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. XXVII (27)

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Monday, June 16, 2008, 8:30 a.m.

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Lansing, Michigan

Monday, June 16, 2008 - 8:34 a.m.

JUDGE PATTERSON: Okay.

MR. PREDKO: Kennecott calls Dr. Donald Tilton.

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

DR. TILTON: I do.

DONALD TILTON, PH.D.

having been called by the Intervenor and sworn:

DIRECT EXAMINATION

BY MR. PREDKO:

Q Dr. Tilton, could you state your full name and spell your last name for the record?

A My name is Donald L. Tilton, T-i-l-t-o-n.

Q And where are you employed?

A Currently I'm the vice president at a consulting firm called Environmental Consulting and Technology.

Q And what's your position there?

A I'm the vice president.

Q And what are you roles as vice president?

A Well, my major primary emphasis is in the ecology and design group. And in that capacity, I oversee all of the natural resources work that's done in the Midwest. We have an office in Florida as well. And by natural resource work, I mean everything from threatened and endangered species

surveys, wetland delineations, we do a lot of water resource-related work, we do wetland mitigation, wetland restoration. We work quite a bit for the utility industry as well as other private-sector clients that have, in the course of their day-to-day activities, reason to manage natural resources.

Q And do you work with evaluation of impacts on wetlands?

A Yes, not just wetlands but also threatened and endangered species. We're called upon by both private sector clients to evaluate projects as well as public sector clients to take a look at projects that are being proposed within their jurisdictions to evaluate impacts.

Q I'd like to talk a little bit about your education. Can you tell us about your formal education?

A I received a bachelor of arts in biology from Ithaca College in 1970. And then I received a Ph.D. in botany from the University of Minnesota in 1975. My graduate work focused on wetlands, wetland -- in particular, the influence of wetland hydrology and wetland nutrient condition on the growth of a species of wetland tree called the tamarack or Larix laricina, its Latin name. And after that, I then came to the University of Michigan where I studied the use of wetlands for wastewater treatment.

Q Do you have any certifications?

A Yes. I've been certified as a professional wetland

scientist by the Society of Wetland Scientists.

Q Do you have any publications relating to wetlands?

A Yes. I've published in several journals; Canadian Journal of Botany, The British Journal of Ecology, American Midland Naturalist. I've also served as an assistant editor for The Journal of Wetlands, which is the scientific journal for the Society of Wetland Scientists.

Q Any other affiliations that are related to the type of work that you've done on this project?

A Well, I think besides the affiliation with the Society of Wetland Scientists, the other relevant one if the Society of Ecological Restoration. I've been a member of that. That is an area that I've spent quite a bit of time working on including teaching a course at the University of Michigan and researching and reading what other people are doing and just trying to stay ahead of that -- stay involved in that.

Q And I didn't ask you. How long have you been with Environmental Consulting and Technology?

A Well, only four years. I joined them -- they actually bought the consulting firm that I was running about four years ago.

Q And can you tell us about that consulting firm and prior employment history as it relates to wetlands?

A Okay. Well, basically we could start in 1979. After I left the University of Michigan having studied the use of

wetlands for wastewater treatment, as I mentioned earlier, I then joined a consulting firm -- actually an architecture and engineering firm, and I was employed in their environmental research division. And what we did basically was prepare environmental impact assessments or whatever environmental study was required as part of their projects, everything from the -- a cemetery here in Battle Creek to the expansion of the CIA headquarters in Washington.

In 1996, I guess, I left that firm to create my own consulting firm, which is a much smaller firm that specialized really in wetland delineation, wetland management and watershed protection, and worked in that firm for about eight to ten years. And that was then -- somewhere in 2004 or something, 2005, maybe, I sold that firm to ECT, which is where I'm employed.

Q And where is ECT located?

A Well, we have five offices in Michigan. I'm based in the Ann Arbor office, but we have offices in Traverse City, Lansing, Benton Harbor, Detroit, Clinton Township. They're sort of scattered around. The headquarters is in Florida where they do the same sort of environmental-related work, a lot of ecology. They also do -- in Florida they do a lot of air quality work.

Q And do you also live in Michigan?

A I do live in Michigan. I live in Ann Arbor.

Q How many years have you specialized in the study of wetlands?
A Well, including my Ph.D. work, I've been involved since 1970.
Q And how long have you been studying Michigan wetlands?
A Well, since 1975 when I started the work in Houghton Lake studying the use of a wetland for wastewater treatment.
Q Now, Dr. Tilton, you were here when a witness testified for Petitioners by the name of Dr. Paul Adamus?
A Yes.
Q And Dr. Adamus said that his work in Michigan was somewhat limited. What percentage of your work over the last 33 years has related to the study of Michigan wetlands?
A Well, I'd say about 98 percent of it has been focused on Michigan wetlands.
Q Can you give us some examples of studies or projects in Michigan that you have worked on?
A I'll try to be brief. But I think one of the best examples was in 1979 I was asked by the DNR at that time before the DNR and DEQ split to do a literature survey of the ecology and values of Michigan coastal wetlands. And this was a document that was basically a literature review that drew upon my experience and the experience of others. And it was used to help justify the Goemaere Anderson Wetland Protection Act. Some of the cases that are most notable, I

guess, is I worked with the Department of Justice on the Bayside Riverview case as an expert witness for them on the takings phase of that case. I've also worked with various open mine cases; Tilden Mine in the U.P. when it was asked -- when it went for a permit to expand, I did the wetland work and all of the wetland mitigation work for that. I also have worked in quarries in southeast Michigan, limestone quarries as well as silica quarries, not so much on the quarry itself but the impact of the open pit quarry on wetlands and streams adjacent to it. And then at Michigan Silica, I was asked to prepare where the wetlands and open water systems could be reconstructed as part of the mine reclamation effort.

Q Are there any projects that are of note where you have evaluated the effects of groundwater drawdown on wetlands?

A Yes. That comes into -- that has come into play in the past when I've been involved in mining. But I'm also currently monitoring the wetlands at the Nestle water -- the bottled water facility near Stanwood. So I'm engaged in this area quite a bit. I'm also -- when I do wetland restoration work, that almost always involves the fact that, during the agricultural drainage period, the hydrology was altered and the wetlands were drained. And part of that restoration effort is to restore those wetlands.

Q Now, during your work as a consultant, have you ever been

qualified as an expert in other court proceedings?
A Yes, I have.
Q State and federal court?
A Yes, both state and federal court. I've also been asked to serve as a special master on two occasions in cases in the Oakland County area.
Q Now, Dr. Adamus when he was here said that he works almost exclusively for public interest groups and government agencies rather than private industry. Can you give the court some idea of the breakdown of your work and your clientele?
Q Well, I'd say over the years it's probably 50/50. I've served as the wetland consultant for a township -- West Bloomfield Township that had its own local wetland protection ordinance. But I also served as the wetland consultant to Detroit Metropolitan Airport when they expanded their airport several years ago and needed to fill wetlands that were in the path of the runway. So I've had experience advocating for both types of clients.
Q I'd like to talk about the types of materials that you have reviewed in connection with this project. Have you reviewed the mine permit application in this project?
A Yes, I did.
Q Did you review the environmental impact assessment?
A Yes, especially the areas that relate to hydrology and soils

and the wildlife section.
Q The wetland delineation report?
A The wetland delineation report prepared by Wetland Coastal Resources, yes.
Q Now, did you review the mine permit itself?
A Yes, I did.
Q Have you reviewed reports on threatened and endangered species?
A Yes.
Q Particularly reports related to the narrow leaf gentian?
A Yes, I have.
Q And have you reviewed the GeoTrans hydrology report?
A Yes.
Q Have I missed anything else of note that you reviewed?
A Well, the only thing that I would add to that list is some of the literature and published articles on topics related to the narrow leaf gentian, for instance, and also some texts on forest hydrology especially as it relates to forested wetlands.
Q I'd next like to talk about your specific involvement with the project. When did you become involved?
A We became involved in the fall of 2005.
Q And what were you retained to do?
A We were retained to investigate wetlands, wetland ecology, wetland hydrology and to work on the environmental

assessment. The first task we were given was basically what we call a baseline summary where we take a look at the existing work and the existing available information and summarize that.

Q And part of that existing information was the reports that are in the environmental impact assessment?

A Yes, including the Wetland Coastal Resources wetland delineation report.

Q And can you tell me about just in general the kinds of site-specific studies that you did?

A Well, after we had reviewed the existing information, we conducted a field visit in October of 2005. And myself and Dr. John Freeland, we went on the property. We met with the engineering team, the other people who were working on the project including the hydrologist. And then we went to the field and were interested in accomplishing a couple of things. First we wanted to get a feel for the ecology of the wetlands that were on the property, their vegetation, soils and hydrology. We also wanted to review the work done by Wetland Coastal Resources to make sure it was accurate and that it accurately reflected the wetlands that we were going to be concentrating on.

Q Okay. And did you do that work?

A Yes, we did.

Q And based upon your review of materials and the

site-specific studies that you and your team did at the site, have you formed conclusions in this case?

A Yes, I have.

Q And have you prepared some demonstrative slides for us to view today?

A Yes.

MR. PREDKO: And we put up on the screen here -- this is Intervenor's proposed 647, this whole group of slides, your Honor. And I put one on the desk for you, too, for your review and have passed these out to counsel.

Q Now, Dr. Tilton, could you tell us what we are viewing on slide 1?

A Well, slide 1 is basically sort of a four-point summary of work that we did and the results that we found, the physical setting of the wetlands. So, for instance, point number one is that the wetlands are contiguous with each other, but they're also upslope so that some of the wetlands furthest away from the river are actually 12 feet higher in elevation than the Salmon Trout River itself, which is -- it's important to understand that so that we -- because later on we're going to be talking about the hydrology. The other thing is that the wetlands over the orebody and in the vicinity of the orebody are mostly forested and scrub shrub. And forested and scrub shrub wetlands in terms of their vegetation are tolerant of water level fluctuations, more

tolerant than, let's say, a wetland dominated by obligate wetland plants. The wetlands over the orebody have a soil profile of 3 to 13 inches or organic matter underlain by silty clay. That's important, because these wetlands are not sort of the classic image that people have of wetlands in the U.P. with the deep peat deposit. These only have a shallow organic matter area, and they've got some sand and gravel in them which is a little unusual for wetlands in the U.P. The key, though, is that there is a silty clay later that underlies the surface and controls and influence the hydrology of these wetlands. And then finally what we observed was that the wetland hydrology is dominated by -- or influenced by precipitation and surface runoff, shallow groundwater and deep groundwater. And we observed this walking around on the site. We could actually see water flowing across some areas down to the Salmon Trout River.

Q Now, based upon the field work and your expertise in wetlands, did you then form conclusions about the project?

A Yes, we did.

Q And if we go to slide 2, can you explain your conclusions?

A There are three primary ones. The first is that there are some wetlands on the site that are -- their hydrology is dominated by precipitation. That's the source of their water. That's -- the water level fluctuation is influenced by the precipitation patterns. As a result, those wetlands

are going to be adversely impacted by any groundwater drawdown, because they don't receive a significant input of water as a result of groundwater. The second set of wetlands are those wetlands along the river. And they also receive hardly any in the way of groundwater inputs. They're really dependent on water associated in the river. And they're not going to be impacted by any kind of groundwater drawdown. And then the final group of wetlands is that there's a group that is dependent on groundwater but they receive so much additional precipitation and surplus runoff that, in our view and during our studies, we don't believe that drawdown -- projected drawdown of the groundwater due to mining dewatering is going to influence the surface hydrology of these wetlands either.

MR. PREDKO: Move to the next slide.

A The other two are that the narrow-leaved gentian, which is a threatened and endangered species on the site, is a threatened species, but it's very common in this region of the U.P., mainly Marquette County and Baraga County, and that, during the study of the distribution of narrow-leaved gentian, it's tolerant of a wide range of moisture conditions. So any kind of influence of change in hydrology where those populations are, they're tolerant. Because when they did the studies of the distribution of narrow-leaved gentian, we found it growing in wetlands such as the ones

over near the mining operation as well as sand and gravel sites. So it's got a fairly wide tolerance of hydrology.

And then finally the last conclusion is that the mining permit as issued by the DEQ will protect the wetland ecology and the populations of narrow-leaved gentians through the monitoring and the measurements that we've required to do that the mining company is required to implement during the period of mining.

Q And now I'd like to get into a little bit more detail about the bases for your conclusions. And we'll talk about also your field studies and get into detail about how those were done. But before we do that, just a little bit of background on wetlands in general. How does Michigan define a wetland?

A Well, wetlands are defined in Michigan through their state statute using wetland vegetation, soils and hydrology. And the first test is to make sure that the wetland -- that the area that you're investigating is predominantly wetland vegetation. It doesn't have to be completely wetland vegetation. There could be scattered upland species mixed in. But it has to be predominantly wetland.

Then the DEQ and the state statute as administered by the DEQ requires you to demonstrate one of the following two categories, first that the wetland is either inundated or saturated within 12 inches of the surface for like 15

days during the growing season. If it's not -- if it's inundated or saturated within the surface, by definition that's a wetland under state statute. If it's not inundated or saturated, you're then required to look at the soils. Because obviously if you go out and do a delineation sometime in July, you may not see those hydrologic indicators. But if the soils have certain characteristics that make them a hydric soil then, even though there's no evidence of hydrology at the time, the presence of wetland vegetation and hydric soil is sufficient to define a wetland under state stature.

Q And do wetlands have functions and values?

A Yes, they do.

Q Can you tell us about functions and values in general of wetlands?

A Certainly. Well, I think they're grouped into sort of like four categories of functions or values. The first is habitat, habitat for both fish and wildlife. There are certain species of wildlife that rely on wetlands in order to complete their life cycle and, as a result, that's perhaps one of the best recognized or known, their value as fish and wildlife habitat. They also have a significant function in terms of the hydrologic cycle in that they -- these wetland areas provide storage during precipitation events and flood events. They also in certain wetland

systems recharge the groundwater and, as a result, influence the hydrologic cycle and the hydrologic balance in a particular region.

They're also recognized in terms of their what we call water quality benefits. But it's basically a biogeochemical function in that certain processes occur in a wetland that change the chemistry of water as it flows through the wetland. And it's recognized now that that can be everything from sedimentation just the fact that, as a sild-laden water hits a wetland and passes through it, the silt is filtered, but it's also being recognized as a special environment that removes organic pollutants that can be in groundwater. And this is being documented now at more and more sites that, as groundwater is flowing through the ground with a contaminant in it, when it hits a wetland as it comes up into a stream, there are biogeochemical processes that occur in the wetland that remove those contaminants. So there's sort of a growing understanding of their value in terms of biogeochemistry.

And then the last sort of general category is the aesthetic element. More and more people sort of are beginning to enjoy the aesthetics and recreation of wetland areas whether it's for hunting or photography or just general relaxation and recreation.

Q Now, are there factors that determine what functions and

values a particular wetland has?

A Yes, there are. After there's lots of work on this. But the primary drivers are hydrology, vegetation in wetlands and then what we call the nutrient regime. So depending on whether wetlands are nutrient poor or nutrient rich, they influence the vegetation patterns as well as the functions and values of the various -- that I just went through, the various functions. But hydrology and vegetation -- and there's sort of a chicken and egg discussion going on when we get together to talk about this. Those are the driving parameters that influence the functions that wetlands provide.

Q Now, getting to your involvement with this project, you had mentioned that, when you became involved with the project, a wetland delineation had already been done?

A Yes.

Q And it was the wetland delineation done by Wetland Coastal Resources?

A Yes.

MR. DYKEMA: Excuse me, Chris. Your Honor, before we get into Dr. Tilton's testifying to the bases for his opinions, may I be indulged to voir dire?

JUDGE PATTERSON: Sure.

VOIR DIRE EXAMINATION

BY MR. DYKEMA:

Q Dr. Tilton, I believe you said that you reviewed existing wetland delineation work and other materials that had been prepared for Kennecott prior to your involvement; is that correct?
A Yes.
Q Have you yourself or has your firm under your direction authored any reports on the wetlands in the area of the mine site?
A We have. We prepared a report that was included in the environmental assessment on the wetland functions, their characteristics, vegetation, hydrology and so on.
Q Can you identify the section of the environmental -- that's Kennecott's environmental impact assessment?
A Yes. I'll hazard a guess that it's section 3. But I can't give you the exact number.
Q Okay. So in the environmental impact assessment, sort of the overview document, there is a section that discusses the wetlands questions and some of the underlying materials, and that is what you or your firm authored?
A Yes; that's correct.
Q And is that the summary document that you referred to when Mr. Predko was asking about your initial involvement in the case?
A Well, I think what Mr. Predko was asking me was what information did I review prior to preparing the segment for

the environmental assessment that was based on the information we reviewed plus our own field work.

MR. DYKEMA: Thank you for indulging me, your Honor. Thank you, Chris.

DIRECT EXAMINATION

BY MR. PREDKO: (continued)

Q Dr. Tilton, we were talking about the wetland delineation work that had already been done when you became involved on the project and specifically referred to Wetland Coastal Resources' 2004 wetland delineation report. Now, did you review that report?

