Court File No. 661/89

SUPREME COURT OF ONTARIO
(Divisional Court)

B E T W E E N:

NSP INVESTMENTS LIMITED

Applicant

-and-

THE JOINT BOARD (ESTABLISHED UNDER SECTION 4 OF THE CONSOLIDATED HEARINGS ACT, 1981, S.O. 1981, c. 20, AS AMENDED), THE REGIONAL MUNICIPALITY OF HALTON, THE CORPORATION OF THE TOWN OF MILTON, THE CORPORATION OF THE CITY OF BURLINGTON, THE WEST BURLINGTON CITIZENS' GROUP, THE MILTON AREA CITIZENS' COALITION, THE HALTON FEDERATION OF AGRICULTURE, WATKIN AND DOREEN MARTIN, WALTER TOMOSKY, THOMAS AND MARY-JEAN MARTIN, MICHAEL AND CYNTHIA REED, AND THE HONOURABLE JAMES BRADLEY, IN HIS CAPACITY AS THE MINISTER OF THE ENVIRONMENT

Respondents

SUPPLEMENTARY APPLICATION RECORD

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Q. I am thinking back to Dr. Rowe's evidence. This model is based, is a simpler version, I take it of the model that Dr. Rowe used at Site F?

A. That is correct, yes.

Q. Am I correct that there is something in the order of a cone that would emanate out of the cracks so you would get a higher concentration at the peak and then spreading into the matrix, sort of a doubling of these lines that you have there?

A. That is also correct, yes. I presented a graph and I believe Dr. Rowe also presented a picture, I believe also taken from Freeze & Cherry showing that effect. I don't believe I have that overhead with me.

Q. If the concentration that is in the fracture, how do you go about assessing the overall increase at a certain depth, an overall increase in contaminant loading or an overall increase in the concentration of contaminants or is that important?

A. I don't think I understand your question.

Q. Let us back up a bit. Is it only important to understand what the relative concentration is in the fracture?

A. No, with respect to the impact on

the upper granular unit, the actual volumetric flow rate is also important. That is determined by the bulk hydraulic conductivity of that unit, be it fractured or unfractured and the hydraulic gradient across it.

Q. Am I correct, Mr. Feenstra, that the problem with Site D, if there is a problem, is that you simply can't have any impact at all on the upper granular unit?

A. That is correct. As, even as the contaminant migration simulations that were performed by myself and Trow, as described in Exhibit H-39, even with the bulk hydraulic conductivity of 8×10^{-8} centimetres per second, in the event of failure of the hydraulic trap because the upper granular unit is very thin and there is no potential for dilution of contaminants from uncontaminated water moving in laterally from off site and the fact that the potential receptors, the groundwater users are very close to the site boundary. Because of those factors, even a very small volumetric flow rate of leachate into the UGU will have a significant impact.

Q. For example, there could be, let us take cell 1 in Site D. There might be in all of cell 1 a half a dozen fractures. Let us take the worst example that extends all the way to the upper granular

unit. So, you might have in terms of overall increase in contaminant levels, you really wouldn't have very much, but the point is you are not allowed anything in the upper granular unit?

A. That is correct.

Q. If you had a situation where you could have some impact because you had more dilution in the UGU or you had more room to the site boundary, it wouldn't concern you as much?

A. That is very true, yes. One of my main concerns with respect to Site D with regard to the effect of fracturing is the actual time factor involved, Not so much the impact on the UGU. As I indicated, even a small volume of flow of leachate in the UGU is going to have a significant impact. If the unweathered upper till is unfractured, then the time for that impact to be felt is measured in years or a few tens of years. However, if the unweathered upper till is fractured, that impact could be felt much more rapidly. It could be in terms of less than a year. So it is not so much that the impact on the UGU will be different, but the time at which that impact is felt will be much more rapid.

Q. As I recall the stratigraphic layers at Site D, there is the upper till which was

taken to actually identify the potential failure of the leachate collection system and the migration of contaminants into the underlying geological units.

In comparison once one decides on alternatives 2 or 3, it is the installation of piped water to the residents or construction of a liner in the landfill, there isn't much that can go wrong with those alternatives. There isn't the same degree of, I am trying to think of the right word, you can't get it wrong once you are committed to option 2 or option 3, where option 1, detailed monitoring has to be done correctly to be effective and it has to be continue to be done correctly as the landfill is operated.

Q. So it strikes me that if that were down to between option 2 and option 3, which is really down to the difference between piped water and the liner?

