts and them through their cross-examination of our experts, this would allow the process to be back on track if we go back and do it with the DEQ's opportunity to review the cores and then see if they would grant this permit.

But in any event, not only should -- if your Honor chooses not to issue a ruling to that effect, not only should Respondents be precluded from offering evidence and testimony based on those cores, but they should be precluded from argument based on those cores and any further cross-examination based on those cores. And the cross-examination that they've conducted should be stricken, because it's completely unfair for us who have been in the

position of a substantially reduced availability of key critical evidence that's being used against us.

In all other respects we support the motions made by Mr. Haynes.

MR. EGGAN: Your Honor, Eric Eggan for the Keweenaw Bay Indian Community. I would echo the thoughts of brother counsel on this issue. These were -- these were items that were requested specifically of Kennecott and of the MDEQ, and they were not provided to the parties in this case. And it became absolutely evident and clear last week just how important they are in this case. It relates to the stability of that crown pillar. It relates to safety. It relates to the geology at the site. It relates to the hydrogeology of the site. So this information is absolutely essential. And not only was it not given to us, it was not given to us intentionally because they felt they didn't have to. Your order on discovery said the following. "It is hard to imagine that much is unknown at this point or that anything exists that cannot be dealt with through cross-examination." And it's absolutely clear now in this instance that this is unknown information that cannot possibly be dealt with effectively through cross-examination.

And so I would join in the motion, and I would add to the Court -- add to you and add to the motion that the

request for an opportunity to discovery this information is essential. And from my perspective, the proceedings can probably end tomorrow and give us two weeks to limit this, and we'll come back after having an opportunity to look at these materials. But, Judge, it's only fair to the Petitioners who are making a legitimate and strong challenge to these permits that we be given this kind of critical information.

MR. LEWIS: Your Honor, Rod Lewis again. Let's see. I'll try to take them in order. I guess, as I understand it, all of these some four or five motions are based on the Petitioners' claims that they are unfairly -- have not been able to see the cores. So I guess we ought to start with when did they request the core samples? They did not request them throughout the long DEQ permit review, public comment, public meetings and so forth process, which took a number of years. They did not request to see the cores until, as I understand it, February of this year, which was -- I believe the petitions were actually filed by the Petitioners in December last year. They never presented this Court with a narrow request to see the cores in their motion for discovery but rather presented this Court with a broadly based motion for essentially total discovery of any and all information they might seek to review through written Interrogatories, through depositions, through

successive rounds of depositions and document discovery and so forth. So this Court has never been presented with a narrower motion than that until this day, now six weeks into this hearing. I think that's some relevant background.

Secondly it strikes me also, your Honor, that this matter -- this characterization of the lack of these physical samples in the DEQ's files and therefore available by FOIA or otherwise from the DEQ, I think, must be akin to similar situations in probably the majority of cases concerning the DEQ that come before this Tribunal. I would think it's more common than not that, when you're dealing with voluminous data concerning the physical characteristics of things that it is presented through reporting. And that's the case here. The data on the 100-some cores that the Petitioners have just spoke about is reflected in the Golder reports as we have looked at already in this contested case. Petitioners' Complaint, as I understand it, is that they feel it's unfair that they're confined to the data in the reports which were submitted as required by law to the DEQ as part of the proper process as governed by the relevant regulations. And I submit to you that's the normal course in nearly any case that comes before this Tribunal. Are we now to demand that every soil sample that was taken in connection with Kennecott's background environmental studies for this project be physically brought into the

courtroom and made available for inspection? Are we going to demand that in any other case that comes before this Tribunal? Are we going to demand that all the water samples, the data for which is summarized in all these reports as is the normal course, be physically brought in and made available to the Petitioners to examine? Air samples likewise? So I think they are trying to draw a dramatic distinction here where no distinction can be made.

Part of the relevant background perhaps that the Court may or may not be aware of is that, after denial of the very broad motion for discovery by the Petitioners, the denial by this Court, they did seek interlocutory review. That was not successful.

So I think it's not appropriate for Petitioners to, in effect, renew a motion for discovery that they brought a long time ago which was denied which was the subject of interlocutory appeal and now apparently seek to renew the motion on the basis I have just described with -- you know, the upshot being that they're demanding a -- I forget -- one or two weeks additional delay in these proceedings now in which there's already been too much delay.

As to the alternative that the Kennecott and DEQ witnesses be barred from testifying, again the data is in the reports. Unless we treat this case very much

differently than I assume a lot of cases that come before this Tribunal, there is no basis in law for that. There's no basis in law for the requested second alternative, some kind of adverse inference that the 101 cores or the ones that the Petitioners did not have physical access to somehow supports the Petitioners' positions because again the data is presented in the reports to the DEQ. The Petitioners have been provided with that data through FOIA's and other methods as is typically the case in these proceedings.

The Petitioners' motion to apparently -- apparently they want to withdraw their stipulation to the admissibility of the mine permit application materials, the groundwater discharge permit materials, I assume the environmental impact assessment. I haven't heard any basis for that, your Honor. I think it's premised on the same arguments for which I don't think there's -- there are any grounds. Thank you.

MR. REICHEL: Yes. Thank you, Judge. First of all, with respect to the Petitioners' motion for peremptory denial of the permit, I don't believe there is any legal basis for that whatsoever. While it's true, as you well know, Judge, that the Petitioners spent a considerable amount of time in their public comments and then in the testimony offered last week in a highly detailed review of rock core samples or photos of the same. And they obviously

are of the view that they are of central importance in this case just to ground this proceeding in the law that governs it. Neither Part 632 nor the Part 632 rules request nor would they be expected to require the Agency to physically obtain all physical or geophysical data collected by somebody that ultimately formed some part of the basis of a modeling exercise and a permit application. The simple fact, Judge is, the fact that the DEQ did not have physical possession of cores or photos of cores or for that matter drillers' logs does not by any stretch of the imagination establish that the Agency was without a basis to review the permit based upon the application submitted and additional review of that as the Court has heard from testimony by outside consultants. So I think that, on a legal basis, that's just specious.

With respect to the contention that the DEQ has hidden the ball or refused to provide data, I want the record to be clear on this, and I think that it should be. With respect to the photos of core logs, again I think the testimony is clear that the Petitioner has got the photos of the core logs for the eight samples that you heard so much about last week, not from the DEQ but from the DNR. The DNR didn't have them. So they didn't withhold them in response to any FOIA request by these Petitioners.

The testimony reflected including the testimony by

Dr. Blake that, as a part of his review of this last year he requested and obtained from Kennecott photos of core samples from three borings. That's on the record. As counsel has acknowledged, that -- they were attached to an email. We didn't offer this as an exhibit, because we didn't feel it was necessary to. But it was attached to an email dated June 15th of 2007 from Mr. Donohue to Wilson Blake transmitting copies of photos of core logs that, as Dr. Blake testified last week, he reviewed. This email and the attached photos were -- I know for a fact that they were disclosed or included within a very large compilation of DEQ emails that I transmitted to counsel on April 1st of this year as I believe Mr. Haynes has acknowledged. I've also been advised that the same email and attached photos were transmitted to Ms. Halley of the NWF in response to a FOIA on January 9th of this year.

So the suggestion that DEQ has somehow hidden or withheld the limited number of core log photographs that it had in its possession is without merit.

But more fundamentally I think the underlying of each of these motions is mistaken. While the Petitioners are free to argue that reviewing core logs or even possibly drilling logs may be relevant to some issue before this Tribunal, they are not, in fact, either legally or otherwise required to be -- that level of physical samples data does

not -- it's not required to be included in the permit application. The fact that it was not does not call into question the legality of the permit that's been issued here. So for that reason, I don't think that there's any basis for this Tribunal to conclude that the decision to issue the permit should be primarily peremptorily reversed or denied based upon the fact that DEQ had in its possession only a limited number of core photos, nor is there any basis for a contention that the DEQ has withheld such information as it had within its possession in response to Petitioners' request.

Again I don't want to belabor this further. The issues with respect to discovery have been made. That's already been pursued unsuccessfully through interlocutory appeal. I don't believe that there is a basis to either suspend or interrupt this proceeding to -- for the purpose of disclosing or providing copies -- either physical access or copies of photos to Petitioners' experts. And I certainly don't think -- just as there is no basis to -- for the contentions that the absence of these documents or materials from the DEQ permit files renders the permit invalid. There's no certainly no basis for the suggestion that some adverse inference should be drawn with respect to the Respondents' position on the issue of premise puller stability because those particular core photos and drillers'

logs were not physically in the possession of the DEQ.

MR. HAYNES: Brief rebuttal, your Honor.

JUDGE PATTERSON: Sure.

MR. HAYNES: First, in the Part 632 case, after our pre-hearing conference -- our scheduling conference, Petitioners, in fact, sent out discovery requests that were targeted to these items. It wasn't a general request. They were targeted to items. And I'd like to review with the Court those items. And this is in the discovery request from Petitioners in the Part 632 case dated February 21, 2008. Item 7A requests all drillers' logs, notebooks, notes and materials from and related to the bedrock drilling cores at the proposed Eagle mining site; item C, drilling cores related to Kennecott's mine permit application for the proposed Eagle Mine; Item J, geologic logs used by Kennecott and its consultants; item L, all drilling logs years 2001 to 2005 used to generate the computerized model GoCAD presented in appendix C2 and C3 including both the field notes and the subsequent computer geologic logs; item M, two Microsoft access databases pre-2004 with 43 holes and 2004 with 49 holes which contain the exploration drilling information that were listed as the phase one study; item N, the 2005 access database with the 109 holes cited in appendix C3 known as the phase two assessment data; item O, the separate database or table of databases of structural features also

referred to as discrete features and referenced on page 13 of appendix C2; item Q, computer algorithms used to calculate the Rock Quality Designations and Rock Mass Ratings referenced on page 5 of appendix C2 and in Table 1, boreholes used in the GoCAD model. Those are pretty specific. Those aren't general; those are specific. So we have targeted discovery tested here.