A Yes, I did.

Q And have you relied on that report?

A Well, we have.

Q And just in general, what methods were used to delineate wetlands by Wetland Coastal Resources?

A Well, they followed the state method. They inventoried wetland vegetation, the plant species that occurred in the wetlands. And they made notes of that. They then also made notes of the soil and they made notes of the hydrology. Then they went out and flagged those -- what we call flagging the edge of the wetland. Once you determine where the boundary is between the wetland and the upland, you hang a flag of various colors. Everybody uses a different color depending on what the firm is. And some of us use a flag

called a wetland -- it says "wetland boundary" right on it. And then they generated a report that recorded all of that information.

Q And is that procedure a standard procedure amongst wetland experts?

A Yes, it is.

Q And as part of that report, they did a map of the wetlands?

A Yes.

Q And I've put up on the screen here what is Figure 3.4 to the Wetland Coastal delineation report. And are you familiar with this wetland map?

A Yes, I am.

Q And, Dr. Tilton, in connection with your site-specific studies, did you independently confirm results that Wetland Coastal found?

A Yes, we did. And in particular where we confirmed it was in this area right in through here (indicating). We didn't get an opportunity to visit wetlands in this area. But this is the spot that we concentrated on from this county road south to about here. So we looked at these particular wetlands and looked to confirm in particular the wetland boundaries that are right here to make sure that that, in fact, is upland and this is upland and that this work was done correctly throughout this area.

Q And when you say "right here," for the record, can you

identify those wetland areas by the numbers that are on this map?

A Yes. It's basically north of the number 6 and north of the orebody and a little bit west between the numbers 8 and 9 and the orebody and the number 6. So it's this area right in here (indicating).

Q Okay. And just generally, as far as wetland types, what did you find in that area?

A Well, there are three wetland types. There are forested wetlands, especially in the area up in through -- in the northern part of the study area. There are scrub shrub wetlands, wetlands that are dominated by tall shrubs or small trees. And then right along the river in a band right along the river there are emerging wetland areas or wetlands that have their -- mostly herbaceous with leaves that stick up out of the water or stick up out of the ground, but there's no woody vegetation in an emerging wetland -- no dominance of woody vegetation.

Q Were you able to form an opinion as to the accuracy and thoroughness of the Wetland Coast report?

A Yes.

Q And what is your opinion?

A Well, my opinion is that it's a good and accurate description of the wetlands as well as the vegetation. In fact, in this particular area, we were able to identify

their -- not only identify their own flagging that was still in the woods, but we agreed with little islands of upland that I'm illustrating right here with the pointer that are located just west of the orebody. To us, that demonstrates that they're doing careful work trying to make sure that they understood the wetland boundary. A lot of people would have just marked the outside edge of this larger wetland and not gone in to delineate these little upland areas. So it was an accurate delineation.

Q And your point was the fact that they specifically identified the little islands that it was your impression that they did a thorough job?

A Yes. And the fact that we could still see the -- their peak flagging, that they had left in the field. And we agreed with where they were drawing the line.

Q Now, when you did your site examination -- well, let me back up. Dr. Adamus testified when he was here that he spent a few hours on the site. When you and your team did your site investigation, how much time did you spend on the site?

A Well, we spent two days on the site and another day meeting with the other team members understanding the mining project, where the hydrology was being monitored and what other studies were underway.

Q And is a thorough site examination important in your opinion?

A Yes.
Q And why is that?
A Well, it's important because all wetlands are a little bit different. And they can even be different within -- if you look at a map such as this, while that looks like it's all one wetland type, there can be differences in soil and hydrology. So it's important to spend some time digging soil borings, understanding what the season hydrology is and getting your monitoring system set up so that you're collecting accurate data so that you can make sure that you understand how the wetlands function.
Q And you indicated that your site investigation was focused in a certain area generally around the orebody. Why was your study focused?
A Well, we were -- although we spent some time down along the county road and up in through here, the reason we were focused in this particular area was this was going to be the sort of the center of mine activities as we understood it in terms of the drawdown, in terms of the development of the ore, the mine itself. Even though the entrance to the mine was going to be off the wetland proper, the fact that the activities were going to be underneath the wetland, that was really where we thought we needed to focus our work.
Q And before we talk about the actual studies that you did, can you tell me about the condition of the wetlands? And

these are the headwaters of the Salmon Trout?

A Yes.

Q Have these wetlands been affected by any human or natural disturbances?

A Yes. There are some signs of disturbance. But it's important to understand that these wetlands are in pretty good condition. They're not pristine or virgin. There have been some roads laid in it. It has been logged. I think there's been some past fire. We saw some indications of past fire in those zones. But they're in pretty good condition.

Q How about effects from beaver dams?

A Yes. The Salmon Trout River, when you look at aerial photographs, you can see dams across the river. And the effect of a beaver dam is to change the hydrology of the emerging wetlands on the edge of the river.

Q Now let's talk about your studies at the site. And one of the things that you studies was the wetland vegetation types?

A Yes.

Q Okay. And I believe that you prepared some slides to illustrate what you found?

A I have. If we could see one of those, that would --

MR. PREDKO: And put slide 4 up on the screen here.

Q And can you tell us what that slide depicts?
A Well, this is a good slide -- it's sort of a typical condition of one of the wetland areas adjacent to where the upland areas right in that area near the orebody. So you have a forested wetland right here (indicating) with wetland vegetation. You notice that it's mostly trees and shrubs. And actually right there you can see one of the wetland flags hung by Wetland Coastal Resources. You'll notice that this wetland doesn't have any standing water in it. This is not sort of like your classic northern hardwood forested wetland that is inundated in the spring and fall. In fact, the wetlands in this particular study area rarely have any surface water in them. And this is borne out by the hydrologic data that we're going to show you in a little white. Notice also that the species of vegetation here are mostly facultative or facultative wetland species, which means that they are capable and frequently do grow in upland settings up to a third of the time in the case of a facultative wetland species and up to two-thirds of the time in some of the facultative species. So you can find red maple growing in a upland area just as much as you can in a wetland area.
Q Can you tell us about some of the dominant species in the forested wetland areas?
A Yes. Well, you can see some of them here. Red maple,

tamarack, we saw a lot of balsam finder, quaking aspen, all good wetland tree species but wetland tree species that are going to actually respond favorable to changes in water level. In fact, when I was doing my research on tamarack during the drought of the Great Depression, the drought of the 30's, when I looked at tree rings, the tamarack actually doubled their growth rate during the drought of the 30's. So the reason I bring this out is because this says a lot about the tolerance of this wetland to water level fluctuations in terms of its resistance to invasive species and its resistance to die-back as a result of natural vegetation due to hydrology.

The second slide shows the emergent wetlands along the Salmon Trout River. These are dominated by sedge, but there's also quite a bit of fowl mannagrass grass, Calamagrostis. Some of -- you can also see the forested wetland in the background here and the little bit of thing in the corner here is tamarack. It's a confer that loses its needles in the fall. That's how you can tell that. This wetland type is a little bit more sensitive to changes in water level fluctuation when it's along the river. And there's very little water level fluctuation due to the steady flow of water in this area. It's are more prone to the fact that a beaver dam might be built downstream or be abandoned and open up than it is to the groundwater drawdown

caused by the mine.

Q And as far as location, you have already said this, but where are these types? Is this closest to the orebody?

A This wetland type is alongside the river south of the orebody, so the orebody is set back off the river a couple of hundred feet in terms of geographic position. And then these wetlands occur along the band of the river.

Q Are any of the species that we see in these -- in this picture tolerant of different moisture conditions?

A Yes, they are. The shrubs are facultative wet. This trees -- this tamarack is a facultative wetland species. The sedges are considered obligate, but they -- the fowl managrass, which is the other co-dominant in this wetland system is also tolerant of wetland hydrology changes.

Q Okay. And you've been using the terms "facultative" and "obligate." Can you give a little bit of explanation of what those terms mean?

A Yes, I can. I apologize. Basically when the wetland regulations were put forth, the U.S. Fish and Wildlife Service generated a list of wetland plant species. And they ranked those plant species according to their propensity for being found in a wetland. Obligate wetland plants are found in wetlands 99 percent of the time. Facultative wet plant species are found in wetlands two-thirds of the time, but you can also find them in upland settings. And then

facultative wetland species such as red maple are considered to be found sort of in a wetland up to a third of a time, between a third and two-thirds of the time.

The reason they did this is so that, when you're -- if you're sort of -- you've identified a plant in the field but you don't know whether this is a wetland plant or not necessarily -- you might be able to make its identification but you don't know, for instance that tamarack can grow in uplands just as well as it grows in wetlands, so they were trying to give some guidance to the wetland delineators as they go through and do the process.

There are shades and nuances. In other words, you can facultative wet plus and facultative wet minus. You can also have some debates as to whether some plants are considered obligate and whether we can see them growing in upland conditions and so on. It's a -- but it's a great tool. It's very useful. And it helps us understand the hydrologic tolerances of these plant species.

Q Okay. Now, Dr. Tilton, did you work with some of the hydrologists or hydrogeologists on this project?

A Yes, we did.

Q Okay. And did you do an evaluation of the slope or topography of the wetlands in connection with your work with the hydrologists or hydrogeologists?

A Yes; yes, we did.

Q And can you tell us what we see in slide 6?
A Well, I want to just -- I produced this slide so that you could -- we could focus for a moment just on the piezometer locations that really show something about the hydrology of these particular wetlands adjacent to the orebody and adjacent to the Salmon Trout River. This is actually a blowup of the large piezometer location map. But it shows the wetland piezometer 29 up here in the very -- this is the northern -- this is north to the top -- the northern limit of the wetland, wetland piezometer 28, 27, 26 down along the river, 23, 26 and 25. It also shows the location of 43 and 44. So that you get an idea of the horizontal spacing and the geographic spacing of these wells within the wetland complex.
Q And Dan Wiitala offered testimony in this case last week. Is he the person that you worked with in connection with these wells?
A Yes, he is. Dan and I worked closely trying to -- he's the hydrologist. I'm the sort of wetland ecologist. And we worked closely together to understand where to put these wells to get a good record of the hydrology of these particular wetland complexes.
Q And I believe you prepared some graphs to show the slope or topography that exists in these wetlands?
A Yes.

Q And we're looking at slide 7. Could you tell us what this shows?
A Well, what this is is, if you remember the previous slide, this is a graph that just illustrates the vertical position of wetland 29 going down to 27 and then down by the river -- the wells down by the river. And remember in the previous -- when I showed you the conclusions, I was trying to make the point that this wetland system has quite a bit of slope to it. It's not dead flat. But it has up to 12 feet of slope as you go from the northernmost wetland limit down to the river. It's about 1,000 feet. It drops in this particular case along this transect, it drops -- what? -- 11 feet or something -- 12 feet.
Q Okay. Maybe if we go back to slide 6.
A Yeah. That would be fine. Here's the wetland well 29, 27 and 26 down to the river. And, you know, the widespread notion that the wetlands are flat, we wanted to try to get an understanding of how much the ground was falling over that distance from 29 to 27 to 26. And this next slide, then, illustrates that. Here's the ground surface. And then these are the wells.
Q Okay. And you've done a similar exercise with some of the other wells on slide 8?
A Yes.
Q Can you tell us what this shows?

A On slide 8, this shows the same sort of pattern from 28 to 44 to 43 and then down to the river at 25.

Q If we back up to slide 6 again, can you tell us what the graph is showing us about the area and what area we're talking about?

A Yeah. It goes from 28 located right up here in the northern limit of this other little wetland arm. Before we were in this little wetland area. Now we're in this little wetland arm. And it goes down to 44 and 43 and then to 25. And the point that -- go to that slide where that's illustrate. The point is that the ground is sloping -- the ground surface here is sloping as it goes down to the river. And this has -- as we see later, this has a significant -- it's a significant feature of these wetlands that bear a lot on their hydrologic functions.

Q Now, the next area of study was your study of the soil conditions in these wetlands?

A Yes.

Q If we go to slide 9, you've prepared a slide to show the various profiles in the wetlands. Can you tell us what you found?

A Yeah. What this slide is illustrating is it's sort of a summary of maybe 30 or 40 soil borings that we dug in the wetland complex during our days that we were there. And it summarizes those findings. Basically we dig the soil boring

4 feet deep, and we make note of what we're observing. But we also list the dominant vegetation and then the soil profile and whether there was any -- what sort of wetland hydrology we observed. The key here that I want to point out is that, notice that in the forested wetland dominated by forested wetland vegetation, that there's only a thin band of black mucky sand or what you consider to be a muck soil, the typical sort of wetland soil. Then at this particular area, there's actually sand and gravel for about 12 inches and then finally this silty clay. And what this silty clay or silty loam acts as is a permeable layer that underlies this wetland. The silt and clay is very slow infiltrating. The water moves through it very, very slowly. So what tends to happen is that the water accumulates on top of that silty clay layer. And we'll see this in a couple of other slides later on in my testimony. In the scrub shrub area because sometimes soils change when you move to wetland types, we encountered some of the same soil profile, just a thin layer of mucky sand, the sand and gravel and then the silt loam at 12 to 20 inches.

And then finally down by the river where the emergent wetland vegetation was, now we start to pick up a little bit more mucky material, 0 to 10 inches, and the sand sort of disappears. We find mostly silt in that soil profile. But even then there's still the silt below the

sort of organic horizon.

And if we go the next slide, you can see what we' talking about and the influence of this. This -- right here Dr. Freeland is holding the silty loam. And what we do is it's called a ribbon test. You rub it between your fingers. And if it forms a ribbon, then it's considered to have a certain proportion of silt and clay. And you can see it held in his palm there. You can get an idea of like it's almost modeling clay. It gives you an idea of how impermeable it is.

And then to illustrate that point, this area right here, this is where the silty clay is on the surface. And you can see the water pooled on the surface of the silty clay. And, in fact, in some spots while we were standing there, it was actually flowing across this zone and going off the slide.

And then finally just to put it in reference to show you the forested wetland character in which we were finding this soil profile, I've included this photograph down here in the right corner.

Q Now, the methods that you and your team used to evaluate the vegetation types and the soil profiles, are those methods that are generally accepted within your area of study?

A Yes. They are the methods that are described in the Michigan Department of Environmental Quality wetland

delineation manual as well as the Army Corps of Engineers delineation manual.

Q And that would include the ribbon test?

A It would in order to determine the soil texture, physical character of the soil, yes.

Q And the next area that you studied while at the site would be the hydrology?

A Yes.

Q Okay. And what did you do to study the hydrology?

A Well, we actually made our own observations. During the -- if you go back to the previous slide, we made our own observations about whether the -- where the soil water was on the site. And notice on these characterizations here that nothing is inundated. The one spot that we found standing water was actually an area where the soil had been scraped off. But as I mentioned earlier, these wetlands don't have standing water in them. The forested and scrub shrub wetlands don't. And with that, we then went back and we also looked at the monitoring well data.

We -- if we can go forward a little bit, I'll show you what I mean by that. We looked at the water level data that was being collected in the piezometers. And Dan Wiitala of the North Jackson Company was in charge of collecting that data. And the data that he collected was shared with us, and then we sort of evaluated what the

wetland hydroperiod was doing. Now, by "hydroperiod," what I mean is the sort of seasonal pattern of water level in the wetlands, the frequency and duration of inundation. And when we looked at the wells, we basically find that there are two different hydroperiods among the wetlands, that the wetlands furthest north from the -- or upslope from the river have a seasonal water level fluctuation versus the water levels in the wetlands alongside the river, what we call the riparian wetlands.

If we go to the next slide, you can get an idea of what I mean by "relatively stable." There are three wetland piezometers illustrated on this graph. Wetland 25, well 23 and well 22. And you can see here that, on the left-hand side, this is feet. So it's 1416.5 and .0. So this is only 6 inches of fluctuation. And notice that we go from January to December on this particular slide. And you notice that there's a little bit of drawdown during the winter but that, during the growing season, this is sort of dead flat. There might be a 1- or 2-inch water level fluctuation going on in that well. On wetland 25 there's also the same pattern. This is generally flat and there's very little fluctuation. And then similarly except for this one little dip in August, the same pattern.

If you contrast that, though, with the wetland on the next slide with the wetland water levels for what we

call the precipitation dominated wetlands or the upslope wetlands, notice that this is the same period of record, January to December. But look at the water level fluctuations. The spacing is still 6 inches. But these water levels start out in the spring at around 1420 and then drop 2, 2-1/2 feet during August. And then a precipitation event brings them back up to about where they were in the spring.

Q If we back up to slide 6, where are the wetlands that you just explained?

A Yes. That's a good point. Wetland 25 and 23 are right down here alongside the river. You can see 25 right here near the orebody, 23 a little further downstream. Wetland 22, the third well, is actually down -- upstream in sort of what we consider like a control area. And we were picking up data there. It's a well near the river, though, in a very similar position as wetland 25 and 23.

Q And that was that first graph that showed that the levels were fairly constant?