A. You could distill it down that far.

Q. Do you have any preference between those two?

A. Hydrogeologically I don't think there is a preference. I think that would depend on factors such as cost and planning issues with respect to piped water.

MR. TIDBALL: Thank you, Mr. Feenstra.

Mr. Chairman, I am about to turn to Site F and this would be a convenient time for the morning break.

DR. KINGHAM: I don't understand your last answer, Mr. Feenstra. Maybe you can think about it over the break. You said hydrologically or hydrogeologically?

THE WITNESS: Hydrogeologically.

DR. KINGHAM: There wouldn't be a difference between alternative 2 and alternative 3. Do you mean from a public health perspective there wouldn't be a difference, but hydrogeologically there certainly would be a difference?

THE WITNESS: The hydrogeologic impact from a health perspective wouldn't be different. The impact on the residents along First Line would be the same with option 2 or option 3.

DR. KINGHAM: The hydrogeologic impact from an environmental perspective is the essential difference between alternative 2 and alternative 3?

THE WITNESS: That is correct; in option 3 there is still a potential for off-site migration that might affect surface water, that is true.

MR. LANCASTER: Fifteen minutes.

--- Short Recess

at Site F, yes, I would anticipate some degree of impact on the surface water system.

MR. TIDBALL: Thank you, Mr. Feenstra. Those are my questions, Mr. Chairman.

MR. LANCASTER: Mr. Estrin.

MR. ESTRIN: Mr. Leitch will be addressing this topic.

CROSS-EXAMINATION BY MR. LEITCH:

MR. LEITCH: Q. Mr. Feenstra, my questions will deal with the opinion which you have expressed as to whether or not one should reject the hypothesis which is contained in the decision tree. So, if you could have that before you.

A. Yes.

Q. As I have understood your evidence, both in-chief and in questions which Mr. Tidball put to you, you take it that as the better course not to reject the hypothesis that significant fracturing exists in the unweathered upper till at Site D?

A. That is correct.

Q. I would take from your witness statement and your evidence that you are of that opinion because of the work done by Mr. Ruland in the Sarnia area?

A. To a significant degree, actually

it was the factor, the main factor which caused me to develop this hypothesis and evaluate the hypothesis for Site D, that is correct.

Q. As I understand his work and what you have done with it, you have taken some of his findings in respect of these rather deeper fractures, which are found in the Lambton area, the till in that area and you have taken the hypothesis that because they are found at Lambton, they are likely to be found at Milton?

A. That is correct. Two of the major reasons why various investigators feel that fractures have developed in clay tills like this in Southern Ontario are weathering features, that would be drying features. During the post-glacial history in Ontario there was a period approximately five or six thousand years ago where temperatures were much warmer than they are today and I believe it to be somewhat drier. During that period, it is possible that deeper drying cracks may have developed in the surficial tills in the Ontario area.

Because of a reasonably wide-scale climatic effect such as that, we would have no reason to expect the tills in the Halton area have undergone a different history than the tills in the Lambton area.

The other possible explanation for the formation of these cracks in basically till materials is stress relief due to glacial rebound following the last glaciation in this area, approximately twelve thousand years ago. Likewise the amount of uplift that has occurred in the area of Halton is quite similar to what was suspected in the Lambton area.

So the two major mechanisms for the formation of these fractures would have been in effect in Halton as they were in effect in the Lambton area.

Q. Would they have been of a reasonably like degree?

A. Yes, a reasonably like degree.

Q. Am I correct that the till to be found in the Lambton area is a glacial till?

A. It is a glacial till of slightly higher clay content than the till you have at Site D, but similar mineralogically in terms of being comprised mainly of ilite and chlorite clays rather than swelling clays like smectites, which occur in some areas in Western Canada and the Western United States.

Q. The till at the Milton area is a glacial till?

A. That is correct, yes.

Q. Do I understand when you say

glacial till that those tills have been picked up by the glacier at some point in its life and dropped out of the glacier at another point in life?

A. That is correct; those materials were actually transported to their present location by the action of ice.

Q. So they are disturbed materials in relation to their glaciation?

A. I am not sure I know what you mean?

Q. How did they come into existence in the first instance?

A. They were deposited either in front of or beneath the ice as they moved through the area at Site D.

Q. I take it that they were picked up by the glacier at some point in time?

A. That's right.

Q. From what did they derive before they were picked up?

A. Any unconsolidated deposits or the erosion of the bedrock formations underneath the glacier, as the glaciers moved along.

Q. Is there anything in the nature of the disturbance itself that would lead to the fracturing that we are talking about?