Secondly Mr. Lewis says that the data are all in the reports. And, in fact, we've found out thus far that the data are not in the reports. The data that we requested in our discovery requests are found nowhere in the reports except summaries. And we can't cross-examine those summaries without the underlying data.

So for those reasons, I think that Mr. Lewis' responses are unavailing. Thank you.

MR. WALLACE: I just have one addition brief word, your Honor. First of all, Mr. Blake and others testified as to the importance of these drilling logs. This is a case that centers very much on water and water loss from the Salmon Trout River into the area that's intended to be mined. And we learned in the testimony last week that drilling logs reflect, whenever there's a water loss in the drilling process, that that water is going into the crevices and fissures of the rock that's been drilled into. This is extremely important information in terms of what this case

is about.

Secondly, Mr. Lewis' litany of our parade of horribles, all the other things that we might have asked for, could ask for, tests that could be sent for, we're just asking for drilling information now. We're not asking for a whole range of additional kinds of samples at this point. This is extremely targeted to the case at this point. And I'm not the most experienced environmental lawyer around, but ever since my first contact with practicing environmental law, it's been conventional with the DEQ to split samples of the very things he says we shouldn't be able to get samples of. You split samples of water. You split samples of soil. This is convention in making sure that both sides have equal opportunity to data from day one when the DEQ is involved. And that's the way it's always been done. This is a mining case of samples of core rock. It has not been part of the history of anybody's environmental experience. But we're there now. We're having a mining case. And just as water samples are conventionally split in contamination cases, core samples should conventionally be made to all parties involved in a mining permit case. And this is the opportunity to announce that rule.

Finally, it must be obvious. It will be terribly disruptive to us to interrupt our case now. We have

witnesses here. We've been putting on our case. And I hope it's reflective of the sincerity of these motions that we're willing to do that and set out case back substantially because this is so important to us. And we hope your Honor will grant the motions as made. Thank you.

MR. EGGAN: I would add, your Honor, just the fact that, while Kennecott would like to continue to make this case like some other groundwater case that you may handle through the course of the work that you do, this is the first of its kind under Part 632. And, yeah, there may be soil samples, there may be water samples in other cases. But if you recall what Mr. Parker said, this is the roof over the head of the miners. And so this is a critical safety issue. And we should be able to examine that safety issue and get a good understanding about it. It really goes to the -- we're talking about core samples. But this request goes to a very core of why we are here. We are here because we want to explore in a meaningful way the basis for this permit. And you have the unique authority to give us the ability to explore it in a meaningful way. And that is what we are asking you to do is give us the opportunity to explore a critical issue in this case, extremely relevant across the board to the Part 632 permit, the Part 31 permit. It's relevant to all issues. And we would -- I'll echo what Mr. Wallace says. This is an extraordinary request. But we

believe that it is an extraordinary request based on extraordinary circumstances. And we'd ask that you grant us this request.

MR. LEWIS: Just one final thing, your Honor -- I think final. I think at bottom, again, Petitioners had opportunities to request information in the permitting process and the public comment process. They did not do it. They could have brought a motion before this Court initially that was more narrowly focused. They did not do it. The problem is that Petitioners are now essentially renewing a motion for discovery. And it's simply too late to be entertained at the outset and particularly in a forum and under rules in which discovery is not generally conducted. Thank you.

MR. REICHEL: I've nothing further, Judge.

JUDGE PATTERSON: Anybody else?

MR. HAYNES: Nothing further.

JUDGE PATTERSON: Before I rule on this, I want to take a few minutes to organize my thoughts. We're going to take a short recess.

(Off the record)

JUDGE PATTERSON: Before I rule, let me ask a question. I'm a little unclear as to the change in the stipulation regarding the application. I think it was characterized by Mr. Lewis as being a withdrawal of the

stipulation?

MR. HAYNES: No, we're not withdrawing the stipulation, your Honor.

JUDGE PATTERSON: I didn't think so. I --

MR. HAYNES: We're clarifying it. We're going to -- our stipulation is that the application and the environmental impact assessment and their appendices and all the materials that relate to the application in EIA -- we will stipulate that they were filed with the DEQ, but we are modifying the stipulation such that we are not stipulating to the truth of the contents of those documents.

JUDGE PATTERSON: Well, I didn't interpret your stipulation to be that in the first place.

MR. HAYNES: All right. Fine. But then --

JUDGE PATTERSON: That's my dilemma.

MR. HAYNES: I just wanted to make sure that that was clear on the record.

JUDGE PATTERSON: Oh. Okay. All right. Oka

MR. HAYNES: Good. Great.

JUDGE PATTERSON: First regarding the peremptory denial. I don't see where I have any authority to do that. Clearly under the APA, a contested case presupposes a proposal for a decision in writing in which findings of facts and conclusions of law have to be made. Due to the fact that the process presupposes that scenario, I don't see

any authority for a peremptory denial. There have been a number of motions for summary disposition made in this. I suppose that would be available if there was no question of fact, but obviously there are substantial questions of fact at this point. I frankly just don't have authority to do that, in my opinion.

Regarding the motion to prohibit DEQ and Kennecott's witnesses from addressing the, if I can use the term, remaining core samples, I don't think that's appropriate at this point. We don't know what that testimony is going to be. I think Mr. Reichel and possibly Mr. Lewis too made a good point; that what we are dealing with here -- and this also goes to the discovery request. What we're dealing with here is what is required to be submitted applicable in the Part 632 under the statute, the contents of the EIA, for example. And it's, I don't think, either necessary or appropriate, in my experience in these cases, for every underlying fact or detail of any particular study of any particular witness be necessarily made part of the record.

Obviously, if -- and I think it's been argued and will be argued in this case, that some of the submissions of the DEQ were insufficient or not based on proper evidence. That argument is still open. And again for the reasons articulated in the original motion for discovery, I don't

see any compelling reason at this point of good cause for delaying this proceeding in the mid stage of the proceedings, particularly given the mandated deadline of resolution. So I will deny both the motion to prohibit the witnesses from testifying, basically at this point, without knowing what the testimony will be and, secondly, deny the discovery request.

Again, I don't think there's any good cause at this point. Regarding the inference that the remaining core samples essentially be used against the DEQ and Kennecott, Administrative Rule 59 only allows that sort of inference if a party refuses to ban order for discovery under that Rule. Obviously in this case there has been no such order of discovery. There's nothing upon which to invoke that inference, so I will deny that as well. Any questions, comments?

MR. LEWIS: No, your Honor.

MR. REICHEL: No.

MR. HAYNES: No, your Honor.

MR. STAPLETON: Your Honor, William Stapleton for Petitioner Huron Mountain Club. I'll be examining the next witness.

JUDGE PATTERSON: Okay.

MR. STAPLETON: And Petitioners call Sub Vel to the stand.

(Witness sworn at this point in the proceedings)

JUDGE PATTERSON: Mr. Stapleton, let me ask before we start, --

MR. STAPLETON: Sure.

JUDGE PATTERSON: Does this witness have any time constraints, just so we can plan for the afternoon?

MR. STAPLETON: I don't believe so.

WITNESS: No, sir, not today.

MR. STAPLETON: I think he can go past 5:00, if that's --

JUDGE PATTERSON: Or can you be here tomorrow if --

THE WITNESS: Yes, I can be here tomorrow; yeah.

JUDGE PATTERSON: All right. Okay. I just wanted -- just so we know where we are at the end of the day.

MR. VEL: Yeah.

REPORTER: Would you raise your right hand, please? Do you solemnly swear or affirm the testimony you're about to give will be the whole truth?

MR. VEL: Yes, I do.

SUB VEL

having been called by the Petitioners and sworn:

DIRECT EXAMINATION

BY MR. STAPLETON:

Q Can you state and spell your name for the record, please?
A My name is Sub Vel. The first name is spelled as S-u-b, and the last name is spelled as V-e-l.
Q And, Mr. Vel, where do you live?
A I live in 790 West Castlebury Circle in Saline, Michigan.
Q And can you just briefly describe for the Court your educational background?
A I have a B.S. in civil engineering and a master's in environmental engineering from School of Mines in Rapid City, South Dakota.
Q And what is environmental engineering?
A Environmental engineering is a discipline that combines the aspects of science and technology to improve the environment, including air, water based and soil.
Q And did you have any area of concentration in your studies at the South Dakota School of Mines and Technology?
A Yes. It's air quality and fate and transport of organic contaminants.
Q Can you give the Court a brief history of your employment, please?
A From 1984 to 1990 I worked in the area of civil engineering in the construction design. 1992 I started my career as an environmental engineer with Beckler Consultants in Farmington Hills, Michigan. And between 1996 and 2003, I worked as an air group compliance specialist with Advanced

Engineering Solutions in Canton, Michigan, and 2003 I joined CRA as an air group leader. And 2007 I became an associate at CRA.

Q And in the course of your employment, have you had a particular area of concentration in your work?

A Air quality is the -- is mostly what I dealt with.

Q And you have been employed with CRA since when?

A Since 2003.

Q And you are an air quality group leader with CRA; is that correct?

A That is correct.

Q Can you describe for us some of the -- well, let me ask you this: As -- in the course of your work with CRA, have you been involved in air-permitting projects for various industries?

A Yes. All my work is related to industries in air quality in the State of Michigan, Ohio, Illinois, Texas, California, Louisiana and New Mexico.

Q And, Mr. Vel, about how many air-permitting projects would you say that you have worked on since you've been with CRA?

A Between 40 to 50 maybe.

Q Okay.

A Yeah. I don't remember.

Q Okay. And could you maybe describe the services that you perform in conjunction with obtaining an air permit for a

particular industry?