A Fairly stable, yeah, hardly -- no more than 3 to 6 inches of fluctuation throughout the year. The second slide, the one that had 2-1/2 feet of water level fluctuation includes wetland 28 and 43. Notice that 43 is in the wetland area right over the orebody and that 28 is north of the orebody. And those were the wells that had 2-1/2 feet of fluctuation.

Q I think we left off, you had described slide 12. And can you tell me what the next slide, slide 13, shows?

A Well, slide 13 shows this distinct difference between the wetlands down along the river, which are -- got a fairly regular and steady supply of water, versus these precipitation dominated wetlands. There is something going on right about in July and August. And what's going on here is that it's not so much that the precipitation declines, although it does a little bit. What really goes on is that this is when evapotranspiration starts to occur in the Upper Peninsula. Evapotranspiration is the process of losing water through evaporation off the soil surface and also out of the vegetation through the process of transpiration. So precipitation in the U.P. exceeds evapotranspiration. But during the summertime, evapotranspiration exceeds precipitation and, as a result, you end up with that pattern right there (indicating).

There's also one other thing that's observable here that's kind of interesting which is, during the winter when all the precipitation is in the form of ice and snow, you can see that the groundwater is actually -- the water level is dropping in the wetland but that's because the natural process of water seeping out the bottom of the wetland isn't being made up by precipitation. You don't see that so much through here (indicating), because there's

enough precipitation falling to make up for that difference. And then you'll see in a little bit -- I'll show you the pattern of water level, and then we're going to overlay precipitation patterns on this. And you'll get an idea of why these things are peaking and why the valleys are forming.

Q Okay. And -- but before we do that, you did a comparison of these graphs that we were looking at -- comparison of the two types of wetland hydroperiods in slide 14?

A Well, again what we've done is the two previous slides we've just put them on the same slide so that you can really -- this really does illustrate the differences between these -- not different wetlands, because it's all one big contiguous wetland but that, within some parts of that wetland, the hydrology is like this (indicating), namely the upslope areas, and then in other part of the wetland, the hydrology is like this (indicating). Very little variation, very little influence of the evapotranspiration compared to the slides -- compared to the wetland area that's dominated by precipitation.

Q And you did mention you wanted to show what was happening with precipitation as the level of the moisture in the wetlands goes up and down. And if we go to slide 15, what do we see here?

A Yeah. Well, this is a good example of what we mean by

precipitation dominated wetlands. Remember that, as we -- again to orient you, this is precipitation in inches over here. So that's a 1-1/2 inch rainfall, that's a 1-1/2 inch rainfall, and that is more like 4-1/2 inches of rain. On this axis is the actual water level at this particular well. And what we've done is we've -- to illustrate this issue, we've just included wetland piezometer 28. So again the same pattern going down, slowing, dropping during the winter. But when with the spring thaw, this water level recovers. This line going across the graph is the ground surface at WLD028.

Q And if we can just flip back to slide 6 to orient everybody. WLD028 is where?

A Right there (indicating).

Q Okay. And this is --

A It's about 800, 1,000 feet away from the river.

Q This is one of the upslope wetlands?

A One of the upslope wetlands, what we call the precipitation dominated wetlands.

Q Okay.

A So right here is the spring melt when all the ice and snow turns to water and the water level comes back up as you would expect. Notice, however, again just to sort of reemphasize this point, that the water level isn't a foot deep in the wetland. It's right at the surface. Then the

precipitation is kind of normal for the U.P., but it -- the evapotranspiration is really working to draw this water level down. Then generally what happens in the fall -- it usually have to be one event like this. But in this particular case, they got a big rainstorm, and this wetland came right back up to its pre-spring water levels. Generally speaking, this pattern is very common. But it's not as abrupt, because there's usually a combination of things going on. Typically in the fall you get more precipitation but the evapotranspiration shuts down because the temperatures are cooling off and the wind isn't -- it doesn't have much influence on the vegetation. But that is very often a very common pattern of what we consider in a forested wetland to be a hydroperiod, the frequency and duration of inundation.

Q And so what this shows is that this upslope wetland area is dominated or dependent upon precipitation?

A Yes, it does.

Q And if we move to the next slide, can you -- this is a for a riparian wetland on the site. And can you tell us what is different about the riparian wetland?

A Well, take a look at this slide. Again this is precipitation. This is the same pattern of precipitation on the previous slide. But this is the water level data from the monitoring well 25, which is down by the river. Notice

first of all it doesn't have the decline in January. It doesn't have the recharge in the spring. And it doesn't have the dip that usually occurred in the precipitation dominated wetlands. Because as the -- it's not that the evapotranspiration isn't occurring, because it is. It's just that it's being made up for the tremendous amount of groundwater and river source of water coming into these wetland complexes. But notice also that, even this wetland does not go above the ground surface. Here's the ground surface right here (indicating). This is not -- it doesn't have a foot of water in it in the spring. And that speaks to the functions and values of this particular wetland as to what type of wildlife will use it and what its value is in that regard.

Q Now, when Dan Wiitala, the hydrologist, testified last week, he was able to characterize the wetlands in the area as precipitation dominated or groundwater dominated or riparian or wetlands relying on the river for their source of water. And if we go to slide 17, this was introduced and admitted in Mr. Wiitala's testimony. Can you tell us what his slide shows first?

A Well, just to orient you again, this is the area that we've been talking about. Here's well 29, 28. There's 43, there's 25 -- I think that's 25. There's 23 and there's 22. What he's added to this particular slide is sort of a line

that depicts the precipitation dominated wetlands in the blue, the groundwater dominated wetlands in the tan and then the riparian wetlands right along the edge that are influenced by the river water level.

Q Okay. And did your studies confirm what Mr. Wiitala characterized here on this slide?

A Yes. We sort of independently developed the same sort of idea; the same process plus the same sort of demarcation of where that line occurs within this wetland complex.

Q And this is an overhead view of the wetland types. I think it would be helpful if you could show us -- maybe draw a diagram of a landscape view of the wetlands in the area of the orebody.

A Okay.

Q There should be a pen up there?

A Yup. If I draw a cross-section through this area that we're depicting -- let's say we start up here (indicating) like this. I'm exaggerating the scale, obviously, because this is 1,000 feet or those and that's about 12 feet. But as we work this -- as you work this zone, even though the land is falling, there is -- there are several layers depicted here. And remember that I told you that there's sort of a silty clay layer that underlies this wetland system. And then there's a zone that if we expand this out, there's a layer of organic matter. And then there's a layer of sand and

gravel. All right. Now, in some spots there are -- this water level, then, that we've observed lays down like this (indicating). And you remember on this particular slide there are some areas where there isn't any wetland; it's upland. That's because this -- the land has got some topography to it. So if there's a hump in the land, you can actually get upland vegetation growing on this because the hydrology is not close enough to the surface to create wetland. And then down here is the river.

Now, notice that the groundwater flow in this surface zone is down towards the river. So you have precipitation inputs, and then during the summertime you have loss. But it's always the surplus water, instead of accumulating on the surface, it's flowing in this surface above the silty clay and recharging and becoming dominating and influencing the wetlands that lay down here. Does that help illustrate it?

Q It does. Thank you, Dr. Tilton.

Q Next I'd like to move to the area of the predicted groundwater drawdown and potential effects on the wetland areas. Now, Dr. Tilton, you testified that you reviewed the GeoTrans Report that predicted groundwater drawdown in the area?

A Yes, I did.

Q Mr. Council testified last week here about that report. And

if we move to slide 18, this was a slide that was admitted during Mr. Council's testimony. And this slide was Mr. Council's worst-case drawdown scenario. Do you remember that in Mr. Council's report?

A I do.

Q And this slide, as far as water drawdown and its location on the wetland, could you tell us, well, first of all what this slide predicts as far as water drawdown near the wetlands, and then tell us whether you believe that drawdown will affect or impact the wetlands?

A Okay. The -- in terms of the impact of the drawdown, the -- Greg Council, GeoTrans, draws these lines of drawdown. So there's (indicating) .5; there's 1, 1 foot of drawdown right there. This line -- that little area right there is two feet of drawdown, and this is also a little two-foot -- or -- yeah, two foot. Get my glasses on to make sure here.

Q Yes.

A Yeah. So that gives you an idea of what the model was predicting. To orient you, in case you're a little confused, this is the wetland area right here (indicating). The purple is the precipitation-dominated wetland. There's wetland 28, the monitoring well 28. There's wetland monitoring well 43, and there's wetland monitoring well 25. The light green are the riparian wetlands. This is the groundwater wetland. So the first thing you'll notice is

that the precipitation-dominated wetland is in an area of drawdown of about a foot. Well, because they're dominated by precipitation there won't be any impact at all there. There's no significant impact compared to the existing hydrology. The groundwater is not a significant influence on that wetland, so therefore changes in it at depth below the active biological zone aren't going to be discernible. There would be no significant impact.

Q And in general that's true. Dr. Adam has agreed, when he was here, that precipitation-dominated wetlands are not affected by groundwater drawdown.

A That's true; yes, I recall that. There is an area where the groundwater impact -- the groundwater-dominated wetland will be influenced by a drawdown curve, the .5, the 2-foot line, the 1-foot line come together right down in here (indicating) alongside the river. The reason I don't think that that will have a significant impact is that there is still this process going on. And if I could go back to my flip chart here, what we're describing -- what GeoTrans is describing is that the groundwater level that they observe in this silty clay layer right there is expected to go down half a foot, a foot; let's say two feet at the maximum. But the reason I don't think that's going to be a significant impact on this particular wetland is, number one, the vegetation. But number two, there's so much surplus

precipitation flowing down through this area making up for the water that might be lost as a result of the drawdown from the de-watering operations, that I don't believe you're going to see a significant change in this water level in this particular wetland.

Q Now, does the natural drawdown, seasonal drawdown that occurs in the area give any support to your opinion?

A Yes, it does. I mean, if we go back and think about what the -- if we can go back to that slide that compared the two -- I think it was 14, perhaps? That one right there (indicating). Here we are up in the precipitation-dominated wetlands, and we don't think there's going to be any impact of the drawdown up there. But right here you can see that the reason this is so flat through the growing season, there's so much surplus water flowing in the -- from the up-slope position that it's enough to make up for this drop. These wetlands don't get significant amount of water from the up-slope position; they don't get a lot of surface groundwater flowing into them, so you see the drawdown. These (indicating) are receiving so much surplus water on the way down to the river that they don't drop at all during the summertime. That's why a little bit of groundwater drawdown, about a foot or so in this particular zone, is mitigated by the fact that there's so much surplus water flowing down through here in the shallow zone of sand and

gravel and the shallow organic layer in that soil.

Q It's been suggested by Dr. Adamus that these wetlands are particularly sensitive. Do you agree with that?

A I don't agree with that.

Q And why not?

A Well, I agree that wetlands -- certain types of wetlands are tolerant and certain wetlands are intolerant of small water level changes. If I could go to the flip chart, I'll give you an example of what I mean. Where we -- as wetland ecologists, where we see this quite a bit is either in a vernal pool or along the Great Lakes shoreline. That's another good example. But I'll show -- I'll draw a vernal pool. A vernal pool is basically a pool, growing in a forest area almost always, that has water in the spring. And then it dries up usually to just a puddle by July or August. And as a result, this -- so this (indicating) is April and this is August, let's say. And this is where the wetland water level used to be. Now, the two- to three-centimeter difference is that --

Q Doctor, when you say "two- to three-centimeter difference," Dr. Adamus testified that he believed the two-centimeter change in water level promotes domination by invasive species. Is that what you're referring to?

A Well, actually, I'm just going to illustrate first how two or three centimeters changes the vegetation pattern in the

vernal pool, and then we'll talk about invasive species.

Q Okay.

A 'Cause there's some other factors that need to be thrown into that. If this is April -- and by the time you get to August, what starts to grow in August are a bunch of annual plants. By "annual plants" I mean things like stick-tight and bidens and that sort of thing. They're annual because they -- we call them annual because they grow from seeds each year. And in order for them to germinate, they need to have the water gone from the pool. And so what usually starts to happen is, as the water level drops through the years, you'll start to get vegetation on the edge. And sometimes you'll actually have persistent vegetation on the edge like cattails. And then the annuals will form. Well, if you have a we that year, for instance, so that instead of it drying out it stays wet, this annual vegetation won't germinate. So in that particular year you'll never get the vegetation of bidens and stick-tight and all that annual vegetation to grow. If it dries out prematurely so that there's, let's say, instead of April there being a foot of water, now suppose there's only six inches of water. Now you have all this exposed mud flat right here (indicating) that's available for species to start to germinate or colonize. In this particular case, two or three centimeters really does have an influence.

Q When you say "this particular case," you mean the case of a vernal pool?

A In the vernal pool. Or if you can imagine the Great Lakes shorelines, the same sort of thing. If the water level is -- well, compared to what they were, let's say, eight years ago when the water levels were up, everybody buying Great Lakes shoreline had a lake right at the edge of their seawall. Well, when the water level drops and it goes off into Saginaw Bay or Lake Huron 300 feet, now all that exposed mud flat is growing wetland vegetation. And in some cases that's only been an inch or two of water level fluctuation. So Dr. Adamus is correct, in that two or three centimeters -- and this has been reported in the literature as well -- is an effective modifier for wetland vegetation, but not when you have forested wetland systems. Because forested wetland systems are persistent. They don't go through this cycle of annual vegetation coming in and colonizing the mud flat, not the types of wetlands we're talking about here. They're either forested or scrub shrub. And when they do have emergent vegetation, it's what we call persistent or perennial, in that wetland plants are growing from rizones or root stalks.

So now we have this situation where, well, does two or three centimeters influence the tolerance of invasive species to come in? And where we're been monitoring

wetlands -- because that's part of the work we do. When we build wetlands or if we're protecting wetlands during the process of a permit, we think there are three things that really influence whether invasive species take over. First of all, a wetland that is -- has a significant change to its hydrology is particularly sensitive to the invasion of wetland invasive species. For instance, there's a shrub called the buckthorn that comes into emergent wetlands when the water level is dropped for drainage or for agricultural purposes. But you need to have two things happen. First of all, buckthorn has to be nearby. They have to have an available source for the seeds to migrate into the wetland. And secondly, there has to be some sort of stress on the native vegetation in order for it to not be able to resist the competition coming from the invasive species.

Q And do we have that here, or will we have that here with groundwater drawdown?

A We will not. WE will not have that because, number one, as -- the quality of these wetlands is pretty much invasive-species-free. I mean, we found maybe one or two scattered little spots, but there are no large populations of either Reed canary grass, purple loosestrife, phragmites, the common reed or buckthorn. Secondly, this drawdown, if it does occur, this change in hydrology will not stress this vegetation. Because this vegetation is adapted to growing

these species, are adapted to growing in drier wetland conditions already, so that the tamarack, the balsam fir, the red maple are all capable of not only withstanding the potential drop in groundwater; they'll actually grow better, as I observed when I was studying my tamarack. So you've got two things working in your favor to protect the wetlands against invasive species. First of all, there are no major sources of invasive species nearby. And secondly, this plant community that we were looking at earlier in those slides is tolerant and won't be stressed by any kind of potential change in water level.

Q And you mentioned that there are some species that actually benefit from some groundwater drawdown. And Dr. Adamus also agreed that species such as black spruce may benefit from some groundwater drawdown. Would you agree with that?

A I would. In fact, this is a principle of growing trees -- forest trees in wetlands. Forest drainage is a standard practice to improve the productivity of forest plantations in wetland areas.

Q And I believe another species he said that may benefit from some groundwater drawdown is sphagnum moss?

A Sphagnum moss. And that's in the ground layer of this forested complex. And the reason that's important is that the sphagnum moss creates this vast mat over the bottom of the forest floor. And one of the other elements associated

with invasive species getting started is if you create bare soil. If somehow you disturb the site and create a place where weedy species can get started, you increase the chances of allowing noxious weed populations to become established. At this particular site we're not going to do that. None of that wetland area is going to be disturbed. And in fact under some of these drier conditions the sphagnum moss will prosper.

Q Now, Dr. Tilton, do you believe that the function or values of this wetland system will be affected by the groundwater drawdown?

A No, I don't.

Q And when I say "groundwater drawdown" I mean during mining.

Q During mining I just don't see a mechanism by which it's going to occur.

Q And how about after mining?

A Well, after mining I think if there is a lowering of the water table, that water table after mining will recover. And the short duration that the mining period is projected is very minor. And the wetland -- if there has been any change, the wetland will be able to recover once the mining is done and the water levels are returned.

Q And we'll talk about wetland recovery in a moment. But before we do that -- now, looking at the -- again, the wetland delineation aerial view, I'm pointing to the area

that's just north of the outcrop there. And is that your understanding of where the surface facilities are to be built?

A Yes.

Q Now, Dr. Adamus suggested that the wetland areas are going to be affected by Kennecott's capturing of the water that falls on the surface facility. Do you agree with that?

A No, I don't.

Q Now, is there any evidence that you've seen that would show that the capturing of water in that area north of the outcrop would affect at all the wetland?