A. That is not a possibility that I had heard of before as a mechanism for the formation of these types of fractures.

Q. My next question has to do with a question that Mr. Tidball asked you about the research that Mr. Ruland has done in respect of this fracturing. Is there other ongoing research at the present time?

A. At the present time I don't believe there is anyone specifically working on the aspect of deeper fracturing in the unweathered clay at the University of Waterloo. I believe there is some additional work going on in the West Lincoln area with respect to the proposed site for the OWMC, their waste treatment facility.

Q. What kind of clay do you find at West Lincoln?

A. That is actually not a till, it's a lacustrine clay, but it is a silty clay, a clay silt material, reasonably similar, the matrix is reasonably similar to the clay tills we are dealing with at Site D and in Lambton County. What it doesn't have is any larger stones or cobbles or larger grain-size material within it.

Q. So it has a larger degree of integrity from that point of view?

A. It would be more homogeneous.

Q. Are you familiar with the work that is going on at the OWMC site?

A. I actually had the opportunity to visit the site on Friday. The consultants for OWMC were digging some deep test pits to examine the presence of fractures in the upper portion of that silty clay material. I believe the public was invited to come out and look and there were various groups that would be represented in the upcoming hearing were also invited to come down and examine the test pits, as was the University of Waterloo. Along that line I also went along and examined the test pit on Friday.

Q. What did you see?

A. In both test pits dug to a depth of five and a half or six and a half metres, there was evidence of fractures along which there had been chemical weathering; in other words there were fracture surfaces that were identifiable as being different colours. In the deepest test pit at approximately six and a half metres, there was also evidence of roots of some age, probably geological age roots. What remains is simply the dry relics of the root material.

Q. Is it more or less likely that you would find fractures and roots as you have described in

that lacustrine clay as opposed to the Milton clay?

A. That is a difficult question to address. One might imagine that in a lacustrine clay, which are clay materials deposited in the bottom of a lake, one would find one would have vegetation growing on the bottom of the lake during most of its deposition in history. On the other hand, the clay till deposits were deposited as fairly thick units and although there may be some intervals during the deposition of those tills where the ground surface was exposed and some vegetation developed and some weathering occurred, the most significant degree of weathering had just occurred at the present ground surface. The fractures that are evident in lacustrine clays in West Lincoln seem to be fairly continuous vertically over distances of, in one particular case, two metres, more than two metres. It is difficult to tell how continuous the root systems are. The nature of the roots at the different levels down to a depth of six and a half metres all seemed very similar. I am still not quite sure how to interpret that. That will also be a topic of much future research.

Q. In reference to the opinion that you have reached as to the likelihood of there being the deeper fractures at Milton, does the work at West

Lincoln support or detract from your hypothesis?

A. There would be some additional supporting evidence that there is a reasonable possibility that fractures exist at depths of 4 to 8 metres on Site D.

MR. LEITCH: Thank you.

MR. LANCASTER: Ms. Cronk.

CROSS-EXAMINATION BY MS. CRONK:

Q. Mr. Feenstra, I don't propose to be very long, but I do have one or two questions arising from part of your discussion this morning with Mr. Tidball and as well a number of items referred to in the body of your reply report which was filed with the Board.

As I read the report and heard your evidence, Mr. Feenstra, with respect to Site D, it seemed to me and I would ask whether this is an accurate view of the essence of the opinion that you have given the Board with respect to Site D, is that what you are saying is that you now, based on all of the information available to you to date, have two concerns with respect to Site D.

The first relates to, as you have explained at some length, the possibility that the unweathered upper till at Site D is fractured and the

second, this is my characterization and please correct me if I am wrong, relates to the possibility in the future for widespread declines in the water levels in the upper granular unit at that site; is that a fair characterization of the two possible points made in your report?

A. I believe that's a fair characterization, yes.

Q. Dealing, if I might, with the second first and I will come back briefly to the issue of fracturing. On this whole issue of the potential in the future for declines in the water levels in the upper granular unit, you will recall that Mr. Tidball raised it with you briefly this morning, we have heard over the course of the many months of evidence at this hearing that the engineering premise of the hydraulic trap at Site D is very much related to the maintenance of the head differential between the level of leachate in the trap and the water levels in the geological units outside the trap. That is an essential ingredient or premise of the engineering feature of the trap itself, is that correct?

A. That is correct, yes.

Q. What is at issue there, as I understand it quite simply, is that the water level in

the units outside the trap must be kept higher at all times than the level of leachate in the trap in order for that trap to function properly?