A Air permitting -- typical air permitting would involve -- whether it's a minor source or a major source, most of air permitting would involve understanding the process emissions; doing an emission calculations, collecting dispersion modeling to evaluate the ambient impact at impact for DSD and the National Ambient Air Quality Standards. And also in Michigan we do Michigan air toxics analysis and best available controlled technology analysis to make sure the controlled technology is technically economically feasible and finally apply for a permit and negotiate the permit conditions.

Q Okay. And can you give us some idea of the range of pollutants that you have worked with in the course of your work with CRA?

A Criteria pollutants, different types of air toxics. When I say "criteria pollutants," it will be relative of any compounds; oxides of nitrogen, sulphur oxide, particular matter under 10 microns in sizes, lead and any other toxic contaminants, including heavy metals.

Q I believe that you mentioned in your description of the air-permitting process that you engage in air dispersion modeling; is that correct?

A That is correct.

Q And can you just describe what that process entails?

A Air dispersion modeling is typically required for an air permit application. Air dispersion modeling estimates the ambient air impact and evaluates and predicts the ground level concentration at specified receptor locations around the emission sources.

Q Okay. And how is that determined? I mean, what's -- what goes into making that determination and prediction?

A Performing air emission calculation using the emission rate and meteorological data from the nearest site. And also there are other parameters, including stack parameters like stack height, stack velocity, stack diameter, exit temperature and many other different parameters.

Q And is air dispersion modeling performed in conjunction with every air permit application that you've been involved with?

A If it's a major source, yes; if it's a non-major source, on a case-by-case basis.

Q Have you been involved with preparing Michigan air emission reporting plans for various industries?

A Yes, I have.

Q And can you describe what those plans are?

A We have conducted annual emissions inventory for major sources and non-major sources and calculated their emissions and prepared annual emissions inventory and a MAERS program, Michigan Air Emission Reporting System program. And also, I have developed an -- architected (sic) and developed an

emission tracking software too that is being used by many industries; a wide variety of industries from testing facilities to surface-coding operations.

Q And you developed that software yourself?

A Yes, I did.

Q And when did you develop that software?

A In 1998.

Q And is that software currently in use by various industries in connection with tracking air pollutants?

A Yes; yes.

Q Have you engaged in any activities with CRA in the area of environmental compliance?

A Yes, I have. There are numerous compliance audits for many facilities: automotive, food-processing industries; suppliers; metal finishing operations. And I have done -- worked on the compliance side in the field of scum water pollution prevention plan preparations and integrated contingency plan preparations and things of this nature, yes.

Q And does your work in conjunction with Environmental Compliance Audits entail the study of air emissions and air quality from various industries?

A From air permitting standpoint and air compliance standpoint, yes, we did -- I did.

MR. STAPLETON: Your Honor, for the record, Mr.

Vel's CV has been stipulated to as an exhibit, and that is -- it is Petitioner's Exhibit Number 129.

JUDGE PATTERSON: Thank you.

Q Mr. Vel, are you familiar with best professional practices in the area of air quality analysis?

A Yes, I am.

Q And can you describe what best professional practices would entail in connection with obtaining an air permit for an industry in Michigan?

A Basic understanding of the process of emissions; doing a detailed emission calculations; considering the actual emissions and potential * 3:19:22; conducting air dispersion modeling analysis; conducting air toxics analysis; best available controlled technology analysis and in some cases lowest achievable emission rate analysis and finally developing -- making sure that it meets with all the Michigan air pollution control rules.

Q And how long have you been servicing industries in Michigan?

A Since 1992.

Q Now, you've mentioned air dispersion modeling a couple of times in your testimony. There's also a function known as deposition modeling; is that correct?

A That is correct.

Q And can you just describe the difference between dispersion modeling and deposition modeling?

A Deposition modeling is conducted to estimate the amount of pollutants deposited in the ground, and the software that is used is the same as the dispersion modeling.
Q Okay.
A And the unit that the deposition modeling -- results are expressed in grams per meter squared per year. It's more of a deposition flux.
Q And what are you attempting to predict for the air pollutants when you engage in deposition modeling?
A There are two things. First is to get them in the extent of deposition, and the second one is to determine the maximum deposition rate at the * receptor 3:20:55.
Q And can you describe the major components that are inputted into an air deposition model to yield the results?
A Just like dispersion modeling, you input your emission rates from various sources from the facility, meteorological data like wind and precipitation. And you also account for your -- you figure out if you need to account for a wet deposition or a dry deposition if you want a total deposition. You also figure out if you need plume depletion calculated.
Q And what is plume depletion?
A When a mass of pollutant passes through an area, plume depletion -- if you account for plume depletion, it detects -- as the mass of pollutant falls down and deposited

in the ground, it detects the total amount of pollutant that is deposited in the ground that's conserving mass.

Q And you also mentioned another component, wet and dry deposition?

A Right.

Q Can you explain that too, please?

A Dry deposition is mainly from the particulates as the particles gets deposited, and wet deposition is mainly related to deposition that happens because of rain and other precipitation such as snow.

Q And you also mentioned as a component a particle size distribution. Can you explain what that entails?

A Every particle, if you look at a mass and then -- particles have a distribution like 10 microns, 7 microns, 6 microns. Everything has an aerodynamic particle-size diameter. Deposition modeling requires you to input those values into the model so, based on the -- because the particles deposited gets deposited because the gas velocity gets lower. And because of the gravitational -- effect of gravitation, the particle falls to the ground. And also, in addition to that, that is dry -- wet deposition that happens. So particle size distribution is required to be inputted into the deposition modeling.

Q And how do you determine particle size distribution for a particular pollutant?

A In a typical case, you could do a * 3:23:26 analysis and find out what the particle size distribution if have a soil; right? But in a gas situation, you -- AP-42 has particle size distribution for, in this case, unprocessed ore, I think it is in appendix B2, where you can get the data and use it.

Q Now, deposition modeling obviously entails consideration of weather factors; correct?

A That is correct.

Q And how is the meteorological data inputted and considered when you're performing a deposition model?

A When you -- you process your meteorological data -- let's say that you obtain the data from -- in the case of Kennecott, you obtain the data from Sawyer Air Force Base for the year 2004 that the MDEQ obtained, and also data was obtained from Green Bay, Wisconsin. We process the data, and then we use the data as one of the parameters.

Q And so that would be in the case of Kennecott the actual weather data from the year 2004 --

A That is correct.

Q -- from Sawyer --

A -- Air --

Q -- Air Force Base?

A Yeah.

Q Now, once you've inputted all this data that you've just

described into a deposition model, what is the next step in the modeling process?

A Verifying that all the input parameters are accurate, and then you run the model and get your results.

Q And then what does the model yield? What sort of information are you able to obtain?

A You establish a grid size, and every grid nodal point gives you a deposition rate in grams or milligrams per meter squared per year of deposition at every grid nodal point. Let's say you have 1-kilometer-by-1-kilometer grade divided it into 50-meter intervals, grid spacing. At every other point it gives you what the deposition rate is.

Q The deposition rate for a particular pollutant?

A That is correct.

Q Within a given area?

A That is correct.

Q And what is the typical area that is considered in the -- the units of measure in a deposition model?

A The unit of measure would be -- grams of pollutant deposited first square meter of the area per year is the unit.

Q And what period of time does the typical deposition model simulate?

A Depends on the type of a project. In this project it is very valid to use a one-year worth of data.

Q Mr. Vel, what were you asked to do for the Part 632 mining

case?
A Review the air permit application and calculate, recalculate the emissions; check the calculations that is provided by Kennecott.
Q The calculations in the air permit application?
A Air permit application -- and run the deposition modeling for copper and nickel.
Q And what modeling software did you use for this particular case?
A We used modeling software, which is an USPA approved, ISCST 3 modeling software. That was used by both Kennecott and MDEQ. And the model that's ISCST 3software that we used was packaged by Lakes Environmental.
Q And is this software widely used in the industry?
A Yes, it is.
Q And this software was used by MDEQ in this case to deposition model pollutants from the mine?
A That is correct.
Q Can you tell us just briefly what documents, you know, overall that you've reviewed in this case in connection with your testimony?
A I reviewed Kennecott's air permit application and draft air permit issued by MDEQ and final air permit and response to comments prepared by MDEQ and also Kennecott deposition modeling impact analysis dated December of 2007.

Q Did you review any part of the mining permit application?
A Only from the process description standpoint and from the point of view of air permitting where I can glean some information out of it.
Q Can you just generally describe for us the air pollutants that will be emitted from this mine?
A The majority of air pollutants in the particulate matter, and also I should say PM10, because PM10 is a subset of particulate matter equal to or less than 10 microns in size, which is a subset of PM. And --
Q Let me back you up a little bit.
A Yeah.
Q You said "particulate matter."
A Right.
Q Can you just give us a general definition of what particulate matter is?
A Particles -- particulate matter * 3:28:41 of in this case many metals -- heavy metals and sulfites in particulate form, and particulate matter under 10 microns in sizes refer to a PM10, and a 2.5 micron in sizes refer to a PM2.5. And particulate matter encompasses everything.
Q And what is the significance of PM10; particles 10 microns and less in size?
A PM10 and PM2.5 are criteria air pollutants, and that is being regulated internationally, being air quality

standards. In addition to that, I must say there are other very not significant pollutants -- criteria pollutants. We have oxides of sulphur, nitrogen oxides, some volatile organic compounds and also a generator from the mine operations due to fuel that's being used in generators and mine heaters.

Q And are those also criteria pollutants regulated by EPA?

A That is correct; that is correct.

Q Now, there will be heavy metal emissions from this mine; correct?

A That is correct.

Q And can you describe for us the metals that will be emitted from this mine through the air?

A Some of the major would be, as you all know, nickel and copper.

Q Yes.