A No. We spent some time walking along this edge when we first got on the site, trying to understand if there were any kind of surface water inputs from the upland, any kind of a stream or any kind of surface water condition, and we couldn't find anything, primarily due to the fact that this sandy plain, the infiltration is so rapid that surface water -- any kind of precipitation event flows into it, goes down into the sand and is stored as groundwater. Furthermore, most of the wetlands in this particular area are all precipitation-dominated. So they don't depend on any kind of surface water runoff from a facility this far away. Lastly, a good part of this zone drains the other way. It drains off to the north, based on our review of some of the topographic information that was available.

Q You mentioned that part of what you do and part of your expertise is in dealing with threatened and endangered plant species?
A Yes.
Q And you did some of that work on this project; correct?
A Yes.
Q And in connection with that work, did you review Wetland Coastal Resources Threatened and Endangered Species Report that was attached to the Environmental Impact Assessment?
A Yes, I did.
Q And did that report identify any either potential threatened and endangered species that were on the site or actually existing on the site?
A Yes, it did.
Q And what were those?
A Well, they identified a narrow leaved gentian, and they also alluded to the possibility of a water lily, small-leaved water lily that they thought might have been identified. But they couldn't get a conclusive identification of that.
Q And let's talk about the yellow pond water lily first. And if we could bring up on the screen Intervenor 262? Now, Wetland Coastal identified what they thought may be a yellow pond lily. And then they -- or Kennecott retained you to further investigate that?
A Yes, that's correct.

Q Can you tell me what you and your team did to do that?
A Well, we focused on the -- whether the small-leaved yellow pond lily was present or not. And we actually went ahead and went back up and did a survey of the habitat during the flowering time frame and looked for the water lilies in the areas where their habitat occurs; mainly the open-water areas of the Salmon Trout River.
Q And this we've put on the screen here is Intervenor 262. Is this the report that resulted from that investigation?
A Yes, it is.
Q And if we flip forward some pages into the report to the pictures, we've got -- back up. There we go. We've got some pictures here. Now, does that depict the yellow lily that you were searching for?
A Yes. That's the target, basically, that we're looking for. That's the target species.
Q Can you tell us just a little bit about the species?
A Well, it is very similar to the common water lily, the yellow water lily that we're used to seeing in the lakes and streams. It's got a yellow flower. But as you can see in the photo on the bottom there, the flower is much smaller than the yellow water lily that you're used to seeing. The yellow water lily has a flower about the size of that leaf, whereas this is much smaller. It's the same genus; it's just a different species.

Q When Wetland Coastal did their assessment, they thought they may have found a yellow pond lily. Can you tell me what they found?
A They found -- I believe they found the leaves. And they weren't sure whether they were the leaves -- the small -- the leaves of the small yellow lily or small leaves of the more common water lily. And when they brought them down to the University of Michigan, the professor there wasn't able to give them a conclusive identification either.
Q And so they sent your team out to further investigate the site, to see if they could locate this lily. And did you -- your team investigate the habitats where this lily would occur?
A Yes. They walked -- well, they walked the entire length of the area that they were studying, looked in habitats such as shown on this site photograph, Appendix A, and looked in the area that they thought was going to be representative of the habitat.
Q And did they find the -- well, first of all, is this yellow lily a threatened or endangered species?
A It's a threatened species.
Q And did they find this threatened species?
A No, they did not.
Q And was a thorough and diligent search conducted of the area?

A Yes.
Q And to your knowledge, since this report which is dated October 2006, has anyone found this yellow pond lily threatened species in or around the mine site?
A Not to my knowledge, no.
Q Now, the other plant species that you mentioned was the narrow-leaved gentian. Is that species threatened or endangered?
A That's a threatened species.
Q Can you tell us a little bit about the narrow-leaved gentian?
A Well, the narrow-leaved gentian is located -- it's been reported in three counties in the Upper Peninsula: Marquette, Baraga and I forget the third one. It is common in those counties, even though it's threatened statewide. In fact, there are large populations of them in Marquette County.
Q And is the gentian also common in other states?
A Yes, it is.
Q Where within the United States? The east coast?
A Primarily. It is actually fairly common in what -- in those east-coast states. It's sort of on the range -- it's on the edge of its range, which brings it into its sort of threatened status here in Michigan.
Q Now, in your connection with this case, have you reviewed

the reports that were done on the narrow-leaved gentian?
A Yes, I have.
Q And there are three. And they are the North Jackson 2004 Baseline Report. Did you review that report?
A I did.
Q And then there is a 2006 update to that report?
A Yes.
Q And a 2007 update to that report?
A Yes, I have.
Q And you reviewed all of those?
A Yes.
Q And can you tell me what those reports -- what the purpose of those reports were, first?
A Well, the purpose of the reports as I understood it was to identify how widespread the populations of narrow-leaved gentians were and what sorts of habitats were the gentians found to be growing in. Were they dominant -- were they predominantly located in wetlands, exclusively located in wetlands, or are they found to be growing a range of different wetland types and upland types?
Q And if we could just go to Intervenor 267? And this is the 2006 update. And I just wanted to show an example of the report. And if we could flip back to the maps at the end -- well, stay right there. We're showing a picture. Can you tell us what we see in this picture that's part of this

report?

A This is a picture of a narrow-leaved gentian. It's got a little blue flower. And then the threatened species is characterized by narrower leaves, compared to the fringe gentian.

Q And now if we go to the maps -- and we're looking at a map here which is Bates stamped KEMC 165737, which is a page of that report. And can you tell us what the -- this page shows as far as existence and location for the narrow-leaved gentian?

A Yes, I can. You can see here (indicating), here's the Salmon Trout River flowing down like this. This is a large wetland complex to the south. And this little symbol right here represents the location of narrow-leaved gentian. As you can see, there's a bunch scattered along here. There's one actually right there. There's a bunch associated with the riverine habitat.

Q And if you could point out for the court, I believe there's a star there to show where the proposed mine will be?

A Yes. I'm sorry. Right there (indicating) is the mine facility itself.

Q And the wetland areas that you've been talking about, Dr. Tilton, that you characterized, where are those?

A Those are located west of the mine site, pretty much right in this vicinity right here.

Q And so there were some colonies of narrow-leaved gentian that were located in or around those wetland areas?
A Yes.
Q Dr. Tilton, do you believe -- in your opinion will the predicted water drawdown have any effect on populations of the narrow-leaved gentian?
A No, they will not.
Q And why not?
A Well, the main reason is that all the studies done so far, including some of the background studies on this particular species, indicate that it's tolerant of small changes in moisture condition. In fact, the survey that was done by North Jackson Company found populations of the narrow-leaved gentian growing in sandy and gravely soil, not just in the wetland areas, alongside rivers where the moisture regime is what you'd expect of a wetland plant. So with that information in hand plus the fact that the population is so widespread in Marquette, I don't believe that the population is at risk. There may be small changes in individual plant species. In fact, North Jackson Company did document some of that, changes in individual plants from year to year. When they went back to visit a site, the population was either smaller or larger. But on balance, the species seems to be tolerant of the sorts of water-level changes that are expected at the mine site and at the mining operation.

Q Now, the Michigan National Features Inventory ranks wetland areas or types of wetlands as to their rarity; correct?
A Yes, they do.
Q And the type of wetland that we've been talking about here, what type of wetland is that?
A Well, there are three groups. There's basically what would be classified as a pore conifer forest, pore conifer swamp; a scrub shrub wetland; or an emergent wetland.
Q And for each one of those types, are those types of wetlands in the State of Michigan common or rare?
A Well, they're considered common. There are hundreds of thousands of acres of these wetland types. Some have been impacted more by settlement than others, but there are still hundreds of thousands of acres of wetland, as illustrated by this slide alone. Just in Marquette County you can see that this is a large wetland complex of mixed wetland types. And the wetland map of Westland Coastal Resources also illustrated that there are large wetland complexes of much -- much larger in extent and of the same wetland types, in areas very close to the mine site.
Q And you said that there are hundreds of thousands of acres of these same types of wetlands in Michigan. How many acres of wetlands are we talking about here that are in or around the mine site?
A Well, I focused just in and around the orebody. And, you

know, the numbers vary, but there are, like, 30 to 40 acres that might be within the groundwater drawdown area.

Q Now, Dr. Tilton, you said that you've reviewed the permit conditions in connection with this proposed mine; correct?

A Yes, I have.

Q Now, do you believe that the permit conditions promulgated by the MDEQ will be protective of first the wetlands themselves and the narrow-leaved gentian?

A Well, they will be protective of the wetland. And the requirements to monitor the gentian populations will protect that species as well.

Q And can we talk about the particular parts of the permit that you believe will be protective over the wetland? And we can put the permit up if you need to, or you can just tell us what those permit conditions require.

A Well, in my opinion the aspect of the permit that is going to really protect the wetland complex is of course the hydrology. There's -- the mining permit first of all doesn't allow any kind of filling of wetlands. You have to protect them; you have to make sure that no actual fill gets placed in the wetlands. And then the mine permit goes into quite a bit of detail, describing which monitoring wells need to be maintained and monitored and what those monitoring wells are supposed to be measuring. And then they describe that if the hydro period changes by as little

as six inches, that further steps have to be taken to understand what's going on with that. In my opinion, this is adequate to understand what's going to go on during the actual mine operation in terms of wetland hydrology.

Q And how about the narrow-leaved gentian? What permit conditions are protective of the narrow-leaved gentian?

A Well, the idea that the population actually be monitored, identified. And there's actually a requirement to go out and make sure that there isn't disease or other disturbance occurring to the populations; to make sure that the health and vigor of the plants is maintained and to understand what's going on with them if something does start to occur.

Q And do you recall whether there is a setback requirement for any action or disturbance within a certain number of feet from the gentian?

A I don't remember the exact number, but there is a setback requirement, to make sure that there's a buffer associated with protecting the population.

Q Does 66 feet ring a bell?

A I'm sorry. I don't remember.

Q I believe the permit is also an exhibit and speaks for itself. But you do recall a setback requirement, Dr. Tilton?

A I do recall a setback requirement; I just can't remember the exact number.

Q Now, you said that you believe that the monitoring requirement for the wetlands will adequately protect them in the event of a drawdown?

A Yes.

Q Dr. Adamus has said something to the effect that by the time that you catch it, it will be too late to fix and the wetlands will be ruined. Would you agree with that?

A I don't agree with that.

Q And why not?

A Well, I think that there are certain wetland types that if you were to draw down the water level, you could cause damage to some of the plant species, but not these. These wetlands, many of the species first of all are tolerant of water level changes, the trees and shrubs in particular. They are perennial; they have a presence in the landscape that isn't dependent on being inundated, for instance. If it's a plant species that needs to be inundated and you take the water away, then that plant species is going to die. But we don't have that situation here. In fact, the trees themselves, based on the literature and my own observations, will probably respond in the event of a drawdown or less water by growing more vigorously.

Furthermore, the time frame over which we're talking, perhaps eight to ten years, is sufficient for these plant species to persist and in some cases actually grow

better, until the mine operation is done. And then the water levels will come back to what they were before.

Q And do you believe -- I mean, assume for purposes of argument that some of the wetland plants were affected. The health of the plants were affected or they died. Is the wetland forever gone?

A No, it's not. And that's another important point. I've been able to restore many wetlands that have had their groundwater drawn down, either through agriculture or through regional drainage projects.

Q Can you give us some examples of that?

A Certainly. As part of a natural resources damage assessment I restored wetlands along Saginaw Bay that had been diked and then pumped. The farmer put in drainage systems, drew down the groundwater by as much as six feet. And he would pump out that wetland every spring, plant his crops and then harvest them in the fall. So as part of that natural resource damage assessment, we re-flooded that wetland system, removed the dike and within two years had a functioning wetland area free of invasive species.

Another example is a natural area owned by the Nature Conservancy near Tecumseh, Michigan, on the Raisin River. It's called Ives Road Fen. And it's a system that had been owned by a farmer prior to the Nature Conservancy owning it. And he had actually installed tiles that drained

not just the surface water but the groundwater from that fen. And then he ran those tiles down to the river. He had dropped the water level in that fen as much as six feet in some parts. And he had maintained it that way for over 40 years. You can imagine the sorts of things that, based on my testimony earlier, had occurred. Buckthorn had invaded that site because it was so dry. And the native species weren't able to compete. So through a combination of removing the buckthorn, reaving all the tiles, within a year or two the groundwater was back to the surface. The native plant species had taken over from seed that had laid dormant in the soil and had replaced the buckthorn. Now, we had to cut the buckthorn and we had to treat the stumps with herbicide, so it took a significant effort. But the point was that despite the fact that it had been drained for almost 40 years, we were able -- by restoring the hydrology, by blocking those tiles, we were able to get the native plant species, along with a threatened species of snake, the rattlesnake -- Massasauga rattlesnake, that population's exploded. It went from, like, six snakes to over 150 of them now in that particular restoration area. So the length of time that -- you know, worse case scenario may occur here; that some of the wetlands may have their water level drawn down to eight to ten years is well within my experience in being able to restore a natural community once

the disturbance is done.

Q Is there anything about the wetlands at this site that would lead you to believe that if these wetlands were affected by groundwater drawdown, that you could not restore them?

A No. There is nothing here that seems unusual or out of the ordinary.

Q Now, Dr. Tilton, I would like now to just go back over your conclusions that you formed. First of all, have we discussed today the basis for your conclusions?

A Yes, we have.

Q And if we could go back to slide 1? And again, if you could briefly review your conclusions in this matter?

A Yeah, if -- that would be fine. I think the key is, as we've sort of gone over here this morning, first of all that the wetlands over the orebody are contiguous with each other but that they vary quite a bit in terms of elevation; that the wetlands are dominated by forested and scrub shrub, wetland types, vegetation type; and that these plant species that make up these plant communities are tolerant of water-level changes; and that the soil of the wetlands has a profile of a fairly thin layer of organic matter that's underlain by silty clay; and that that silty clay influences the hydrology of the wetland to a significant extent; finally, that the wetland hydrology of various wetlands, although it varies from wetland to wetland depending on

where you are out there, is influenced by precipitation, surface runoff and then a combination of groundwater.

Q And on slide 2 your conclusions, Dr. Tilton?

A The conclusions, based on our study and the review of the available information in the reports, is that the wetlands that are dominated by precipitation will not be adversely impacted by any sort of predicted groundwater drawdown; that the wetland hydrology along the river of those emergent plant systems, because of the hydrology of the river, will not be adversely impacted by a groundwater drawdown; and then finally, that the wetland hydrology in the groundwater-dependent wetlands will be mitigated by the surplus precipitation and shallow water in the ground that comes from the higher wetland systems flowing down in the sand and gravel and in the surface soil, mitigating for any -- for the groundwater impact that will occur.

Q And so the drawdown as predicted by GeoTrans, will that have an effect on any of the wetland types?

A It won't have an effect on any of the wetland types.

Q And the last slide?

A The last two slides relate to the narrow-leaved gentian as a threatened plant species. But it's very common in this region, and it's been found to grow on a wide range of moisture conditions. So it's got a lot -- it's got a wide tolerance of moisture conditions; and then finally that the

mining permit that relates to wetlands and the narrow-leaved gentian population, will protect the wetland ecology functions and values, as well as the populations of narrow-leaved gentian.

Q Thank you, Dr. Tilton.

MR. PREDKO: Your Honor, I do have some housekeeping exhibit types of things that I'd like to do. But if we'd like to take a break before that, I can do that and then pass the witness.

JUDGE PATTERSON: Okay. Why don't we do that?

(Off the record)

MR. PREDKO: Just a few exhibit housekeeping issues, your Honor.

JUDGE PATTERSON: Okay.

MR. PREDKO: First, by stipulation of the parties, Dr. Tilton's Curriculum Vitae is already in evidence as Intervenor Exhibit 242. Next I would like to offer into evidence Wetland Coastal Resources Wetland Delineation Report of 2004 which was a part of the appendices of the environmental impact assessment submitted with the mine application. That is Intervenor Exhibit 12 Bates stamped KEMC108859 through 109063.

MR. DYKEMA: The stipulation -- he's correct. The CV is stipulated to. We would object to Intervenor Number 12. It hasn't been authenticated. Neither the author nor

the supervisor of that board has been here to testify. Dr. Tilton has offered opinions to some extent based upon his review of that which he's entitled to do whether it's admissible or not, but that doesn't make that report admissible, so we object on grounds of hearsay.

MR. PREDKO: And in response, your Honor, Dr. Tilton has testified that he's relied on this report in both doing his own surveys and forming his conclusions. This is the type of report that he has expertise in, and it is admissible in this case under APA 75.

JUDGE PATTERSON: I agree, Counsel, and I've done that previously when similar exhibits have been offered, so I will overrule the objection. Mr. Reichel, I assume you had no --

MR. REICHEL: No objection, your Honor.

(Intervenor's Exhibit 12, Bates 108859-109063, received)

MR. PREDKO: Next, your Honor, is the North Jackson 2004 Baseline Narrow-Leaf Gentian Report, and that is Intervenor Exhibit 12 Bates stamped KEMC109250 through KEMC109260.

MR. DYKEMA: Same objection.

MR. PREDKO: Same response, your Honor.

MR. REICHEL: No objection.

JUDGE PATTERSON: That was admitted through Mr.

Wiitala?

MR. PREDKO: No, not the Narrow-Leaf Gentian Report.

JUDGE PATTERSON: Again, same ruling; under Section 75 I'll deem it admissible and overrule.

(Intervenor's Exhibit 12, Bates 109250-109260, received)

MR. PREDKO: And the next three are in the same category and so I will just read them altogether. The next one actually is Mr. Tilton's report. It's the ECT 2006 Yellow Pond Lily Report, and that is Intervenor 262.

MR. REICHEL: No objection.

MR. DYKEMA: No objection.

JUDGE PATTERSON: All right. No objection, it will be entered.

(Intervenor's Exhibit 262 received)

JUDGE PATTERSON: And here's what I was referring to: The next two actually fall in the category of the others, both North Jackson reports. First the North Jackson 2006 Narrow-Leaf Gentian Update, and that is at Intervenor 267. And next, the North Jackson 2007 Narrow-Leaf Gentian Report, and that is at Intervenor 266.

MR. DYKEMA: Objection on grounds of hearsay.

MR. REICHEL: No objection.

JUDGE PATTERSON: And again I'll rule they're

admissible under Section 75 of the APA.

(Intervenor's Exhibits 266 and 267 received)

MR. PREDKO: And, your Honor, we would offer the slides that Dr. Tilton discussed as Intervenor 647 and also Dr. Tilton's -- were there two pages of drawings?

THE WITNESS: Two sketches.

MR. PREDKO: To sketches as Intervenor 648.

MR. REICHEL: Mr. Predko, just to be clear, the slides are 647; is that correct?

MR. PREDKO: Yes.

MR. REICHEL: And so the two sketches you want to label as demonstrative 648?

MR. PREDKO: Together 648, the sketches, yeah.

MR. REICHEL: I have no objection.

MR. DYKEMA: With the understanding that they're being offered purely for demonstrative purposes we have no objection.

JUDGE PATTERSON: With that understanding I will admit them.

(Intervenor's Exhibits 647 and 648 received)

MR. PREDKO: And with that, I pass the witness, your Honor.

MR. REICHEL: Your Honor, I have no questions at this time, but we reserve the right to pursue questions on cross-examination -- based upon the cross-examination.

JUDGE PATTERSON: Mr. Dykema, are you going first?

MR. DYKEMA: I am. Thank you, your Honor. May I use some of your slides?

MR. PREDKO: Absolutely.

MR. DYKEMA: Good morning, Dr. Tilton.

THE WITNESS: Good morning.

MR. DYKEMA: It is an honor to ask you questions.

THE WITNESS: Same.

CROSS-EXAMINATION

BY MR. DYKEMA:

Q Your field results talk about conclusions that you reached about wetlands over the orebody. If my understanding that your own research on the site, your own focus, was wetland -- the wetland complex directly over the orebody encompassing sites 6, 8 and 9?

A Yes.

Q So you did not evaluate the other wetlands that were identified in the wetlands delineation report elsewhere on Kennecott's property?

A If by that you mean the wetlands south of the river, you're correct. We didn't go into that area. We didn't look at those. But we did look at the wetlands all the way down to county road and then upstream a little bit from the orebody especially during the threatened and endangered species survey. But, you're right. We didn't look at -- I don't

know what the numbers are, and I'd have to pull that up graphic, but we didn't look at some of those wetlands to the south.

Q But the conclusions that you've offered today -- putting aside the endangered species material, --

A Okay.

Q -- the conclusions you've reached today on the nature and potential risk to wetlands were focused on the wetland complex directly over the site.

A Well, for the most part, but remember that the wetland complex extends north of the orebody. Maybe if we could pull up a graphic, if you go to that -- like, the third slide, I can show you what -- keep going. Maybe the sixth -- there. You see how the orebody -- the wetlands directly over the orebody are only a portion of we've been focusing on. We actually are studying wetlands up here (indicating) and down here as well. But to your point that these are the wetlands that we focused on and not the complete area that was the purpose of the wetland delineation, you're correct.

Q Okay. And so the record is clear, you're looking at your demonstrative slide 6, and your point was that your assessment did extend to the monitors, number 26 through 29?

A Yes, and to the west to monitoring well 23 and to the east to monitoring well 43. That's a good point -- that's a good

way to put it.

Q And am I right that in analyzing the issues that Counsel put to you and you reach the conclusions about likely impacts of groundwater drawdown, you did not yourself perform or direct the performance of any independent hydrologic modeling?

A That's correct.

Q So your hydrologic assumptions with respect to potential groundwater drawdown, were those produced by the GeoTrans model?

A Yes.

Q Now, are you aware that other firms have done other efforts at groundwater drawdown modeling in the context of this proceeding?

A Yes, I am.

Q If you were to be persuaded that a different model that projected substantially greater groundwater drawdown were more accurate or more reliable, you would need to revisit your conclusions, would you not?

MR. PREDKO: Your Honor, I'd just want to place an objection for the record. There's been no evidence set forth so far in this case that there will be any other drawdown other than that predicted by GeoTrans, and specifically there's been no other evidence as to the specific location of the drawdown, how much the drawdown will be and the location of the drawdown within the bedrock.

MR. DYKEMA: May I have one moment, your Honor?

JUDGE PATTERSON: Sure.

MR. DYKEMA: Your Honor, my understanding is to the contrary, that Dr. Prucha did just that; he did project groundwater drawdown and matched groundwater drawdown -- whether that is true or not, certainly the modeling exercise that GeoTrans did was, according to Mr. Council himself, Dr. Council, a matter beset with uncertainty. And I'm at least allowed to pursue with this witness the question of whether if those predictions are not reliable, he would need to revisit this analysis.

MR. PREDKO: I would agree on that last question, your Honor, that he can ask Mr. Tilton if the GeoTrans predictions are unreliable, would that change his analysis? However, I would disagree that there had been any testimony again as to a specific drawdown, the location of that drawdown, the depth of that drawdown. And I would again disagree about Dr. Prucha's testimony. Dr. Prucha testified that there may be a different inflow but certainly did not testify about any certain drawdown or the location of that drawdown.

MR. DYKEMA: The transcript will resolve counsel's and my quarrel on that particular claim. What I want to ask the witness is the extent to which he would need to revise his analysis and conclusions.

JUDGE PATTERSON: Okay. I'll allow you to go ahead with it.

Q Dr. Tilton, would I be fair in concluding that if you were of the belief that the groundwater drawdown could be substantially greater than GeoTrans predicts, you want to revisit your analysis?

A There would be a -- for some of the wetland areas, yes, certainly, I would be interested in doing that.

Q And by -- for "some of the wetland areas," you're talking about for some of the wetland areas within that area that you yourself focused on?

A Yes, that's correct.

Q So you're not in a position today to offer opinions as to -- I'll withdraw that. When you were summarizing your first conclusion in your slide number 2, Dr. Tilton, what I wrote down is that you actually added a couple of words. And I just want to make sure that I heard you correctly. What you said as opposed to what's written is that wetland hydrology in some wetlands on the site is predominantly dependent upon precipitation. But would it be fair to say that your conclusion here is, again, focused on that area on or almost directly over the mine site itself?

A Yes. That's a good clarification; yes.

Q In commenting and expanding upon your third conclusion on slide number 2, you expanded by saying that the projected

drawdown will not have significant adverse effects, my words, not yourself. The words I mentioned again are the words, the projected drawdown. And there again you're referring to the drawdown as projected by GeoTrans?

A Yes, that's correct.

Q Did you yourself or any other members of your team conduct any endangered species inventories other than your analysis of the gentian and the small lily?

A Well, yes, in the context of when we were looking for a particular species, the person is always open to other species that we might encounter. In other words, you're not -- just got blinders on looking for the small yellow water lily. If you find painted trillium, you'd make a note of that.

Q Your Ph.D. was in botany?

A Yes.

Q And my sense was, when Mr. Predko reviewed your impressive resume, that your focus since then has been on the botanical aspects of wetlands; is that fair?

A Well, I would say that it's more focused on the function and ecology of them.

Q Okay. But you don't consider yourself an expert in reptiles and amphibians?

A Oh, that's correct. No. You're right. In the sense that it's plant communities and how plant communities respond,

you're correct.

Q Let me fill in a couple of fairly minor lacune I noted on your CV. What was the company that ECT bought?

A Tilton & Associates.

Q Tilton & Associates. You've mentioned that you did an analysis of potential wetland impacts at the CIA headquarters. Do you have any continuing affiliation with the CIA?

A No, I don't.

MR. PREDKO: He can't tell you.

THE WITNESS: Yeah, that's true.

Q If you have to shoot me, I'll withdraw the question. Counsel described or had you describe the extensiveness of your experience in the State of Michigan and contrasted that with Dr. Adamus who has described in his testimony some studies he's done in Michigan and some inventory mechanisms he's created for Michigan. But the point was, he has spent a good deal less time here than you have.

A Yes.

Q Do you know Dr. Adamus personally?

A I don't know him personally, but I certainly know his professional reputation.

Q Are you familiar with his work?

A Yes, I am.

Q Do you admire his work?

A I do. It's been -- it's been very useful, added quite a bit to the advancement and knowledge and understanding of wetlands.
Q I believe you said your visit to the site was in October of '05.
A Yes, that's correct.
Q And you were there for two days and then met with the authors of the reports you were reviewing for one day?
A Yes. Two days of field work, one day of sort of meetings and collaboration on continuing studies.
Q And I gather you returned to the site when you were on the trail of the small lily.
A Yes; uh-huh.
Q And that was in the spring? Or was it?
A No, it was -- I believe it was in the summer. My staff actually did the visit itself, but I believe it would have been in the summer of 2006, the flowering period of the water lily basically.
Q Are there any disadvantages in doing the sort of general wetland review of survey to doing it in the late fall?
A Not for what we were interested in. Certainly if you are going out looking for a spring flowering plant and you go there in October, you're at a disadvantage. But when you're interested in sort of the hydrologic function and value and looking at soils and the predominant vegetation type, the

fall is not a significant impediment.

Q Returning again to the area, geographical area that you focused on which is above the mine site and with some bulge, particularly to the north, am I right that the reason you focused on that is that that was the area where GeoTrans projected in their base case a half foot drawdown?

A No.

Q Please correct me.

A At the time that we were conducting the baseline survey GeoTrans wasn't involved. We were working basically with North Jackson, and it was based on the understanding of having talked with Dan and also working with Kennecott to understand where the orebody was and where the ore mine was going to be and where the surface facilities were. That was how we discerned what we should be studying. And it was based on the drawdown sort of general idea what the drawdown would be at that time back in 2005 that we based our studies.

Q Who provided you with the a general idea of what the drawdown would be?

A Dan Wiitala -- you know, I don't remember specifically. It was at a meeting with Jon Cherry and the wetland hydrologist -- not the wetland hydrologist but the geohydrologist. Steve Donohue was present. So I think we -- at that meeting -- I guess the reason I'm hesitating

is a I can't speak to exactly who told us what the level of the drawdown was going to be at that time. It was more a general impression that it was going to be a drawdown. It would be in the vicinity of the orebody, and you should focus on the wetland ecology in this particular area.

Q Could it have been Mr. Cherry who gave you that notion?

A It was at a meeting at which he was attending. It could have been him, yes.

Q In reviewing your career you mentioned a couple of instances in which you had studied the relationship between a mine and area wetlands.

A Yes.

Q Are you aware of any instance in which an underground mine was constructed directly below a river and wetland system?

A Yes.

Q Where is that?

A Certain of the salt mines in the Detroit area extend under the Detroit River. And although I've not have any experience with the salt mines, I'm aware of that.

Q So you haven't studied the salt mines or their effect on area hydrology?

A No, I have not.

Q Are you aware of any cases where a sulfide mine was proposed or constructed directly underneath a wetland and river complex?

A I'm not, no.
Q The wetland delineation reports prepared for Kennecott all focused, as I understand it, on the acreage owned or leased by Kennecott. Do you share my understanding? Or perhaps you don't know.
A Well, they were limited by a boundary. That's for sure. I don't under- -- I thought they -- I don't know whether it's owned or leased. I thought it was some sort of property ownership pattern. I don't know which is which, in other words.
Q But is it your understanding that that boundary was provided to the researchers by Kennecott?
A I don't know. I don't know the answer to that.
Q The three wetland types -- and let me apologize in advance. I'm sure I'm going to get some terminology wrong. Please be bold in correcting me.
A Okay.
Q As I understand it, the three wetland types that you analyzed were the scrub-shrub, --
A Yes.
Q -- emergent --
A Yes.
Q -- and forested.
A Yes.
Q And none of those is groundwater dependent as a general

matter?
A On this particular site?
Q Yes.
A Yes, some of them are groundwater dependent.
Q And so are the riparian or the ones hear the river?
A And some of the scrub-shrub and a small portion of forested, I believe, is also groundwater dependent.
Q You showed us some grass that traced water levels over time and in some cases compared that with precipitation. Do you recall that?
A I do.
Q And one of the main points you were making is that the water level in the riverine wetlands is pretty flat over the course of the year, --
A Yes.
Q -- while the water level in the more upland wetlands fluctuates a great deal more?
A Yes.
Q And one of the morals you drew from that is that the more upland wetlands are much more heavily influenced by precipitation?
A Yes.
Q Does the flatness of the water levels in the riverine wetlands suggest or could it suggest that those wetlands are substantially supported by constant groundwater flow?

A Yes.
Q I apologize for jumping around.
A That's okay.
Q If you need background or you want to look at an exhibit to reorient yourself, please do. One of the discoveries that you made in doing your soil borings was that in much of the area you looked at, beneath a fairly thin layer of muck there was a thicker layer of sand and gravel.
A Yes.
Q I understood you correctly?
A Yes.
Q What's the word for the process by which a liquid is drawn upwards?
A That's generally referred to as capillary action.
Q Okay. Does capillary action happen in sand and gravel?
A It does, but to a very limited extent compared to some other soil types.
Q Where did your daily precipitation data come from?
A From the Marquette Airport. They have a station there and we obtained data there.
Q I noticed on your graphs that for the more upland wetlands, there was a water level drop during the winter.
A Yes.
Q And I believe you explained that that's because -- in my words, not yours -- the precipitation is tied up in snow and

ice.

A Yes. And the effect of the groundwater recharge of water percolating down through that silty clay layer is causing the drawdown. So it's a combination of no resupply but the drawdown, the recharge is occurring.

Q If the more riverine wetlands actually show a slight increase in water level over the course of the winter, might that again suggest that they're substantially supported by groundwater flow?

A Yeah, I believe it does. I think that's one of the things that, when we say groundwater dependent systems, that we're saying that that river, the stream and the wetlands alongside are dependent by groundwater -- on groundwater.

Q Revealing, perhaps, my color blindness, I need some help with this slide. Now, the pale green --

MR. DYKEMA: Do we have a laser pointer?

Q Well, do you have a laser pointer with you?

A I do. The pale green?

Q The pale green is the riparian wetland.

A Yes, right there (indicating). And there's a big blob right down there (indicating). That's the best place to see it.

Q Okay. And the blue -- can you sort of outline for us the blue?

A The blue is this kind of octopus-shaped area up in here.

Q Okay. So that's sort of the water colored part.

A Yeah.
Q Or purplish. And then the tan is the groundwater supported.
A Right here (indicating), this band that lies between the upland and the river, so right in through here (indicating).
Q Okay. So by comparison, there's a whole lot more tan than there is green or blue. Am I looking at that correctly?
A Yes.
Q In this piece of map.
A Yeah, from county road all the way to the edge of the map, yes, you're correct.
Q If the Department of Environmental Quality were to conclude that a substantial groundwater drawdown -- and let me say "substantial" is a foot or more -- would actually occur over a large area of the tan wetland depicted in your demonstrative 17, do you believe they should have serious concern about the environmental impacts of this mine?

MR. PREDKO: Your Honor, I would just place the same objection, that there's been no even suggestion that the MDEQ has made such a determination and there's been no testimony from Petitioners to support that.

MR. DYKEMA: I disagree about the state of the record, but it's a hypothetical question.

JUDGE PATTERSON: I'll allow it on that basis.

A A foot may or may not have an impact on the wetlands. And let's just talk about the wetlands in the brown area right

here (indicating).
Q Those are the ones you studied?
A Yeah.
Q Okay.
A If the DEQ determines that they're projecting a foot drop, it depends on what the nature of that foot of drawdown is, its seasonality, its magnitude, its duration, because the wetland can tolerate all sorts of different scenarios, more than others, for instance.
Q Again, talking about the wetland that you looked at?
A Yes.
Q Okay. So I gather you're not in a position to offer opinions about the vulnerability of other wetlands in the area to groundwater drawdown other than those you focused on?
A That's correct. You know, these area -- that's right. This is the area that we've really done all of our background work.
Q And on slide 17 what you're indicating with the laser was essentially with the red, irregular circle?
A Well, no. From 23 -- basically the triangle that's formed by the river on the lower leg from 23 to 29 and then the norther limit of the wetland down to -- I think that's 28, that sort of triangle is the area we focused on.
Q Towards the close of your testimony you talked about the

monitoring program that the DEQ has asked Kennecott to carry out.