A In addition to that, MDEQ has done analysis, deposition modeling analysis with numerous other metals like arsenic, cobalt, manganese. And I don't remember all the metals but --

Q Mr. Vel, in reviewing the air permit application and then in conducting your own calculations, did you note any differences in the methodology for the deposition modeling employed by MDEQ as opposed to CRA --

A Yeah. I can tell you major --

Q -- in just -- in summary form?
A Yes; just some major differences. When MDEQ conducted their deposition modeling -- the report was produced in December of 2007 -- they considered two major emission sources. One is vent raise. Another one is crusher building bag house. If you look at the total amount of emission of copper and nickel, that amounts to about 70 percent of the total emissions of these metals. What CRA did, what we did was we added coarse ore bins. There are two coarse ore bins and two final bins, and that resulted in accounting for 97 to 98 percent of the emissions. Now, you may ask why we considered -- MDEQ considered two and we considered six. The reason being, if you considered all the sources that is in the mines that are insignificant sources and try to run a deposition modeling with plume depletion. It may take months of computer time, and you may not get the results. So we wanted to account for most of the emissions, and we used 98 percent as a -- and we considered 70 percent, and we considered 98 percent.
Q How is the difference in the number of sources considered by CRA and Kennecott reflected -- how is that difference reflected in the deposition analysis?
A Because we considered -- these final bins and coarse ore bins, they're volume sources. And since we considered those, the maximum deposition rate that we obtained at the

property and closer to the property is a little higher -- when we did copper, the maximum deposition rate that we obtained through the modeling is 71 -- I might be wrong. I'm just giving a number -- approximately 71.7 for copper and 72.7 for nickel -- milligrams for -- mil squared per year.

Q And that's considering the six sources?

A Six sources.

Q Okay.

A When MDEQ considered two sources -- both are point sources, which as toxin gets emitted. The maximum deposition rate that they got for copper is 1.12 milligrams per square meter per year, and for nickel they got 1.14 milligrams per square meter per year. So the difference on a maximum deposition was in the order of about 64 times just maybe on one receptor or a few receptors. But we always look at the maximum deposition rate and, when you conduct the deposition modeling, that was a difference that we obtained.

And the second issue is the particle size distribution. When Kennecott's consultants conducted their emission calculations for underground mine area, they considered a concept called gravity settling chamber theory. It's a great concept. Gravity settling chamber theory considers -- there are particulate matter that gets emitted from different activities within the mine. Not all of them

gets emitted out through your mine vent raise, which has got about 470,000 3:34:20 * coming out. Some of them, because of a gas velocity, gets lower when -- as it passes through the mine, and it drops because of the gravitation.

When Kennecott conducted their -- Kennecott's consultants conducted their analysis, they used all -- all the particulate matter has a particle size equal to 10 microns in size. What is the issue in this? Particles have sizes ranging below 10 microns, which are lighter size -- lighter particles, and about 49 percent of them consists of particle sizes greater than 10 microns, which are heavier particles. Heavier particles tend to settle much faster than lighter particles so, by considering PM10, certain sources, we have underestimated the emissions -- they have underestimated the emissions in certain sources within the underground mine, and certain other sources they might have overestimated the mines.

As we go through different exhibits, I can show you what other differences -- which sources have underestimated the emissions and which sources they have overestimated their emissions. And that's a second major difference between what we considered. We considered a particle size distribution. Incidentally, you should also remember that MDEQ, when they did the deposition modeling, they considered particle size distribution from the AP-42

for unprocessed ore.

So here is emissions coming out of the mine, but we considered all particles to be equal to 10 microns in size as soon as it goes out. And in the deposition model, we considered a particle size distribution there. So there is a little disconnect there. We fixed that issue in everybody's model.

Q Let me just back you up for a minute. Can you remind us what AP-42 is, please?

A The AP-42 is the USCPA's compilation of the emission factors, and we used -- everybody used first edition.

Q And was that part of the air permit application, AP-42 reference?

A Yes; yes, it is; yes, it is.

Q And was that utilized by CRA in its deposition calculations?

A Yes, it was used by CRA and Kennecott's consultants and MDEQ when they review their application too. And third difference would be silt content in the underground mines. When Kennecott did their calculation, they considered the silt content within the mine to be 1 percent. If you look at appendix C, page 31 of the air permit application, the calculation states that development rock mined ores -- temporary development rock storage -- every one of those rocks have a silt content of 3 percent and -- but that is being referred in the permit application. But when the

calculation was done, 1 percent was used. We fixed that. We thought that is an -- that's an error, and we fixed that issue.

Q And what's significant about the silt content, whether it's 3 percent or 1 percent? Why does that matter?

A When a vehicle travels through unpaved roads, for example, outside -- right? -- I mean, if you have more silt content, more emissions occur; whereas, if you have less silt content, you will have very little emissions that occurs. So depending upon the ratio, here is 1 as to 3. And I'm not --

Q So the higher the silt content, the greater the emissions? Is that -- in essence?

A That's correct; that is correct.

Q Was there any difference in the grid size that you considered in your deposition modeling as opposed to MDEQ and Kennecott?

A Yes. We considered a uniform grid size of 40 kilometers by 40 kilometers, a total size of 1600 square kilometers. And therefore, to capture all the -- all the metals that is emitted gets captured, and so we can estimate -- we can do a type of a mass balance. And also, this is a uniform grid, and MDEQ used a smaller grid.

Q And so what is the end result when you're looking at the final results for the deposition analysis between using a

larger grid versus a smaller grid? I mean, what differences are we talking about in terms of what is depicted?

A When you have a larger grid, we observed that copper and nickel is the only two pollutants that we did the deposition modeling on, and it spreads a lot farther than if you consider -- the constraint of a deposition model is you -- the grid you choose is the one area it's going to depict your concentration. If you choose 10 kilometers by 10 kilometers, that is the area it's going to give you a deposition on. So we considered a larger grid so we can capture these pollutants.

Q And did your deposition model establish pollutants, metals being deposited across the 40-by-40-kilometer grid?

A Yes. There's a high concentration of deposition very close to the property -- mine property, and then, as you move farther, the deposition concentration rapidly decreases.

Q Mr. Vel, you mentioned that you considered six sources for copper and nickel emissions from the mine. Let's just list what those sources were, if we could.

A Mine vent raise, which has got different activities within the mines, so there are drilling, blasting, developmental processing, backfill operations and work processing at two different levels, level 293 and below and 293 and above. And I may have missed one or two.

Q And I didn't mean to interrupt you but, when you say "vent

raised," what -- can you -- what are you talking about?
A The emissions coming from the mining operations from underground.
Q Emissions generated underground coming out through a vent raise?
A Yeah, through --
Q That gets emitted into the air?
A That is correct.
Q And about how tall is the vent raise?
A I hope I remember this. The revised one -- the revised -- based on the response to the comment, I know it is about 65 feet.
Q Okay.
A Yeah. From 40 feet it was raised to 65 feet, I think.
Q So we had the vent raise as one of the sources that you considered?
A That is correct. And the next one is the crusher building bag house.
Q And what is that? What's its function with the mine?
A The ore when it comes in gets crushed in there and -- using grizzlies. And --
Q And what's a grizzly?
A A grizzly is a crushing machine. And that is in an enclosed building, and it has a bag filter, and I think grizzlies have their own bag houses associated with it so -- and we

considered a crusher building bag house and --

Q And the other four sources?

A Those are volume sources. Those are final bins -- two final bins and two coarse ore bins. And that is considered in the permit application as what we considered.

Q And of these six sources, which is the largest source of copper and nickel emissions?

A Miner vent raise -- mine vent raise is the largest source that accounts for 63 percent of the emissions.

Q You mentioned that the vent raise emissions are a combined result of various activities that occur underground; is that correct?

A That is correct.

Q And I think you listed some of those activities before: the mine heaters, blasting; is that right? Is that one of the activities?

A Backfill operations?

Q Backfill operations?

A Right.

Q Vehicle traffic?

A Vehicle traffic, blasting; that is, production blasting; drilling.

Q And development rock processing; is that --

A Development rock processing.

Q Okay. And did you conduct an emissions analysis for each of

these activities?

A Yeah. Kennecott's consultants conducted the emissions analysis, and we made -- we checked all these calculations, and we did the calculations ourselves. So the methodology of calculations, there is no change in the methodology as what CRA did versus what Kennecott's consultants did except for considering the particle size distributions and silt content and vehicle traffic.

Q So the emissions data that you analyzed, was that all taken directly from the Kennecott air application permit?

A That is correct. It is in appendix C.

Q Well, why don't we take a look at some of those activities that we've been discussing related to the underground operations?

A Sure.

MR. STAPLETON: For the record, I've put on the screen Petitioner's Exhibit 77N.

Q Mr. Vel, first of all, did CRA prepare this exhibit?

A Yes, CRA prepared this exhibit.

Q And did you personally verify all of the calculations in this exhibit?

A Yeah, I checked the calculations.

Q And is that true for all of the CRA exhibits today? Did you personally verify all of the calculations?

A Yes.

Q Can you tell us what this exhibit depicts?
A There are four propane heaters, and the loading rate -- the heat input rate is 4 million Btu per hour. And we considered the propane fuel usage, which gives you how many thousand gallons per hour as the maximum usage, and this is the average usage -- in this case both are the same -- and the operating hours, and the emission factors from USCPA is AP-42 and conducted the emission calculations for PM. And we used average long-term emission rate in our deposition modeling calculation, and MDEQ, I think, used the same number too.
Q Mr. Vel, I see over here, there's a short-term calculation and a long-term calculation?
A Right.
Q Can you explain the difference in those calculations and why you use one over the other for deposition modeling?
A In this case a PT is the potential * 3:45:41. This assumes that the heater will be running throughout the entire year, 8,760 hours a year. This (indicating) gives you a worst-case emission rate, and this gives you an average long-term emission rate. That'll be -- if you look at it, that'll be no difference between what Kennecott calculated and CRA calculated for mine heater emissions.
Q And what is the amount of PM emissions in pounds per year resulting from this activity?