A Yes.

Q Is there a monitoring well directly above the orebody, do you recall?

A Well, there is a well within the orebody. I don't know whether it's centrally located. It would be the 43, that well right there. We used that in our studies, and we've got a good record of what it shows, not just for 2007, but going back in time. So we've got a couple of years to make some comparisons, but it's sitting right there. So I think that's pretty good a well.

Q What does the QAL stand for -- or this is not an acronym test. What is a QAL-type well?

A It's the name the hydrologist gave the well. And QAL stands, I think, for quaternary, but that's all I know is that it -- it's not like a separate kind of well. When I looked at the well log, it is -- it's a piezometer, so it's the same construction, some type of screen depth as some of the other wetland wells. The wetland wells just weren't set as deep as the QAL wells.

Q I'd like to return to your discussion of the likelihood that if there's a groundwater drawdown in the groundwater dependent wetland within your study area, that loss of water will likely be compensated for through surface water

precipitation; is that -- can you --

A Yes, that and the shallow groundwater, so you have precipitation and then shallow groundwater that's going to compensate for the groundwater drawdown.

Q And am I right the shallow -- the source of the shallow groundwater is itself precipitation or not?

A Ultimately, yeah. Ultimately it is.

Q If the water in the groundwater-dependent wetland within your study area is replaced -- if groundwater is replaced by precipitation or shallow surface water, that will alter the water chemistry of the well, will it not?

A Not significantly. The precipitation has a different chemistry than the groundwater. There's no question of that. But by the time the shallow groundwater works its way down through this sort of layer of organic matter and sand and gravel from the upslope position and gets down into the groundwater dominated area, the precipitation chemistry has been buffered by all the leaching and contact with all that mineral matter. So it's not as if those groundwater dominated areas are going to be converted to ombrotrophic precipitation dominated bogs. The second thing that is working to mitigate the impact of that precipitation replacing the groundwater is that those plants are rotted in sort of a mineral soil. They're rooted either in the sand and gravel or in the silty clay itself. So while, you know,

groundwater chemistry may shift a little bit more towards the precipitation side, the plants are really obtaining their nutrients from the soil.

Q Will that replacement of groundwater with surface water or shallow groundwater result in a change of water temperature regime?

A No, I don't believe it will.

Q When Dr. Adamus was on the stand he quoted from a peer reviewed paper to the effect that the changes in water level in a wetland -- and I think the focus was a fen; I'm not sure -- of just a couple of centimeters can have profound effects. Do you recall that?

A I do.

Q And Mr. Predko asked you about that. And am I right that your opinion is that, while that is true, it's true only under very limited circumstances?

A Well, I wouldn't characterize it as very limited, but it's true under circumstances that don't exist at these wetlands.

Q And by -- "these wetlands" being the ones you focused on?

A Yes; uh-huh.

Q And the two instances where you suggested it may commonly be true were vernal pools and lakeshores?

A Well, I gave those as examples for today's discussion. But there are other wetland types where an inch or two of water level change can have some impact.

Q I gather you are not in the position to educate us as to the number or extent of vernal pool-type wetlands that exist within, say, a mile of the mine site?
A That's correct.
Q As far as you know, there may be quite a lot?
A Well, as far as I know, I would doubt that, but I can't tell you how many there are. I doubt it because the geology and the plant cover, the vegetation that you see here doesn't show any kind of vernal pool-type signature on that aerial photograph, plus this is all from what we've seen, sand plain. So you need -- you don't get surface water sitting upon the ground in small depressions in these kind of sandy glacial outwash areas.
Q South of the Arctic anyway.
A Yeah, that's true, but --
Q But there are forested areas here.
A There are.
Q And those may hold vernal pools.
A They may. You're right.
Q And those pools may be sensitive to a very small change in groundwater levels.
A Well, we would have -- if the pools were there, we would have picked them up in the wetland delineation. They would have been identified.
Q But only to the extent that they appeared within the

designated area that Kennecott provided for that delineation.

A I agree.

Q So if there were vernal pools or other wetland types outside of that delineated area, they would not have been picked up?

A That's correct.

Q And, indeed, outside of that area there are extensive wetland systems within a mile or two of the mine site.

A Yes.

Q Do you agree with that?

A Yes.

Q Would you agree that, generally speaking, this area appears to be very rich in wetlands?

A Yes.

Q Dr. Adamus testified a fair amount about fens as opposed to other kinds of wetlands. Do you recall that?

A I do.

Q Do you share his opinion that fens are particularly valuable in that they support diverse and unusual organisms?

A Yes, I do.

Q Are fens also particularly vulnerable to groundwater drawdown?

A Yes, they are.

Q Am I right that you're not in a position to opine at all as to the number or extent of the groundwater dependent fens

within, say, a mile of the mine site outside of the area that you yourself looked at?

A That's accurate, yeah. I've not had an opportunity to do an inventory outside the area that I did my work in. You're correct.

Q Are fens or can fens be another example of a wetland in which a fairly dramatic changes in, for example, plant composition can be changed by the change in water level of only a couple inches?

A I would say in my experience, no. Where I've seen significant changes in vegetation in fens it requires an order of magnitude two or three feet to really begin to get the vegetation to start to shift.

Q Help me to understand the relationship between the sort of average water level, which I think is what we've been talking about all this time, and normal annual fluctuations. As I understand it, the root zone is 12 inches.

A For some plants, yeah. For purposes of wetlands, 12 inches is a good number to use, yes.

Q Okay. So to be a wetland, there has to be saturation of some significant part of that 12 inches for some part of the year.

A Yes.

Q If there are normal fluctuations from one year to the next in an area that take -- that put the wetland at the edge of

being able to maintain hydrophytic plants, could it take only a fairly small drawdown to push it over the edge?

A If you have a situation where you barely have a wetland system; in other words, the wetland plants are codominant with upland plants and that the soil is only saturated for 15 days in the upper 12 inches, if you had that scenario and you took away the water for 10 or 15 days so it was never saturated, for instance, then that's quite possible that that wetland would tip the balance towards upland species. The soils would still stay the same, but the hydrology would go away, so technically you might be able to do that. And that happens all the time. Wetland boundaries shift all the time in the field, so the scenario you're describing is very possible.

Q I gather the wetland area that you focused on doesn't -- none of the wetlands in there meet that description.

A That's correct.

Q None of them are borderline.

A None of them are borderline. The dominant wetland plant -- the wetlands are dominated by wetland plants. In other words, there's not 50/50. We don't have a stand of black cherry in among the tamarack. And the hydrology is inundated -- as you can see it's inundated within 12 inches of the surface the whole year long for some of those wetlands, yeah.

Q But you're not in a position to opine as to the number or extent of wetlands outside of the area you focused on that might meet that description; namely, a groundwater dependent wetland that's on the edge, and it could be profoundly affected by a relatively small groundwater drawdown.
A Not without some more study. I think you're right; yeah.
Q You talked for a little bit about a subject that is near and dear to the hearts of all Michiganders, invasive species.
A Uh-huh (affirmative).
Q I think we are the world champions at invasive species in this state. And you pointed out that there are -- in talking about the risk of an invasive to take over of valuable wetlands, there are some impediments; is that --
A Yes.
Q That's my word, but is that okay with you?
A No, that's good; yeah.
Q One was you've got to have the seeds; right?
A Yes.
Q I mean, the seeds don't come from outer space. You've got to have seeds in the area in order to colonize.
A Yes.
Q And you said that there -- you need to have some other source of stress to that the invasive plant has some advantage; did I understand you there?
A Yes; uh-huh.

Q And on the subject of stress you noted that a lot of the trees in this forested wetland in the area you focused on are facultative and actually a dry year or two does them well.
A That's correct.
Q Now, that's going to be true for what they call obligates?
A That's true.
Q And obligates are plants that can only live in a wetland, or as you put it: 99 percent of them live in wetlands.
A That's correct.
Q Okay. So if you do get a drawdown in an area that is dominated by obligates, the stress impediment has been taken away for an invasion by exotics; fair?
A That's a much more serious situation. That's fair to say, yes.
Q And I gather in the wetlands that you focused on, there were none that were dominated by wetland obligate plants?
A That's correct; yes.
Q You're not in a position to say the number or extent of wetlands outside of that area but within a mile of the mine site that are dominated by obligate wetland plants.
A Well, the wetland delineation report does give you an idea of which of the wetlands are dominated by obligates. And my impression of that report is that very few of them were that kind of community. Basically the mixture of plant species

always had some sort of facultative wetland plant growing among them.

Q But again that delineation report is limited to the acreage that Kennecott prescribed?

A That's true.

Q So even it tells us nothing about the nature, extent or quality of the wetlands outside that designate area?

A That's true. In order to go to that you'd have to go to the National Wetland Inventory map that is prepared for Marquette County.

MR. PREDKO: Could we just place an objection? Counsel used the term "Kennecott prescribed," and the witness said he didn't know.

MR. DYKEMA: The witness said he did not know.

MR. PREDKO: Yes.

MR. DYKEMA: That's a fair point. Thank you for clarifying that.

MR. PREDKO: Thank you.

Q A moment ago you agreed with me that if a wetland is dominated by obligates and there is a significant drawdown, we have, vis-a-vis, invasive species problem on our hands. Okay?

A The higher risk of invasive species, yes.

Q The higher risk.

A Uh-huh (affirmative).

Q Give me some -- my words were "a wetland dominated by obligates." I assume that's an easy question, but give me a sense of it. At what point would you be worried? Would it be if you have 30 percent of the plant community as obligates? 40 percent? 50 percent? Or is that even a meaningful question?

A You know, it's a multi-variate risk assessment, only part of which depends on the wetland ranking of the dominant plant species. You need to, as I mentioned, take into account whether the disturbance results in a bare soil. Does the disturbance result in -- does the disturbance occur in a setting in a wetland that's surrounded by other populations of aggressive species? In other words, if we had two wetland types, one on Harsens Island surrounded by Phragmites and one in the Upper Peninsula on the Salmon Trout River with hardly any invasive species, the same changes don't necessarily bring with them the same levels of concern because a drop in water level on the Salmon Trout River where the obligates might be stressed, that opened niche, if you will, that opened space in the wetland might just as likely be colonized by facultative wetland species, native facultative wetland species; whereas, on Harsens Island, if you stop cutting the grass, the Phragmites will take over down there. So I've used two extremes to kind of illustrate the point, but I hope that you get the idea of

how the stresses themselves don't necessarily immediately result in invasive species coming into the wetland.

Q I stand justly accused of grossly over simplifying, and I plead guilty. On the first impediment that you mentioned that the seeds have to get there, do you recall if the environmental impact assessment paid any attention at all to the question whether the introduction of heavy daily truck traffic in this area might provide a vehicle for the introduction of exotic seeds?

A I don't recall whether that is described in the EA. It is a mechanism. It is a mechanism for introduction.

Q In your opinion is that a legitimate concern that should be thought about?

A Well, for the wetlands that I studied, no, because we don't have truck traffic going through it. We're not going to cut any new roads through the area. Most of the heavy equipment, the daily routine stuff is going on to the east. So I'm not too concerned if --

Q How about for wetlands in the area where the trucks go by?

A You know, to the extent that those trucks are driving through wetlands that have invasive species and then loose the mud on the way to the mine site, yes, possibly.

Q It does happen, doesn't it?

A Yes.

Q In fact, isn't that a fairly common mechanism for the

dispersal of exotic plants?

A It's one of them, yeah.

Q Do you know if the pitcher plant is a listed species in Michigan?

A That's a good question. I don't know.

Q Did you or your team happen to see any pitcher plants when you were there?

A I did not see any pitcher plants.

Q I wrote down here and I put quotation marks around it so I'm claiming that I heard you exactly, "Groundwater drawdown will not harm this wetland system." Is that a statement you made?

A Possibly, yes.

Q But you need -- to be precise, we'd need to qualify that by saying that the groundwater drawdown projected by GeoTrans will not harm the wetland system that you and your team focused on?

A Yes. That's a valid clarification.

Q If the groundwater drawdown in the area you looked at for the gentian is substantially greater than GeoTrans predicts, would you agree with me that the gentian community there could be put at risk?

MR. PREDKO: Same objection, your Honor. If I could have a continuing objection then I won't interrupt the testimony.

MR. DYKEMA: I have no objection to his continuing objection.

JUDGE PATTERSON: Okay.

A Not necessarily because, you know, we -- in the survey of where the gentian is growing, it is over a wide range of moisture conditions. So it is quite possible that a more significant drawdown, because it's mitigated by the mechanism of surplus precipitation and groundwater, surface groundwater, the shallow groundwater, it might be sufficient to mitigate that. In addition, the populations along the Salmon Trout River, they wouldn't be influenced by a greater groundwater drawdown.

Q Would they be influenced if a groundwater drawdown resulted in a loss of water in the Salmon Trout?

A Possibly. Possibly. But they still have that sort of tolerance of dry conditions, sandy conditions. So it depends a little bit on how much of a drawdown of the Salmon Trout River plus where they are actually growing. If they're growing in some of the muck, the zero to -- the mucky soils that we found, they're going to be buffered against that drawdown to a certain extent because that muck soil has a little more holding capacity to it, a little moisture holding capacity unlike a sandy soil which tends to be fairly droughty. So some of those might be able to tolerate a greater drawdown.

Q If you were persuaded that the groundwater drawdown was going to be substantially greater and over a substantially wider area that GeoTrans projects, would you want to revisit your analysis of the potential impacts on the gentian?

A Yes.

MR. DYKEMA: Your Honor, I'm not going to finish my cross-examination before lunchtime, and I think I may be able to save us all a little time if I address a technological issue while others have lunch.

JUDGE PATTERSON: Okay.

MR. DYKEMA: But I don't think I have more than about an hour to go, so we will make an early day.

JUDGE PATTERSON: Okay. Want to come back at 1:00 o'clock?

MR. DYKEMA: That's fine.

(Off the record)

JUDGE PATTERSON: Okay.

MR. REICHEL: Judge, with Mr. Dykema's consent, I just wanted to address a procedural matter here.

JUDGE PATTERSON: Okay.

MR. REICHEL: Because of a scheduling conflict, I may need to leave early today. I've asked one of my colleagues, Assistant Attorney General Dan Bock, B-o-c-k, who is seated with me, to sit in for me for the remainder of today's proceedings.

JUDGE PATTERSON: Okay.

MR. REICHEL: Thank you.

Q Dr. Tilton, we're looking at a passage from a piece that you and others authored that Dr. Adamus commented on. And in the middle of that passage, I've highlighted the phrase, "Wetlands are the most important habitat for wildlife in the Great Lakes region." Do you believe that today?

A Yes, I do.

Q At the end of the passage that's quoted in our slide number 1, it states that:

> "Alteration to microbial habitats alters regional patterns of mineral cycling and can cause an increase in nutrient loading to contiguous lakes and streams."

Can you explain how that increase in nutrient loading happens?

A Well, one of the most common mechanisms is that there's an alteration of the nitrogen cycle. And what can happen is that, if -- there's a component of the nitrogen cycle that is mediated by certain species of bacteria that occurs in anaerobic conditions. And it's the process by which bacteria take nitrate, a molecule of nitrogen that's dissolved in the water, metabolize it and convert it into nitrogen gas, either nitrogen N2 or nitrous oxide, and release it into the atmosphere. So by virtue of doing that, nitrate, which can be a limiting nutrient in certain aquatic

systems, is removed and transported to the atmosphere where it just becomes part of the nitrogen pool. So that reference right there refers to the possibility if you alter the microbial habitat so that the denitrification is no longer active, that you -- then that nutrient -- the nitrate is now free to migrate down to the -- in the lake or stream. That's what it refers to.

Q Am I right that anaerobic conditions are one of the hallmarks of a wetland?

A Yes; uh-huh.

Q And hence that is one of the critical environments for anaerobic bacteria?

A Yes.

Q And anaerobic bacteria play a critical role in the nitrogen fixing cycle?

A That's correct. Nitrogen -- well, the nitrogen cycle. That's true. The nitrogen fixing part of it is also true, but it's a little broader than that. It's both the denitrification as well as the nitrogen fixing.

Q Am I right that wetlands also serve an ecological function in that they store metals and other toxins?

A Yes.