A 460 per year from the mine heater. Please note, for all these exhibits that you're -- that we have developed, this is all uncontrolled emissions. We used all these emissions. Then we went to a summary sheet where we considered controlled emissions, which we considered a bag house.

Q Okay. So these are all uncontrolled emissions?

A That is correct. These are all uncontrolled emissions.

Q And was there any difference between your calculations for mine heater emissions and those done by Kennecott's consultant?

A I don't think so. This is exactly probably the same number.

MR. STAPLETON: I'd move to admit Exhibit 77N.

MR. KOHL: Your Honor, rather than voir dire the witness further, I'd like to deal with that on my cross, and then we can deal with admission of these exhibits and closer to my cross.

JUDGE PATTERSON: All right.

Q Mr. Vel, I have put on the screen which -- what is Petitioner's Exhibit 77L, and it's entitled "Drilling Emissions." Can you take us through these calculations, please?

A Yeah. The methodology is the same as what Kennecott has done. We have considered average long-term emission rate, and this calculation is done based on the ore processed and based on the emission factors and number of days per year

that the building operations will occur. And Kennecott used a settling emission factor of 0.43. And when we used a particle-sized distribution, we came up with 0.3. So for drilling emissions, actually the emissions decreased from what Kennecott had calculated. So Kennecott estimated the emissions to be 16 pounds a year, and we came up with 11 pounds a year.

Q And can you describe the basic activity that's occurring that's resulting in these emissions?

A During drilling operations -- drilling operations within the mine occur through track motor drill rigs. And most of the emissions are calculated based on pounds of emissions per ton of ore processed. This is an emission factor that is right out of the AP-42, which Kennecott and -- Kennecott's consultants and CRA used. And this is the total amount -- this is the average amount of ore processed per year, and this estimates the total tons per day, and we calculated it based on applying a settling emission factor. We came up with 11 pounds a year.

Q And as I understand it, CRA utilized a revised settling emission factor for this activity; correct?

A That is correct. When Kennecott used -- Kennecott used an emission settling -- yeah, settling emission factor of 0.43. That is considered all particles to be equal to PM10. And when we considered the revised, it dropped down. It came to

0.3, and that reduced the emission for it by 5 pounds a year.

Q And so you calculated that there would be 11 pounds per year of PM emissions from this activity?

A That is correct, uncontrolled.

Q Uncontrolled?

A Yes.

Q Mr. Vel, I put on the screen what is Petitioner's Exhibit 77H entitled "Level 293 and Above Emissions." Can you describe these calculations for us, please?

A Yeah. The mine -- the mining is going to happen in 10 production levels, and there are different ore-handling activities that happen level 293 and above, and different activities happen 293 and below. At any point of time, there will be activities that you can -- either activities will happen in 293 and above or 293 and below. So you take -- you do the calculation for 293 and above and 293 and below, consider the worst case, and that is what was used in the deposition modeling by MDEQ and dispersion modeling by Kennecott's consultants. This talks about 293 and above. This resulted in maximum emissions. And most of them are handling -- ore handling. And because of the handling, these emissions occur. This is taking the mock ore and loading into -- by the production loaders, load it into the trucks, transfer it. It gets transferred to the central ore

pass grizzly, and it is being pulled into the grizzly, and through the ore pass it is transferred to the production truck. If I remember correctly, it is at level 263. And this is the process through-put, which is the * 3:52:16 9,000 tons of ore is processed, and this is the emission calculations, and that is, a grizzly has a control efficiency because it has a bag house of 9- -- that controls the PM emissions by 90 percent. So that results in -- that resulted in an emission of about 17,800 pounds a year. And again, when we applied it, advised settling emission factor based on particle sized distribution, the emission actually lowered and from 7,653 came down to 5,385. And actually, emissions got lower than what was stated in the permit application.

Q Okay. And that's -- your calculation is 5,385 pounds per year of uncontrolled PM?

A Uncontrolled PM emissions. That's correct.

Q From this particular activity --

A Correct.

Q From this group of activities?

A Right.

Q Let's move to the next underground activity. Mr. Vel, I have put on the screen -- it's a little difficult to read. This is Petitioner's Exhibit 77G entitled "Vehicle Emissions."

MR. STAPLETON: Can we zoom in on that a little bit?

A That's it.

Q Yeah, that's a little better.

A Yeah.

Q Can you describe for us first the activity that is calculated in this exhibit?

A We calculated the vehicle emissions from underground activities, and that involved movement of ore production truck and backfill truck. In the ore production truck, there are two different subgroups. One is a transfer of ore from portal to point A and point A to the access ramp. And considering the -- one of the differences here -- let us talk about the differences. One of the differences here is the silt content that I talked to you about before. The frc between Kennecott's calculation and CRA's calculation is the silt content was considered to be 1 percent in Kennecott's calculation. When we reviewed that permit application -- I think it was page 31 -- it clearly states it is 3 percent ore, so we made the change. And again, because of the particle size distribution, the settling emission factors changed. For example, portal to point A, the settling emission factor was 0.44, calculated by Kennecott's permit application. And I don't -- I can't read that number. It is something like 0.52 when CRA calculated the revised

number. These are the revised number that we calculated.
Q And once again, from where did you obtain the information about the silt content being 3 percent in the mine underground?
A From the air permit application attachment, appendix C.
Q Now, moving over in this exhibit, can you describe what the calculations were for PM emissions from this activity?
A CRA estimated the PM emissions to be 35,637 pounds a year, and the application stated it was 14,933. And just a rule of thumb, if you look at it, it's about three times here. And also, because of the change in the settling emission factor from 0.44 to 0.52 here and 0.3 to 0.59, that is a marginal difference because of settling emission factor. That resulted in the increase of emissions from that permit application to what CRA calculated.
Q Now, is the bulk of the difference between these calculations attributable to the difference in silt content?
A That is correct; that is correct. I don't know what is the percent distribution between silt content and settling emission factor revised value, but bulk of it would be from the silt content.
Q And that would be 35,637 pounds per year of uncontrolled PM emissions --
A That is correct.
Q -- from vehicle traffic underground; is that correct?

A That is correct.
Q All right. Let's move on to the next underground activity here. I have put on the screen Petitioner's Exhibit 77E entitled "Development Rock Processing." Mr. Vel, can you describe this calculation for us, please?
A This is the underground activities due to handling of development rock. Prior to ore extraction, all the rocks from the stopes and other areas needs to be removed to access the hole, and these are all related to handling of these development rock. There are three activities. And when we calculated the settling factor -- only change here you would see is the settling factor. The revised value for PM was 0.3. And I don't think it states here but, when Kennecott calculated it, it was -- 0.03 was the settling emission factor. So the value went up ten times. So the PM emissions calculated by CRA is 1,444 pounds a year. And if you look at the permit application, the PM emissions would be 144.4. And since you have been talking about settling emission factor, this is a easy number to look it up in my settling calculation just to have a sanity check how I did the calculation so I can show that to you.
Q Oh, sure.
A If you can go to --
Q Yeah.
MR. STAPLETON: Let's go to Exhibit 77K.

JUDGE PATTERSON: Which exhibit number?

MR. STAPLETON: 77K.

JUDGE PATTERSON: Thank you.

MR. STAPLETON: Okay. I've put on the screen Petitioner's Exhibit Number 77K.

Q Mr. Vel, for those of us who struggled in math in school, can you maybe explain this exhibit for us?

A Yeah. This gives you the particle size diameter; this (indicating) is ten microns in size; this is lower particle sizes, and here particle size greater than ten microns in size. And we estimated the settling factor, this yen therefore does not refer to settling emission factor. How much particulates gets settled. Let's look at for ten micron in size --

THE WITNESS: Can you move it to the right a little bit, please? Can you move it to the right a little bit more? Yeah. Thank you. Okay. Go down a little bit. Go down to the next -- okay. There you go. That's what I was looking for.

A If you look at ten microns in size here, if you go back to the settling factor for the axis ramp you will see 0.9664, which is 0.97 is the settling factor; which means only three percent of the particulate matter gets emitted from this process just considering PM 10. Okay? But if you look at all the PM 10 particle sized distribution -- if you go

down -- the settling factor here is 0.7 if you consider particle sized distribution. And so 30 percent gets emitted if you consider the particle sized distribution, whereas if you just consider ten microns then only three percent gets emitted. And --

Q And was that the basis of the DEQ using the 0.3 settlement -- settling efficiency --

A No, Kennecott's consultants used that number. DEQ when they did the disportion modeling they considered particle sized distribution. And so overall it is 30 percent gets emitted here and that accounts for the difference of ten times that we talked about in the previous -- in the previous life, which talks about 1,444 pounds a year on development rock processing where it says 144.4 calculated. So it goes both ways. Sometimes emissions goes up because of certain parameters and sometimes it goes down. But everything was calculated based on the -- this type of analysis.

MR. STAPLETON: Okay. Let's go back to the previous exhibit.

(Pause in dialogue)

Q So, Mr. Vel, back again to Exhibit 77-E that you were discussing. Once again, can you just tell us what the PM emissions in pounds per year as calculated by CRA would be from development rock processing?

A 1,444 pounds a year uncontrolled.

Q Okay. And what were the PM emissions in pounds per year calculated by Kennecott's consultant?
A Maybe it's 144 pounds a year.
MR. STAPLETON: All right. Let's move to the next underground activity, which would be 77-Q.
Q I've put on the screen Petitioner's Exhibit 77-Q entitled, "Backfill Operation." Mr. Vel, could you describe this calculation for us, please?
A After completion of the mining in one level then the back -- then that level is backfilled and primary stopes are backfilled with cement and flyash, and the secondary stopes are backfilled with aggregate and lime. And this -- we did an estimation based on the process throughput, the calculation, the emission factors at exactly the same way as Kennecott's consultants did it and this is the PM settling factor of 0.89 and that resulted in a PM emission of 13,408 pounds a year. And I don't have the emissions from the permit application, and this particle size distribution lowered their emissions, so -- from the permit application.
Q CRA calculated lower emissions for this activity?
A Yes. CRA calculated lower emissions for this activity.
Q Because of the particle distribution size factor?
A That is correct.
MR. STAPLETON: All right. Let's go to 77-M.
Q All right. Mr. Vel, let's move to the next underground

activity. I've put on the screen what is Petitioner's Exhibit 77-M entitled, "Blasting PM Emissions." Can you describe the calculations in this exhibit, please?

A This is for the blasting operations that happen within the mine. This is calculated based on how many blasts occur per year times the emission factor how many pounds of PM gets generated per blast, and there is no control efficiency here. And PM emissions are estimated based on -- in pounds per year. And the blasting emissions decreased because of the emission factor -- particle size emission factor because 0.43 to 0.3, and what Kennecott calculated to what CRA calculated. So CRA lowered -- because of the particle size distribution it lowered the emissions.

Q Okay. And that's 502 pounds per year of PM from this activity?

A Yeah, based on this -- I don't remember, but that is very close, yeah.

Q Okay. Let's move to -- now, CRA prepare a summary of the emissions from the underground activities through the vent rays?

A Yes. From all these sources, yes.

Q Okay. Let's take a look at that for a moment. I've put on the screen what is Petitioner's Exhibit 77-O and -- entitled -- is that a typo up there, Mr. Vel; should be "Vent Rays Summary"?

A Yeah, "rays." Yeah; that's right.
Q Okay. Can you describe the numbers in this exhibit for us, please?
A Based on all the previous spreadsheets that you have seen, this gives you emissions from each of these activities. And the total PM 10 emissions from an uncontrolled emission is 6.5 pounds per hour and with a controlled PM emissions we calculated it to be about .86 pounds per hour, which translates to .109 grams per second. And once we calculated the PM emissions we --
Q And I don't mean to interrupt you, but I just want to be clear. Is that the summary of controlled and uncontrolled PM emissions from all of the activities that we just discussed underground?
A That is correct.
Q Okay. All right. I'm sorry. I interrupted you.
A Then once we got the PM 10 emissions in grams per second we used the concentrate -- we used the percentage of copper and nickel that is present -- if you'd go down a little bit more; if you'd just move down a little bit more. Yeah.
Q So of these overall PM emissions coming out of the bent rays, a certain percentage of those emissions will consist of copper and nickel; correct?
A That is correct.
Q Okay. And where did you -- from what information did you

determine the percentage of copper and nickel in these emissions?

A This was taken from page 8-10 of the appendix C of the Air Permit Application. And this is for the whole development flyash and native soil, this was the copper and nickel percentages. And we used that to calculate the actual copper emissions in gram per second, which comes to the -- and then the nickel in grams per second, and the total emitted from the vent rays for copper is about --

Q Can you show us where --

A Yeah, 99.

Q That is PM -- I'm sorry. That is pounds of copper emitted from the mine on an annual basis?

A That's correct.

Q Okay. And is that a controlled number?

A That is a controlled number, yes.

Q Okay. Let me ask you about that. When you say "controlled" and "uncontrolled" and as --

MR. STAPLETON: I think you can scroll up on the exhibit.

Q I think that was one of your -- two of your column headings here. What do you mean by "controlled" and "uncontrolled" emissions from the mine?

A Kennecott proposes to install a filter bag house which has an efficiency of -- a control efficiency of 85 percent. And

this number here --
Q Excuse me. Have you seen any specifications for this bag house, this control that is proposed for the vent rays?
A No.
Q Was it part of the Air Permit Application in some fashion?
A No.
Q Was it mentioned in the Air Permit Application somewhere; is that why you're that making that assumption?
A No, it was mentioned in the response to comments that Kennecott proposes to install a filter bag house, which has a control efficiency of 85 percent. We got that from -- we got that information from that document.
Q So you ran calculations, if I understand it, for PM emissions coming out of the vent rays without the filter and with the filter?
A That is correct.
Q Is that correct?
A That is correct. That would be uncontrolled and this would be controlled emissions, yes.
Q Did you do a -- let's talk about the uncontrolled emissions. Did you do a calculation for the uncontrolled PM emissions coming out of the vent rays in pounds per year?
A I don't have that number here, but the straight conversion, 0.890 grams per second was converted to pounds per year, and that would come to 57,000 -- a little less than 57,000; I

think 56,900 pounds a year.

Q Pounds a year in uncontrolled PM emissions?

A That is correct.

Q And from the PM emissions you take a percentage of those emissions and calculate the copper and the nickel; correct?

A That is correct, based on the concentrations.

Q And how many pounds per year of nickel emissions are coming out of the vent rays?

A Based on this number it's about 101 pounds a year.

Q 101? Okay. Now, once again, that's a controlled emission; correct?

A That is correct.

Q What would the copper and nickel emissions coming from the vent rays be in pounds per year uncontrolled?

MR. KOHL: Objection; irrelevant.

MR. STAPLETON: Well, Judge, I mean --

JUDGE PATTERSON: I'll overrule.

Q You can answer, Mr. Vel.

A Okay. It's a straight -- again, a straight conversion. I would think about -- this is an estimation. I'm converting grams per second to pounds per year, so that would be about, say, 600, 650 pounds a year.

Q Of each -- 650 pounds of copper and 650 pounds of nickel?

A Uncontrolled.

Q Uncontrolled?

A Yes. It would be very close. I didn't do the calculations, but it has to be very close.
Q Now, if you consider the calculations that Kennecott performed for the vent rays emissions in terms of pounds per year of PM coming out of the vent rays, did you do that calculation?
A Yeah, just to check and make sure there was a difference and came up with around 40,000 pounds a year.
Q Of PM per year?
A PM.
Q And that would be uncontrolled?
A Uncontrolled.
Q Now, Mr. Vel, you talked about the vent rays, which is just one source of the copper and nickel emissions that you considered; correct?
A That's correct.
Q And you also took into consideration five other sources in your deposition modeling; is that correct?
A That is correct.
Q Okay. And what was the basis of your calculations for those emissions?
A All the calculations were conducted based on the Air Permit Application, appendix C and for the fine ore and the coarse ore bin you will not see any difference in the emissions between what Kennecott's consultants did and what we did.

And for the crushed ore bin there is no difference in calculation; however, when the MDEQ did their deposition modeling they considered two sources as we talked about. One is of mine vent rays where they considered PM, particulate matter. And for crusher building bag house they considered PM 10. And just to make sure we have everything on the same type of contaminants, so PM 10 on their estimates, the emissions I considered for the deposition modeling the PM emissions and not the PM 10 emissions. So that's the only difference.

Q And was everything else the same in terms of the emissions data that you used for the deposition modeling?

A That is correct.

Q We're trying to get --

MR. STAPLETON: For the record this is Kennecott Exhibit 16, Bates number 101706.

Q And, Mr. Vel, can you -- does this exhibit reference what you were just discussing?

A Yeah, it does refer in the above-ground activities all these different processes relate to either crusher building bag house or fine ore and coarse ore bin.

Q And where is this exhibit taken from?

A Appendix C of the Air Permit Application.

Q And can you indicate in this exhibit the other activities for which you considered emissions in your deposition

modeling?

A For the crusher ore bin this was done by Kennecott in the Air Permit Application and the use just the same. Transfer to -- for the crusher building bag house it is transfer the crusher ore grizzly and then the grizzly and stationary rock breaker and convey the crusher would be for -- those are the four sources that was considered for crusher building bag house. And as you can see, this is an enclosed area and it has a control efficiency of 99 percent; the PM is control 99 percent. And the fine ore and the coarse ore bin I saw transfer operation. Most of them are conveyed to coarse ore bin. And the coarse ore bin emissions and loading trucks would be -- for the coarse ore bin and for the fine ore bin the first two operations transfer of the coarse ore by -- and muck ore and these two operations refer to fine ore bin -- fine ore bin calculations. So we just took exactly the same emissions.

Q So the emissions that are indicated here in PM in pounds per year you would have inputted that data directly from the Air Permit Application into your deposition model?

A No, we would have used -- we would have calculated the crusher building bag house -- we would have added it; that is in pounds per hour. And then what we would have done is we would have converted that into copper and nickel concentrations and then inputted those values into copper

and nickel deposition modeling.

Q Okay. You would have done the conversion into copper and nickel?

A Yeah.

Q But done it based on the emissions from the application?

A That is correct.

Q Mr. Vel, you may have mentioned this before, but what percentage do these six sources that you considered constitute of the total copper and nickel emissions coming from the mine?

A Can you repeat that question?

Q Yeah. Of the six emissions that you considered for your deposition modeling what percentage do these sources constitute of the total copper and nickel emissions from the mine?

A From all these six sources it would constitute about 97 to 98 percent, and from the mine vent rays alone it would be around 63 percent.

Q Okay. Now, did CRA prepare a summary of the total copper and nickel emission rates from the mine?

A Yes.

Q Okay. Let's move to that exhibit, which is 77-D. All right. Mr. Vel, I've put on the screen what is Petitioner's Exhibit 77-D and it's entitled, "Copper and Nickel Emission Rates for March 2008 Deposition Modeling." Can you take us

through what this exhibit summarizes, please?

A There are six sources we considered, the first six sources is what we considered here. And mine ray -- vent rays plus mine heaters, this is the PM emissions in grams per second. If it was a walling source it would be grams per second per meter squared. And this is the copper -- this is the PM emissions and this is the copper percentage, so we would have estimated the copper emission rate in grams per second. This is the number we inputted into the modeling in grams per second and -- for copper. And if you look at it here the first six sources constitute about 98 percent of the emissions.

Q And is that --

A That's right. And for nickel it's the same thing and total for six sources constitute about 97.3 percent.

MR. STAPLETON: Okay. Can we scroll down the exhibit?