Q And if a wetland is desiccated and the soil is washed out into surface waters, does the introduction of those metals and other toxins represent a potential adverse effect to

wetland loss?
A Hypothetically, yes; that's correct.
Q I gather you don't believe that that's a risk in the specific area of wetlands that you looked at in this matter?
A That's correct.
Q But you're not in a position to opine as to whether that might be a risk at other wetlands in the area of the mine?
A Yes, not ones that I haven't studied. That's correct.
Q Dr. Tilton, let me give you a moment to read the text that's reproduced on slide number 4.
(Witness reviews slide)
Q Is there anything in the language that we've excerpted from this paper by Bedford and Godwin with which you disagree?
A No.
Q And are the statements made by Bedford and Godwin here any less true of fens in the Upper Peninsula of Michigan than they are of fens elsewhere?
A No.
Q I believe you testified that you reviewed the appendix to the environmental impact statement that comprised a survey of threatened and endangered species?
A Prepared by North Jackson or was that the Wetland and Coastal? I think it's Wetland and Coastal that's in the appendix?
Q I believe that right.

A Yeah.
Q I will represent to you that it was Wetland and Coastal Resources, Inc.
A Okay. Yes.
Q And do you recall that, in the context of that study, Wetland and Coastal did an analysis of several sites under the Floristic Quality Index?
A Oh, yes; yes.
Q Okay. Can you briefly explain to what the Floristic Quality Index or FQI is intended to do?
A Okay. Imagine that you go into a plant community and you get a list of all the plant species that might be in that area within eyesight. What the botanists worked out several years ago, several really respected field botanists in the state, is to try to come up with -- if you look at different wetland community -- or any kind of plant community assemblage, what's the degree of, for lack of a better term, naturalness or weediness of that plant community; in other words, what's the floristic quality. And what they tried to do is they tried to say, look, there are some species that are rare or threatened. There are some species that are considered native. There are some considered weeds because they were brought in. And then there are invasive species. So they gave the native rare plants the highest floristic quality score, and they gave the weeds the lowest floristic

quality score.

Q Even lower than the exotics?

A I'm using weeds and exotics sort of interchangeably, yeah. So then the idea is that you take your plant list and you go through some mathematical manipulations and you come up with a single number that describes the floristic quality of that plant community. And in that way, the idea is that we sort of have a yardstick by which a single number is meant to describe the floristic quality of the plant community you look at.

MR. DYKEMA: Number 7.

Q Thank you. This is two quotes that Dr. Adamus excerpted from the Michigan Natural Features Inventory publication. Is it your consistent with your understanding that the MNFI regards wetlands in the 50's as extremely rare and areas with an FQI higher than 35 as floristically important from a statewide perspective?

A Yes. That is my understanding, yes.

Q All right. Now, of the sites that Wetland and Coastal Resources applied the FQI to, do you happen to recall how many included wetlands?

A I don't, no. I'm sorry.

Q That's fine. Let's go to slide 6. These are three portions from the EIA, Appendix F, the threatened and endangered species assessment. And these excerpts describe habitat

area B, habitat area E and habitat area F. And do you see for habitat area B it states in the second sentence that, "Both wetland and upland habitats occur within this area"?

A Yes, I do.

Q And area E, it describes three different types of bogs?

A Yes.

Q And habitat area F includes emergent sedge meadow and scrub shrub wetlands adjacent to the Salmon Trout River?

A Yes.

Q Okay. So would you agree with me that these three areas at least include wetlands if they're not entirely wetlands?

A Yes, I do.

Q Now, can we go to slide 8? Dr. Tilton, you were here when Dr. Adamus testified, so you may recall this excerpt from the same Wetland and Coastal Resources work. It is their Table 3.2. And this sets out their FQI values?

A Yes. I do recall the slide, yes.

Q Okay. And do you see that area F, which is described as emergent sedge meadow and scrub shrub wetlands, gets a score of 56.5 and under all plant species 55.6?

A Yes, I do.

Q And under the Michigan Natural Features Inventory system, that location would be scored as extremely rare?

A Yes.

Q And the -- full disclosure here. Those arrows are not in

the original Table 3.2. I added those with my crayolas.

A Okay.

Q But you see the other two wetlands, area B and area E.1, score north of 40?

A Yes.

Q And that, under the MNFI system, would characterize those areas as possessing sufficient conservationism and richness that they are floristically important from a statewide perspective?

A I agree with that.

Q Okay. And is -- the area F, I believe, is in the -- in or close that based on the description the area that you focused on?

A Yes; that's correct.

Q And would you agree with me that -- would you agree with the suggestion of the FQI index approach that that is exceptionally rare real estate?

A The habitat F is extremely rare in terms of its quality -- in terms of its floristic quality. The species composition, that makes it extremely rare. But the important distinction in my mind is that the wetland type is not rare.

Q Understood.

A Okay.

Q But is the extraordinary -- well, does a high FQI index allow us to characterize an area at least from a botanical

point of view as pristine?

A No, not necessarily pristine meaning lack of disturbance or no disturbance whatsoever. It just allows you to describe it as being dominated by native plant species. Take a look at the column up there, native plant species. That is a very good score. And I don't mean to diminish the quality of the wetland. I'm just trying to put it in context.

Q I understand. Is that quality of the wetland likely to be a significant part of the explanation for why the Narrow-leaved Gentian is relatively abundant there?

MR. PREDKO: I'm just going to place an objection, your Honor. I believe it mischaracterizes the evidence. There's been no evidence in this case to show that the Narrow-leaved Gentian is actually abundant in any one of those three areas.

MR. DYKEMA: I'll rephrase.

Q I believe you testified -- and correct me if I'm wrong -- but one of the reasons why you do not believe this mine is going to have a substantial adverse effect on the Narrow-leaved Gentian in the area that you studied is because it's relatively abundant there? Did I hear you correctly?

A That is one of the factors, yes.

Q One of the facts.

A Uh-huh (affirmative).

Q Okay. Is the high quality of the wetland as reflected in its extraordinary FQI value likely one of the reasons why the Narrow-leaved Gentian is relatively abundant there?

MR. PREDKO: Same objection, your Honor. There's been no evidence to show that the Narrow-leaved Gentian is abundant in these areas that Mr. Dykema has taken off of this slide that depict a high FQI. There are certain other areas that have lower FQI's. And it's not been established whether the Narrow-Leaved Gentian exists in lower FQI's, higher FQI's or both. There's nothing in the record.

MR. DYKEMA: Your Honor, I think I have laid the foundation. But if Dr. Tilton wants to clarify the subject, he's fully able to.

JUDGE PATTERSON: I'll allow him to answer.

A The -- this number is not a -- it's not a causative factor in the distribution of Narrow-leaved Gentians.

Q Of course not.

A What it is is sort of a reflection of the fact that, well, this is a really nice wetland. It's got a lot of native species. Narrow-leaved Gentian can occur in 17.4 just as well if the habitat were right for it, namely that it's got that sort of sedge associates, even some of the sand and gravel. So, I mean, just to say that Narrow-leaved Gentian is limited to the extremely rare areas is not fair. It's a much broader distribution. It may be there, and it may

contribute to that high number. But that high number is not -- it's sort of the opposite. That high number doesn't mean that's where Narrow-leaved Gentians are going to be limited to, because they found them in some dry and gravely that, I doubt, had 56-1/2 as an FQI.

Q I'm interested in the two different columns in Table 3.2 of the Wetland and Coastal Resources analysis. As I look down the two columns, I see either no difference or fairly small differences between the two values. Is that a fair characterization?

A That is a fair characterization, yes.

Q And am I right that that reflects that there is very little presence of exotic species?

A That's correct.

Q So the entire area surveyed has very high natureness, as you put it?

A Yes, in terms of the flora. Yes.

Q Do you have any reason to believe that the fauna is not comparably natural and rich?

A No, I don't. I don't have any basis to believe that.

Q We've been talking mostly about plants. But -- and while you're not an expert in animals to the same extent you are an expert with respect to plants, is it also true that wetlands support a broad variety of animal wildlife?

A Yes, it is true.

Q And is it true in Michigan that wetlands support several state-listed animal species?
A Yes.
Q Am I right that the mine site -- the proposed mine site is located underneath the headwaters of the Salmon Trout River?
A A portion of the headwaters. You're correct in that; yes.
Q And is it close to the headwaters of the Yellow Dog?
A Well, I don't know about close. It's -- let's say it's in close proximity.
Q Okay. That's fair.
A It's within -- yeah. Let's leave it at that.
Q Okay. So the wetlands that you looked at and surrounding wetlands are part of the headwater complex of the Salmon Trout River?
A Yes.
Q Dr. Adamus testified and invoked some literature to support the point that headwater wetlands are especially important; do you agree with that?
A I do.
Q Why is that?
A Well, there are a couple of different reasons for them. Taken as a whole, when you look at the wetland complex, they do a couple of different things. First of all, they -- in some situations where there's groundwater discharging from wetlands, they help buffer the flow of the streams so that

they -- you know, the old days we used to think they acted as sponges sort of slowly soaking up water -- slowly letting water leak out. Since then, researchers, especially in Wisconsin, have helped clarify that analogy so that we recognize that some wetlands provide that function; other wetlands don't provide it at all. They provide this biogeochemical function that I described earlier where they collectively in lots of different locations in the headwaters filter sediment, remove nutrients, take out contaminants, trap metals. They are frequently in their headwater position especially for certain species of fish very important from a spawning perspective and a nursery area. And then there's also some pretty good evidence now emerging that describes their capacity as sort of jump starting through the release of nutrients and dissolved carbon the cycle of life, if you will -- that's a little too broad a perspective. But what they do is they release phosphorus and dissolved carbon out into the stream in the spring so that aquatic insects, young of the year fish, tadpoles, young of the year amphibians have algae to chew and eat and survive. So that flush of nutrients is viewed by some as sort of jump starting the cycle of life for a lot of organisms. So it's sort of, to summarize, everything from hydrologic all the way down to habitat for fish and wildlife.

Q Dr. Adamus invoked a passage from a paper from the North Carolina Division of Water Quality. And it -- well, let's put up slide 10.

(Witness reviews slide)

Q Dr. Tilton, do you agree with the statement that I've highlighted -- or that Dr. Adamus highlighted at the end of this excerpt which reads, "Therefore maintaining the ecological integrity of these system" -- and by that is meant headwater wetlands -- "is necessary to protect the quality of the entire downstream watershed." Generally speaking, do you agree with that statement?

A Generally speaking, I do.

Q Do you have any reason to believe that that statement is less true of the wetlands at the headwaters of the Salmon Trout River than it is at other rivers?

A No; no, I don't.

Q We've talked a little bit about groundwater modeling and the GeoTrans modeling that you relied upon. Generally speaking, if groundwater levels are reduced, does that result in a reduction or lowering of the surface water in wetlands that lie above them?

A Not necessarily, no.

Q But my question wasn't whether it necessarily does. My question is, generally speaking, do those two things happen together?

A Yeah. But the phrase "generally speaking" to me -- you know, I can think of so many places where that doesn't occur that -- in terms of wetlands that I have a hard time answering it for you.
Q Okay. Let me limit it, then.
A Okay.
Q If we're talking about fens, would you agree with me that, generally speaking, the water level in a fen will go down if the groundwater level below it goes down?
A No. I don't agree with that.
Q Okay. On direct examination, you discussed a little bit the ability of wetlands that have been dewatered -- my word, not yours -- to recover if the water is restored to them.
A Yes.
Q And you pointed out that, in fact, it's possible by human intervention to reestablish a wetland and to reestablish native plant communities there.
A Yes.
Q Would you agree with me that wetland restoration is often difficult and is not invariably successful?
A It's difficult. It's always successful in terms of reestablishing hydrology. It doesn't always result in plant communities that -- right away that you expect. You sometimes have some unexpected outcomes in terms of plant communities established. And I'm not just talking of my

work now. I'm talking, of course, of the work by many conservation groups and the federal government and all the wetland restoration work that goes on. Some are easier to restore than others. And that's why I sort of picked apart your statement a little bit.

Q Let me focus in on the first part of your answer, which was that you can always restore the hydrology.

A Yes.

Q I don't know. The biological community may be a little harder to control?

A Yes.

Q If as a result of an underground excavation the connection between the groundwater and the surface water in the fen is broken, you can't assure anyone of your ability or anyone else's ability to re-create that fen, can you?

A Well, no. It depends on the nature of interruption. If the groundwater has been drawn down by virtue of inserting a source of disturbance that takes water out of the system for a short period of time and then you stop doing that so that the balance of precipitation and inflow of groundwater can be restored, then it can come back. If --

Q Would --

A I'm sorry.

Q No. It's my duty to let you finish your answer.

A Okay. If on the other hand you've done something in the

process of -- let me -- let's say that you punctured a silty clay layer so -- or you did something significant to the hydrology in such a way that the groundwater pattern and the distribution, the balance between groundwater and precipitation is permanently disrupted, that's more difficult. Yes.

Q That's what I was getting at.

A Yeah. That's more difficult. But if it's you have a pump in the ground and you're pumping groundwater out and you don't alter any of the stratigraphy underneath that wetland upon which the wetlands depended, if you just turned the pump off, in my experience, that's usually adequate to restore the hydrology of the won't.

Q It's my understanding -- and I want you to correct me if you have a different understanding -- that the GeoTrans modeling does not purport to project for how long a period of time their predicted drawdown will occur.

A My recollection is that I agree, that it does not. What it does is it projects a drawdown based on a water withdrawal rate. But they don't have a temporal variable that I can recall.

Q Staying on this subject of restoring wetlands, if a fen is dried out and the soil is washed away, will that wetland naturally return to being a fen or can it?

A That is a little more of a difficult restoration project.

Technically the fen is defined as a wetland type dominated by groundwater inputs. So the fact that the soil has been -- we're talking hypothetically now. The fact that the soil was maybe mined for peat mining or something of that sort, that stops and now you bring the water level back. It meets the definition of a fen. But you're going to have a difficult time getting the vegetation reestablished without the soil present. Because the organic really does in a way influence the types of plant species that you get there. There are some fens that I've restored where the peat had been taken down, and we got right into the marrow or the sort of calcium carbonate silty clay that underlay the peat. Once we brought the water level back, the fen was growing. It just had different species growing there than we were growing before.

MR. DYKEMA: Can I have slide 13?

Q Dr. Tilton, Dr. Adamus excerpted a piece from page 37 of the environmental impact assessment. Take a moment to review this, and I'll have a question about it.

(Witness reviews slide)

A Okay.

Q I'm interested in the second half of this where the authors wrote -- by the way, were you the author of this?

A I don't recall writing this. I'm not sure who was the author of this.

Q I'll read it.

"Because Wetland Complex 6 is a wetland upland complex, there are both groups of plant species in close proximity to one an. Upland species, under dryer soil conditions, would grow from seeds already present in the soil or spread rhizomatously from dryer to former wetland positions. The former wetlands would remain vegetated."

And then I have a lacunae there indicating that's not the end of the sentence. Do you read this to acknowledge that, under these conditions, a wetland would be lost and would be replaced by a different ecosystem?

A Well, that a wetland could be lost. I think that's what they're trying to describe in this assumption.

Q Am I right that the only potential adverse wetland impact that you considered was groundwater drawdown?

A Yes; that's correct.

Q Okay. And I'll note by way of a footnote that you also considered some other impacts on the threatened plants?

A Yes.

Q But you considered that they're not going to be driving trucks over them and so on?

A Yes.

Q But in looking at the wetlands -- clay wetlands, the only potential adverse impact that you studied was groundwater

drawdown?

A Yes. It was my understanding from the beginning that there'd be no fills or anything of that sort, that the major disturbance to these particular wetlands, there wouldn't be any vegetation clearing, there wouldn't be any cutting of trees or opening up of spots. The only thing that was going to be changing would be the groundwater levels.

Q How about acid mine drainage? Did you consider the potential impact of -- well, let me back up. Are you familiar with the term "acid mine drainage"?

A Yes, I am.

Q Okay. Did you consider the potential impact of acid mine drainage on wetlands in the areas surrounding the mine site?

A No, I did not.

Q Were you told not to?

A No. In fact, acid -- wetlands are used to treat acid mine drainage in many parts of the country. So there wasn't a limitation on my part. It was just that it was not -- based on where the mine was and where the rock was going to be handled and where these wetlands were, we didn't see acid mine drainage as a significant source of impact.

Q So did you and your colleagues perform an analysis of the likelihood of acid mine drainage?

A No.

Q Did you perform an analysis of the likely impacts should

acid mine drainage occur?
A No.
Q Did the environmental impact assessment consider potential impacts on wetlands should acid mine drainage occur?
A I don't know. I don't know whether that was part of it.
Q How about airborne contamination? Did you or any of your colleagues consider the potential impact on area wetlands should this mine emit significant quantities of airborne metals and sulfur-causing compounds?
A No. That wasn't part of our charge.
Q Okay. Were you asked to assume that that wouldn't happen?
A No.
Q Did the environmental impact assessment, to your recollection, evaluate the potential impact of toxic metals and sulfur-causing compounds in airborne particulates?
A I don't recall.
Q How about subsidence? Do you consider or were you asked to consider what impact on area wetlands might result if the mine caved in?
A No, I wasn't asked to evaluate that.
Q Mr. Predko asked you some questions about Dr. Adamus' opinion regarding the possibility of very rapid damage to area wetlands; do you recall that?
A I do.
Q Okay. And this was in the context of the conditions that

the DEQ has imposed in the permit?