Q So, Mr. Vel, can you just describe all of the columns above the bottom line numbers here. Are these all different sources for copper and nickel at the mine?

A That's correct. That's correct. We'll only consider six sources.

Q Okay. And you considered the first six; correct?

A Yeah.

Q Okay. And what did you conclude about the copper and nickel

emissions from the mine from these six sources?

A The total copper emissions from the mine would be 156 pounds a year; that would -- assuming that the mine's operation would be eight years -- mine will be in operation for eight years; that would be 1,250 pounds of copper. And with nickel it's 160 pounds in a year of emissions and that would equate to 12,000- -- 1,276 pounds in eight years. And this is considering six sources.

Q Okay. And these are controlled rates -- I mean, these are controlled emissions? Excuse me.

A That is correct.

Q Okay. Once again, were you able to calculate what the uncontrolled copper and nickel emissions would be from these six sources?

A I would have done it. It would be around 600 pounds, 650 pounds a year maybe. I'm going off my memory right now. I did calculate; I don't have that number with me right now.

Q Okay. Now, once you calculated the total emissions for copper and nickel from these six sources, that data is inputted into the deposition model that you discussed previously?

A Yes. For the all -- for the six sources that we described about we inputted the emission rate in the modeling.

Q Okay. Now, can you describe for us when you did the deposition modeling what are the -- give us a description of

some of the other input data that went into the model in order to form your conclusions.

A We considered for the two sources, mine vent rays and crusher building bag house due to considered stack parameters, stack height, stack diameter, exit velocity, temperature, and for the other sources we would have considered the length and the height of these piles -- sorry -- for the walling sources, which would be coarse ore bin and the fine ore bin. And meteorological data was used like we talked about; it's from Sawyer 2004. And for our *(listening 4:25:39) data we used Green Bay, Wisconsin data. So both were used by MDEQ and the same numbers were used here. And we considered dry and wet deposition and estimated the total deposition. We considered plume depletion and those are the important parameters. We got input data file from MDEQ and we didn't change anything. We first ran the model just to make sure the number, the results of MDEQ matches with what CRA is coming up with. And then we did was we changed the emission rate, added the -- added those four sources in there, changed the emission rates for -- based on our calculation and changed the grid from a smaller grid to encompass 40 kilometer by 40 kilometer, good size, which would be 1600 square kilometers and reran the model.

Q But aside from the emission rates, was all the other input

data the same as used by MDEQ in its deposition modeling?
A That is correct. Except for the grid size and then --
Q Except for the grid size?
A Yeah.
Q So you input all of this data into the model and then does the software digest the data for some period of time? How does that work?
A Yeah, it depends on the size of the project. It may take from few hours to few days, and this could have taken like a day or so to run the model.
Q Okay. And what period of time did the deposition model simulate for the mining area?
A We inputted the data for the year 2004 data, so it would have simulated the total deposition from -- for each grid known for the year 2004.
Q Okay. Now, just in general terms what does the deposition modeling that you performed tell us about the copper and nickel emissions from the mining operation?
A Can you repeat the question, please?
Q Sure. And just generally speaking, what does the deposition modeling that you performed tell us about the copper and nickel emissions in terms of transport and location and that type of thing?
A Both the deposition followed the similar contour patterns of the distribution patterns. Most of the deposition occurred

at the property or very close to the property and -- however, we could see some deposition that happened as far away as close to 35 to 40 kilometers. From the center it would be like 20 kilometers up north and south and you would see in the contours as to how the distribution was. And the maximum deposition rate for copper -- I'm going off my memory -- could be 71.78 milligrams per square meter per year, and for nickel it could be 72.74 milligrams per square meter per year was what we observed as the maximum deposition rate at the property.

Q Okay. Let's take a look at the summary of the copper deposition resulting from your modeling.

MR. STAPLETON: 77-B.

Q Mr. Vel, I'm putting on the screen what is Petitioner's Exhibit 77-B and -- entitled, "Copper Deposition." Can you describe what this exhibit summarizes for us, please?

A We set up a multi-tiered grid, because the area is too large. We set up a final grid with a spacing of 50 meters for an area of up to 2500 meters from the center, and a medium grid of 200 meters in size for up to 40,000 square meters, and a coarse rate of a thousand meters spacing for up to a million square meters and very coarse for four million square meters. And we wanted to estimate the total copper deposition. We know what is coming out of the mine; we wanted to make sure we have captured everything. So we

took -- there are 2,098 grid points; you are seeing only part of it. We went to each and every one of these grid points, found out what the area is and -- and if you go to the right a little bit -- we estimated how many pines and based on the concentration that we observed we calculated the deposition at that grid. We added everything -- we are only soliciting a snapshot here. We added everything and we came up with 155.3 pounds of copper a year. And as you may recall, it's very close to what was emitted from the mine.

Q Okay. So did your deposition model account for nearly all of the copper --

A Very close.

Q -- emitted from the mine?

A Very close, yeah.

Q And once again, this is assuming a controlled emission?

A That is correct.

Q Okay. Now, did CRA also run the deposition model using only the two sources for copper and nickel employed by MDEQ?

A Yes, we did.

Q And I put on the screen what is Petitioner's Exhibit 77-A entitled, "Copper Deposition" again. And can you describe this exhibit for us, Mr. Vel?

A This is not exactly the same as what MDEQ did. What we did was we used the same 40-kilometer by 40-kilometer grid to capture all the copper emissions coming out of the mine and

we went through the same exercise that we talked about. If you look at it here, the maximum copper deposition rate -- let's talk about in milligrams. It's about 8.25 milligrams per square meter. And when we did the calculation --

THE WITNESS: If you'd go down; scroll down a little bit, please. Can you move to the right? Thank you.

A -- we came up with a number of 105.7 pounds a year.

Q And this is using just the two sources used by MDEQ?

A That is correct.

Q And what's the approximate difference in annual deposition of copper between using two sources and using the six sources that CRA did?

A I would say about between 45 to 48 pounds.

Q Pounds of copper per year?

A Yeah; that's right.

Q Now, you also ran the deposition model for nickel as well; correct?

A That's correct.

Q Okay. Let's take a look at the nickel deposition summary. I'm putting on the screen, Mr. Vel, Petitioner's Exhibit 77-C entitled, "Nickel Deposition." Can you describe what this exhibit depicts for us, please?

A We are trying to -- for the six nickel sources we are trying to calculate what is the total deposition. Same methodology as we used for copper. Went through each and every grid

point, try to find out what's the total deposition and we come up with a pretty close number to nickel also; about 157.5 pounds a year.

Q And that's 157.5 pounds of nickel per year deposited?

A Controlled, yes.

Q Uncontrolled?

A No, this is controlled.

Q I'm sorry. Controlled?

A Yeah.

Q And how would this compare to the nickel deposited over a year if you only used the two sources that MDEQ did in its modeling?

A The difference would be very similar, about 45 pounds. That accounts for those other sources, fine ore bins and coarse ore bins.

Q Now, the deposition modeling in addition to predicting the pounds per year of pollutant that would be deposited also predicts the area over which that -- those pollutants will be deposited; correct?

A That is correct.

Q Okay. Let's look at a summary of that data. I'm putting on the screen what is Petitioner's Exhibit 78-C.

MR. STAPLETON: And, Counsel, for the record, this is an enhanced version of what you were provided, because we actually --

MR. KOHL: It's legible now. It's legible now.

MR. STAPLETON: We actually couldn't read it very well before, but it's the same -- it's the same exhibit with the same data.

Q Can you describe Exhibit 78-C for us, please, Mr. Vel?

A Yes. This is a zoomed in version of the modeling. This doesn't depict the entire deposition modeling area that we considered. And just we wanted to show where we got our maximum deposition rate for copper and the number is -- let's talk in terms of milligrams because that would be a little easier. It's 71.76 milligrams per square meter for the year of copper. And this is the area of the maximum deposition rate and this is the grid point that we observed that.

Q Okay. And where is -- is the mining area depicted on this exhibit?

A Yeah. This is mine area and you can see this is generator plant. I think this is a lab essay and if you scale it up it will be about hundred meters north of this building here.

Q How many meters?

A About hundred meters.

Q And roughly what size area does this exhibit depict?

A Probably about one kilometer by one kilometer.

Q Okay. It's a small --

A Very small.

Q It's a small part of the --
A I am just guessing here. I shouldn't, but --
Q Okay. And can you just -- you mentioned the maximum deposition rate there. And just for clarification, can you once again describe for us what "maximum deposition rate" means?
A We establish a grid and the deposition -- the model tries to predict the maximum rate of deposition of copper at every grid point here, and these are the numbers. And out of all these grid points that were chosen for this modeling analysis, which we have 2,098 points on a grid area, and this is the maximum that we observed very close. And the reason you're observing very close is because of the ore bins that were considered, and so it is -- it doesn't have a * listening 4:39:08) foreign pack; it has got it nearly packed because of the height.
Q Okay. And what would the maximum deposition rate for copper be considering only the two sources used by MDEQ?
A If you considered just the two sources used by MDEQ you'd have gotten a maximum number of 1.14 milligrams per square meter per year of copper. I don't have the deposition map of MDEQ with me, but based on the output file that we got that's the number.
Q And, Mr. Vel, there's -- this exhibit is full of lots of little numbers?

A Right.
Q And can you just once again explain what each of those numbers represents?
A Each of them represents the deposition of copper -- how much copper gets deposited at each of these noted points. This is a prediction; the deposition model is a prediction. It predicts how much copper gets deposited at each of these grid points in one square meter of an area in one year. And for example, this (indicating) one would be 71 milligrams of copper gets deposited in one square meter in a year. For the year we considered as a mid data, which would be 2004.
Q Okay. Let's take a look at the summary for nickel deposition. I've put on the screen, Mr. Vel, what is Petitioner's Exhibit 77-C -- I'm sorry -- 78-B and can you describe this exhibit for us, please?
A This is very similar to copper and you can see the maximum deposition at this -- of this area, which would be 77.27 milligrams per square meter for the year for nickel. And this also located very -- at a very -- approximately to where we found the copper exceedence -- copper deposition -- maximum deposition rate.
Q Okay. And once again, what would the maximum deposition rate for nickel be using only the two sources used by MDEQ?
A It would be -- this is again based on the deposition impact -- Kennecott deposition impact analysis dated

December of 2000 reported by MDEQ. It will be 1.14 milligrams per square meter per year. And it will not be in the same location. I do not have the location. And this is based on the deposition modeling considering all the six sources.