A Yes; that's right.

Q And correct me if I'm wrong. But if I understood your point, it was that the kind of immediate wetland destruction that Dr. Adamus was describing is not likely here because the wetlands you looked at were dominated by facultative plant types?

A Well, that's the major mitigating element. But the vegetation should be encounter a drawdown -- unexpected drawdown in the water table that reflects its way up to the surface of the wetland, the major mitigating factor is the fact that the wetland plants had quite a bit of tolerance of moisture conditions.

Q So your opinion on that subject wouldn't necessarily apply to wetlands other than those you studied in which obligate species dominate?

A Well, yes and no. Some of the obligate plants that exist out there are things like leather leaf, which is a shrub. And although it's ranked obligate, it is pretty tolerant of some water level changes. And actually another species, Carex -- well, a group of species lumped under the genus Carex is also -- responds well to changes in hydroperiod. But some of the obligate plants like water lilies or some of the pond weeds that grow in the Salmon Trout River, for instance, they would experience some adverse impacts should

a water table drop occur greater than what we had modeled.

Q Going back to the restoration of wetlands that have been damaged, did the Environmental Impact Assessment provide any guidance or outline any procedures by which damaged wetlands would be restored?

A I don't believe it was dealt with in any detail, other than to just describe how those impacts could be mitigated once the mining was complete, during the restoration phase of the project.

Q Have you reviewed any of the rock mechanics studies that have been performed when trying to characterize the rock mass in the area of the mine?

A No, I haven't.

Q Do you have any understanding of the extent to which the rock mass surrounding the mine is characterized by faults?

A I have -- you know, other than the day that I sort of spent in the overlap of the witnesses, that's the only exposure I've had to the rock mechanics.

Q But groundwater modeling is something you have more than a passing familiarity with?

A Yes. But I'm not an expert in it. I mean, I understand wetland hydrology, but the nuances of creating the groundwater model I leave to the experts.

Q Is it your understanding, based on your experience with those experts, that groundwater modeling is an uncertain

business?
A Not when you're talking with them. They seem to be pretty confident as to what's going on.
Q But that's also true of economists?
A It's probably true of wetland ecologists, too, to a certain extent. But, you know, it's like anything else. They are trying to make sense of a complex situation, so there must be some uncertainty associated with it.
Q Given those uncertainties, would you agree with me that the area of wetlands that could potentially be harmed by this mine extends well beyond the project boundaries?
A Well, you know, almost -- just from my perspective, the rate at which they're ground -- taking water out of the ground, I just don't see how that's a possible scenario.
Q But it's certainly possible that that rate is underestimated, isn't it?
A I've heard people say that it's been underestimated, yes.
Q If well-qualified professionals are of the opinion that it's seriously underestimated, would you agree with me that the area in which wetlands could be adversely affected by this mine potentially extends well beyond the mine site itself?
A Well, I guess what I'd agree is that if you want me to review another scenario at a much higher groundwater withdrawal rate, I'd need to do that in order to conclude -- or to make a statement as to what the condition of the

wetlands under that scenario is going to be. I would agree with you that if we changed the groundwater withdrawal, we should recheck our evaluation of wetland conditions.

Q In the context of that recheck would you want to look at the nature and extent and quality of wetlands over a much larger area?

A Yes. Because that's -- it all depends what the modelers tell me. If the cone of depression spreads out under this new scenario, then I'd want to see where it intercepts the other wetland boundaries, and we should go pick up those wetland boundaries. But if the cone of depression is still real tight and that -- those drawdown curves don't go out significantly, then it may be that I've already looked at the wetlands I need to look at.

Q Fair enough. I'd like to ask you just a couple of questions about the Jackson studies. There was the original study and then the two follow-ups?

A Yes.

Q And I believe you testified that one of the things you did when you went out and spent a couple days examining the wetlands yourself was, you did kind of a quality check on Jackson's work?

MR. PREDKO: Objection. I think it mischaracterizes his testimony. I think he testified that as to the Wetland Coastal Reports, not as to the North

Jackson Reports.

MR. DYKEMA: Oh, I'm sorry.

Q Is Mr. Predko right?

A That's correct, yeah.

Q Did I get that wrong? Okay.

A It was the wetland delineation that I was going out to do a quality check on and make -- just to see if the boundaries were accurate, because I've got to rely on those boundaries. It was the North Jackson Report that I reviewed to see where the piezometers had been installed and to see what kind of water levels we were dealing with.

Q Thank you. And I apologize for my own confusion.

A That's okay.

MR. DYKEMA: Dr. Tilton, I have no further questions. I thank you very much for your patience and cooperation. I gather my partner in crime, Ms. Halley, has a few questions for you.

THE WITNESS: Thank you.

MS. HALLEY: Hi, Dr. Tilton. I'm Michelle Halley, representing the National Wildlife Federation and the Yellow Dog Watershed Preserve. I have just a few questions if you'll stick with me for a few minutes?

THE WITNESS: Okay.

CROSS-EXAMINATION

BY MS. HALLEY:

Q Mr. Dykema asked you if you had considered the potential impacts of sort of a cave-in of the roof of the mine, catastrophic subsidence event; right?
A Yes.
Q And you said you had not done so?
A And I had not; that's correct.
Q I'm left wondering, though, if you've considered the impacts of a far less drastic subsidence scenario, where it's a slower and more gradual process than a catastrophic failure of the crown pillar?
A Well, we've only, you know, considered it in the context of a very small amount, though; I mean, like, only several inches; certainly nothing like the kind of magnitude that you read about in the newspaper or the project I worked on in Grosse Isle where they actually had a catastrophic failure of some brine solution mining. So it's in that context that we sort of thought about what would happen to the wetlands with only a several-inch drop in subsidence.
Q What did you conclude?
A That again it would be not a significant adverse impact in the context of the way the wetlands are working with their hydrology and the fact that they are not isolated, so that they're all sort of sloping down to the river. So if the elevation of the wetlands and the uplands; in other words, the whole unit drops; that it will be an insignificant

effect.

Q What if only a portion drops? Let's say we're looking at the footprint of the crown pillar. That's sort of the red irregular ovalish shape we've seen. What if only a portion of that subsides bits at a time?

A I mean, I think the one thing that could happen is that it's possible that you could get sort of like a depression forming in this slope. But again, suppose there's a depression and it slumps a little bit. As long as there's still an outlet for that water to sort of flow into it and then flow out, we didn't anticipate a lot of vegetation change, a lot of accumulation of water, because there would always be an outlet available to -- for the water to flow down to the Salmon Trout River.

Q Now, correct me if I'm wrong, but did you analyze -- well, let me back up. My understanding of your analysis of looking at the impacts of the diminution and flow of the stream is limited to the predictions done by GeoTrans in their latest model; is that correct?

A Yes.

Q And did you look at a range beyond what GeoTrans predicted?

A No, we haven't; no, we haven't done that -- any significant study.

Q Now, are you aware that there's wild rice growing in the Salmon Trout River right in that vicinity where you studied?

A I did. I was aware that -- I think Wetland Coastal Resources reported that species in their reports.
Q And what would the impacts on the wild rice be if this diminution in stream flow occurred and the potential drawdown of the wetlands?
A Well, the magnitude that GeoTrans is predicting, which is what I have to go on, that's such a small drop in flow and level that I don't think it will have any significant impact on wild rice populations. You need a much more significant change in water chemistry or water level to effect an impact on the population.
Q That analysis is based on the inflow of 60 gallons per minute; correct?
A Yes. And then the resulting reduction in flow in the Salmon Trout River, yes.

MS. HALLEY: I have no further questions. Thank you.

MR. PREDKO: Dr. Tilton, I do have some follow-up questions for you.

REDIRECT EXAMINATION

BY MR. PREDKO:
Q You were asked some questions about FQI, Floristic Quality Index?
A Yes.
Q And you agreed that areas with an FQI in the 50's and higher

are extremely rare?

A I did, yes.

Q And Mr. Dykema pointed out to you one area in the Westland Coastal Resource Report that was in the 50's, a 56.5 for Area F. Do you recall that?

A I do.

Q I'll put up on the screen for you the Aerial Wetland Coastal Resource Habitat Location Map as soon as technology warms up here. Now, the hard copy document I have in front of me, and I can offer this to you if that version on the screen is unreadable. It indicates that Area F -- and I will use my pointer -- is indicated by kind of a light blue area that runs along the river?

A Right. That's my recollection of their report as well.

Q And what kinds of wetlands are in that area?

A It's a combination of emergent, sedge meadow, scrub shrub wetlands all along the Salmon Trout River.

Q And that's the area, according to Wetland Coastal's Report, and the only area that is above an FQI value of 50?

A That's correct.

Q And if we could go back to --

MR. DYKEMA: Can you leave that up there for just a sec? Are we looking at the same thing?

MR. PREDKO: Yeah, for the record, what I was looking at is from the 2004 Wetland Coastal's Threatened and

Endangered Species Assessment, Figure 3.2 to that, which is entitled "Habitat Location Map." And for the record it's Intervenor 12, KEMC 109206.

MR. DYKEMA: Thank you. And please forgive the interruption.

Q If we could go back to slide 18 of your PowerPoint exhibits, and Dr. Tilton, can you tell me where this area of riverine wetland is with respect to the predicted drawdown estimated by GeoTrans?

A Yes. The blue area, the one with the very high floristic quality index, lies in this light green all the way down through here (indicating) and then on down the river. And you'll notice that the predictions on the groundwater drawdown just barely touch it right there (indicating); that the bulk of this wetland, with its high floristic quality index, is outside the zone of impact. And it's unlikely that that's going to receive any drawdown, given the quantity of water that's passing through the river there.

Q And so what is your opinion on whether the drawdown as predicted by GeoTrans is going to have an effect on the floristic quality index of that area?

A Well, I think that the key is that in my opinion the highest quality plant communities along the river will be protected during the mining operations, by virtue of this modeling of the drawdown.

Q I've put up on the screen here again -- this is the figure from Wetland Coastal's Wetland Delineation Report.
A Yes.
Q And could you again, with your laser pointer -- what I'd like you to do first is to point out your area of study.
A Well, as I mentioned, we sort of went from here (indicating) up to about there with detailed study of hydro geology and soils and vegetation right in through here. This is the area where all the piezometers were located. But we basically confirmed this wetland boundary all the way from here down to there.
Q And Mr. Dykema asked you some questions about something along the lines of, "Well, if there are fens or vernal pools that are outside of your study area that you don't know whether they exist here close to the mine site" -- do you recall that line of questioning?
A I do.
Q And is that true?
A Well, I mean, I question that. The study by Wetland Coastal Resources, it's more than a study. I know the professionals personally who did the work. The report is very good and those people are very good. And if there were vernal pools up in here (indicating) or even in this area between these two wetlands, they would have found them. This is a very thorough study. I mean, they found that (indicating) little

wetland; they found these little wetlands right here. They broke up the wetland complex right there into these little upland pieces. So it gives you an idea of the scale that they were working on. I mean, look at the little wetlands that they found in this area of the site. So it's not as if they were just going through broad stroke across the countryside, not worrying about the little things that occur at a vernal pool kind of scale. And if they existed here (indicating) or here, I'm sure they would have found them.

Q And in another line of questioning, Mr. Dykema was asking you about the groundwater drawdown effects on areas that may be outside of your focus study area. Do you recall those questions?

A I do.

Q And if we could put slide 18 -- now, looking at this slide 18 which has the GeoTrans drawdown on it, are there any wetlands, other than the ones that you studied, within the potential drawdown estimated by GeoTrans as shown on slide 18?

A No; no, there isn't.

Q Dr. Tilton, have you been involved in other cases involving wetlands where the DEQ, by way of permit, has in fact authorized the destruction or alteration of wetlands?

A Well, yes. But we don't like to use the word "destruction." We sort of think of them as a use; that you get permission

to fill a wetland so that you can use it for something. You have to go through a fairly involved process. But eventually if you demonstrate to them that there are no prudent and feasibles, you can get permission to fill a wetland, as long as you agree to replace the functions and values of that wetland through one of various approaches.

Q Now, does the permit here in this case anticipate or authorize any such disruption?

A No, it does not.

Q In your opinion, Dr. Tilton, under the potential drawdown scenario outlined by GeoTrans, will there be any time in which the wetlands in the area of the mine site cease becoming wetlands?

A No. I don't believe that's going to occur.

Q In your opinion, under that same GeoTrans scenario, will the wetlands function and values be diminished in this headwater wetland area?

A No, it will not be diminished in any significant way.

Q Along the same lines, Dr. Tilton, will the predicted drawdown diminish habitat for wildlife in your opinion?

A No, it will not.

Q There was some discussion about the temporal nature -- or maybe the lack of the specific indication of the temporal nature of the drawdown in the GeoTrans Report. Do you recall that?

A Yes, I do.
Q Okay. Now, regardless of the temporal nature of the drawdown, do you believe that the permit issued by the DEQ in this case will be protective of the wetlands?
A Yes. I think the key is to monitor the water levels in the wetlands, make sure that there isn't a drawdown beyond what was modeled in the wetlands themselves, and then take the necessary steps should that occur. So I think the permit is adequate to protect against any unexpected outcome.
Q Now, you say "take the necessary steps should that occur." Do you believe that if there is a drawdown that requires necessary steps, that steps can be taken to return the wetland back to its original state?
A Yes, I do.

MR. PREDKO: Thank you, Dr. Tilton.

MR. BOCK: I have nothing further.

MR. DYKEMA: Just a couple.

RECROSS-EXAMINATION

BY MR. DYKEMA:
Q Dr. Tilton, you testified just a moment ago that there are no wetlands, looking at slide 18 of your demonstratives, within the area of GeoTrans' projected drawdown. Do you recall that?
A Yes.
Q I think you misspoke, but correct me if I'm wrong. You see

the contour line I'm pointing to here is the half-a-foot contour line?

A Yes.

Q And that's the one that cuts more or less through the area of your primary interest?

A Yes.

Q Fair?

A Uh-huh (affirmative).

Q And then there's a zero contour line that heads north at about the middle of the map. And the zero contour mine on the bottom of the map itself, --

A Oh.

Q -- right about to where the "Intervenor 636" label is --

A Yes.

Q So the whole southwest -- 40 percent of this map -- and that 40 percent is done by eyeball -- is somewhere between half a foot and zero. Do you read the map the same way I do?

A Well, I'm not sure. I certainly see your point right here about where that zero cuts through this little wetland right here (indicating). But I'm not sure that that's the same drawdown curve out here. I don't think you can interpolate from the other side of the river to here, because there's a different hydro geologic system going on here. But I think your point is well taken right here; that between the .5 and the zero there might be some impact to that wetland right

there.
Q Okay. Well, looking at the area immediately south of the mine site, we have the gray shaded area, a very large area of groundwater-fed wetland; right?
A Yes.
Q On both sides of the Riverine Wetland; right?
A Yes.
Q Now, tell me if I'm wrong or if you disagree with me. I do not interpret this one-half foot contour line that runs more or less through the mine site or a little bit to the west of it, as indicating that everything to the south and west of that is zero drawdown; do you?
A Well, my understanding when talking with the GeoTrans guys is that there's no impact over here.
Q You're indicating to the west of the river?
A To the west of the river. AS a result of the mine pumping.
Q So all impacts are limited to the east side of the river is your understanding --
A That's my recollection of our conversation.
Q -- of what GeoTrans --
A Yeah.
Q -- concluded? Okay. So somewhere in through here (indicating) there's a drawdown, between half a foot and somewhere in here, there's zero. But it doesn't extend to the side of the river. To the west side of the river was my

recollection when I asked them about that.
Q So let me ask the question again, based on that better understanding and your explanation. There is substantial groundwater-fed wetland south of the site and to the east of the Salmon Trout River?
A Yes.
Q Would you agree?
A Yes.
Q And the implication of this map is that the drawdown in that area is somewhere between half a foot and zero?
A That's correct.
Q But we can't say it's zero?
A We can't say it's zero. You're right. And by the way, that's our little monitoring stations, WLD 22, where we are monitoring water levels. And we know that this is one of those groundwater-fed wetland systems right here.
Q And presumably those stations are there because there's a possibility of meaningful drawdown there?
A Well, I'm not sure why they were put there. But I'm saying that we have do some information on these wetlands between here and there that we can use to understand what the hydrology of those wetlands are.
Q Just one other clarifying question. Mr. Predko asked you a lot of questions about your opinion as to whether this adverse impact or that adverse impact might happen to the

wetlands. Just so the record is clear, your answer is in every such question limited to the wetland you, yourself focused on?

A Yes.

MR. DYKEMA: That's all.

MS. HALLEY: No questions.

MR. PREDKO: Nothing further, your Honor.

JUDGE PATTERSON: Thank you, Doctor.

MR. PREDKO: And as I said earlier, Dr. Tilton is the only witness for today. And so if there are no objections, we adjourn early?

JUDGE PATTERSON: No objection. We can go off.

(Proceedings concluded at 2:14 p.m.)

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