Q And what is CRA's maximum deposition rate in milligrams?

A It would be 72.74 milligrams.

Q Now, did your deposition model for copper and nickel generate a map showing the deposition of the pollutants across the area?

A Based on these deposition contours we developed -- based on the deposition rates here we developed a contour, yes.

Q Okay. Let's take a look at the first deposition map. Mr. Vel, I've put on the screen what is Petitioner's Exhibit 81 and can you describe for us what this map depicts? And actually, it's --

A This is the copper deposition. This is a zoomed in version of the deposition contours and the yellow line depicts the deposition contours. And red line here (indicating) depicts the mine property. There's the orebody. And as you can see, most of the concentrations are located within the -- very close proximity to the mine. And you can see the extent it is spreading out.

Q Can you give us a sense of the size of the area covered by this particular map?

A It's about five kilometers in length and five kilometers in height; close to that.
Q Okay. And just once again, each of these yellow lines is representative of a concentration of copper?
A That's right.
Q On the ground?
A Yeah, this is -- there's two milligrams per square meter for the area. This is the contour that is -- that depicts that. And you can see the density very close inside and as you go out you can see the contours, different contours.
Q Now, Mr. Vel, is this the concentration that would occur over a one-year period of time?
A That's correct.
Q Okay. So over a ten-year period of time these concentrations would accumulate; correct?

MR. KOHL: Objection; lack of foundation with this witness.

MR. STAPLETON: Well, Judge, I mean Mr. Vel is -- you know, he's testified that he has conducted deposition modeling for 50 or 60 different air permits and that it typically lasts -- the typical period is a year. And he's done this modeling for many different projects, many different substances. And I simply think he's qualified to be able to tell us that -- answer the question as to whether these substances would accumulate over a period of time

based on the deposition model.

MR. KOHL: Your Honor, the grounds for my objection -- I have no problem with him testifying as to what his deposition models would say deposited over a given location over a period of time, but deposited and whether or not that deposition becomes cumulative in soils or whatever involves environmental fate of the metals after their deposited. I don't think he's -- there's any foundation here that he's competent to testify with regard to fate of metals and soils in Northern Michigan.

JUDGE PATTERSON: In other words, your problem is there may not be times this failure with the conclusion of a ten-year period due to --

MR. KOHL: Exactly. I mean, you know, fine. If he wants to testify that .25 milligrams per square meter is modeled to deposit a location and if you multiply that by eight we can all do that math too.

JUDGE PATTERSON: Maybe you can.

MR. KOHL: I can't, but to say that that means anything with regard to what's in the soils eight years later or ten years later or 25 years later -- which is what I think this question does or at least sounds like it -- is different subject matter and he's not qualified to testify to that.

MR. STAPLETON: Your Honor, we can connect -- we

can connect it up later with other witnesses. I'll ask a different question.

JUDGE PATTERSON: All right.

Q So, Mr. Vel, the concentrations depicted on the map are over a one-year period of time; correct?

A That is correct.

Q And for each year you ran the deposition model would indicate an additional accumulation of this concentration?

MR. KOHL: Same objection.

Q Or it would depict a -- the concentration on a map like this for year two; correct?

MR. KOHL: I don't have any objection to that question.

JUDGE PATTERSON: Finally.

A If you take two-year period -- I'm not an expert in soils, but if you look at two-year period it's going to give you a cumulative effect over -- you average over two-year period and -- but still the concentrations that I would be getting out of this model would be how many grams per meter square per year. You could run ten different years and you can find out how the cumulative effect is going to be. But from the modeling standpoint it would be based on how many years you are going to put in there. It's going to give you the effect of that.

Q But this amount depicted in the map here would be deposited

each year under your model?
A This is limited to one year; that would be based on the net conditions for the year 2004.
Q Okay. Let's move to a larger area for copper deposition. While that's loading, Mr. Vel, did CRA prepare another map for copper deposition which depicted a larger area than what we were looking at?
A yeah, we did one for the 40-kilometer by 40-kilometer grid size that we are -- that we modeled for.
Q Okay. I've put on the screen, which is now finally loaded, Petitioner's Exhibit Number 83. And can you describe what is depicted by this map?
A The pink --
Q yeah, starting with the big red square there.
A The square; this square represents the grid that's CRA used and the green -- this area is the grid that MDEQ used for the deposition modeling. And the yellow lines here (indicating) depict the distribution -- deposition of copper across the study area. And this you can see it very closely that are very closely concentrated contours here and as you move farther. And I don't know what the number is here, but I can do it.
Q What is the size in square miles depicted by the red square?
A It's 1600 square kilometers and I don't know what the conversion is. 1600 square kilometers to mine could be 620,

630 miles; very close to that.
Q Okay. And are you familiar generally with the location of the Huron Mountain Club?
A It's in here (indicating).
Q Okay. And did your deposition model establish copper deposition over the lands of the Huron Mountain Club?
A Yes; that was the reason we went with the larger grid, to cover Huron Mountain Club.
Q Okay. And does your deposition model establish copper deposition over those entire lands?
A Yes. Yes.
Q And once again, these are the concentration contours for copper for one year; correct?
A Yeah, these are the deposition contours for one year. Yes.
Q Let's take a look at the nickel deposition. And did CRA also prepare deposition maps for nickel?
A Yes, we did.
Q Once again, Mr. Vel, while it's loading, did CRA prepare maps of the same proportion that we were looking at for nickel as it did for copper?
A Yes, we did.
Q Okay. There was a five-kilometer map and then a 40-kilometer map?
A That's right.
Q Okay. All right. We finally have -- let's see -- Exhibit

Number -- Petitioner's Exhibit Number 86. And can you describe for us what's depicted on this map?

A Similar to copper, this is the mine property and these yellow lines depict nickel deposition contours. And this is more concentrated at property boundary and very close to the property boundary or in the vicinity of the property boundary. And this shows the extent of five kilometers. And these numbers here represents the deposition in terms of milligrams per square meter per year.

Q Okay. What is the red circle -- the square there?

A This (indicating) one?

Q Yes. Do you know what that --

A That's the mine orebody.

Q That's the mine orebody. Okay. All right. Let's look -- let's take a look at the larger nickel deposition map and that -- once again, this next map will depict a 40-kilometer by 40-kilometer area; is that correct?

A That is correct.

Q Okay. We've put on the screen what is Petitioner's Exhibit 84 and this is very similar to the copper deposition map we were looking at. Once again, Mr. Vel, can you describe what's depicted in this map?

A This is similar to what we saw in the copper. This shows CRA's grid area and this is MDEQ's grid size here (indicating). And these yellow lines here represents the

nickel deposition contour maps that was generated and you can see the extent of the contours. This is an extension of the concentration -- deposition concentration and grid that we put in and left the contour for it. And you can see this concentrated close to the property and then you can see concentration -- deposition contours extending here.

Q And once again, Mr. Vel, where is the Huron Mountain Club depicted on this map?

A Somewhere in here (indicate'). I don't have it marked here.

Q Okay. And did your deposition modeling establish the deposition of nickel across the lands of the Huron Mountain Club?

A Yes.

Q Now, Mr. Vel, you indicated that as part of the materials that you reviewed in this case included the deposition analysis performed by Kennecott -- or MDEQ actually performed it; is that correct?

A Yes. I reviewed that report, yes.

Q Okay. And that was a report December 14, 2007?

A Yes.

Q Mr. Vel, can you -- first of all, before we talk about the analysis, did you review the input and output data for this analysis?

A Whatever input and output files that was provided by MDEQ we did review it.

Q Okay. And can you describe the methodology employed by MDEQ in their deposition modeling?
A MDEQ considered a worst-case scenario of ten years that the mine is going to be in operation. They considered two sources that we talked about: mine vent rays and crusher building bag house. And they used different approach, but the results between CRA and them would be the same. They considered a unit emission rate for these two sources and finally the results were multiplied, the results were prorated for different metals here. And CRA only conducted deposition model for copper and nickel and MDEQ did sulfide, arsenic, cobalt, manganese, in addition to copper and nickel.
Q And what is depicted in Table 1?
A This provides the emission rates in grams per second. This is the particulate matter emission rate and that has been prorated based on the concentrations of each of these compounds here. And here you can see that the particulate matter MDEQ used total suspended particulate for mine vent rays and PM 10 for crusher building bag house.
Q Okay. And Table 2; what's depicted in Table 2?
A These are the emission rate of sulfur dioxide. Sulfur dioxide emissions come out of the mine vent rays and mine heaters and generators -- there are two generators: generator 1 and 3. And this gives the emission rate of the

SO2 in grams per second.

Q In what form does the sulfur come out of the vent rays?

A I haven't done the modeling but I can -- based on the report I can tell you that it comes in particle phases and also the asheous phase.

Q Okay.

JUDGE PATTERSON: It's 5:00 o'clock. I don't think we're going to conclude today with this witness. Is that a fair assumption?

MR. STAPLETON: Yes, Judge. I think that's a fair assumption. I mean, I've probably got another maybe 15 minutes.

JUDGE PATTERSON: Cross?

MR. KOHL: Oh, yeah, we'll have cross.

JUDGE PATTERSON: Okay. Let's continue tomorrow.

MR. STAPLETON: Okay.

JUDGE PATTERSON: 8:30?

(Hearing adjourned at 5:01 p.m.)

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