A. That is correct, yes.

Q. I am sorry if I am repeating old ground, but we have been here for some considerable time and I want to be sure before I proceed much further that I have the bases correct.

That is so because the implication, as soon as the differential between the water levels outside and the leachate level changes is a probability of trap failure; is that correct?

A. As soon as the leachate level increases to the point where it is higher than the groundwater levels in the underlying geological units or the groundwater levels in the geological units decline to the same point, so that they are less than the head in the landfill, then you will, by definition, have failure of the hydraulic trap and potential for the movement of leachate out of the landfill.

Q. In essence then, the two basic concerns that you raised with respect to Site D are somewhat interrelated, if I can suggest that to you. Because, once you have trap failure, it at all, because of changes in that balance between the water levels and

the level of the leachate in the trap, the potential exists for the spread of contamination by virtue of the movement of leachate out of the trap?

A. That is correct, yes.

Q. If the geological units underneath the trap, that gives rise to the concerns you have outlined to the Board as to the speed with which contaminants will move?

A. That is correct, yes.

Q. Am I right then that anything that on a reasonable basis could be said to be likely to cause a change in the relationship of the water levels outside the trap and the level of the leachate in the trap is of concern. Any depletion or reduction in the water levels outside the trap has to be a concern?

A. It certainly does.

Q. Is it then from that rationale or from that basis that you have expressed your concerns to the Board about the possibilities in the future for the declines of the water levels in the upper granular unit?

A. That is correct, both short-term fluctuations and the possibility of long-term. In the event that the unweathered upper till is unfractured, then short-term or seasonal fluctuations in the

underlying groundwater levels beneath the site are of fairly little concern, because although for a short period of time there may be the possibility of some movement of leachate downward through the unweathered upper till, if that till is unfractured, then that movement is going to be very slow. It may only move a very small distance through the unweathered upper till.

Q. And conversely if it is fractured, what you are talking about is the type of increases in travel time you have already outlined for the Board?

A. That is right.

Q. I understand the essence of your evidence to be not that the concentrations of contaminants will change, but rather the speed at which they move and therefore the timeframe in which significant contamination could occur?

A. That is correct; simply the timeframe rather than the actual magnitude of the impact.

Q. Would you agree with me, Mr. Feenstra, that under the best of conditions from an engineering perspective, the maintenance of that head differential is really an object of maintaining a delicate balance between the water levels outside the trap and the leachate levels in the trap?

A. It is certainly something that has to be balanced, yes.

Q. It's a balancing exercise?

A. Yes.

Q. Given the implications for failure to do it in a proper way, it is really rather a delicate balance?

A. It is an important, a very important consideration because, as you mentioned, that difference is the basis for maintaining the hydraulic trap and preventing leachate movement out.

Q. As I understood what you said in your reply report to the Board, there are two particular scenarios that you regard as being of concern with respect to the issue of lowering the head in the upper granular unit; the first being the consequences of a drought and the second being the consequences of elimination of natural recharge to the upper granular unit consequent upon introduction of the landfill itself?

A. That is correct.

Q. I would like to briefly explore both of those with you. On the drought aspect of it, in your report you have suggested, as I understand it, were a severe drought to occur at any time over the

A. Yes, I believe that is a possibility.

Q. Is it not also the case that, for example, if a drought over several weeks period of time or several months during the spring and summer were to occur, that there will also be a time period after the end of the drought that would be required for the natural levels to be restored in the granular units?

A. There would certainly be some time lag between the end of the dry conditions and the recovery of the water levels.

Q. I am sorry if I appear to be stating the obvious. What I am trying to have confirmed if I am correct is that we are not just talking about the length of the drought itself, we are talking about the time period over which a drought occurs,plus an add-on time period during which the otherwise natural levels of water have to be replenished?

A. That is not entirely correct because if you can look into the future and you say that a drought is going to start at such-and-such a date, it is going to take a period of time before the effects of that diminished recharge or those drought conditions are actually evidenced in the groundwater

system. In the same way that there is a time lag in the recovery of the groundwater system following drought conditions. I don't think you can add the two periods of time together.

Q. Am I correct in my understanding that the reason that the consequences of a drought in the Site D area are now of significance to you, flows really from the hypothesis of the possibility of fracturing in the unweathered upper till?

A. It doesn't necessarily follow from the hypothesis. The implication, the implications of the effect of drought conditions or seasonal fluctuations in water levels underlying Site D are really of no consequence if there are no fractures extending through the unweathered upper till. They are really only of consequence when the till is considerably fractured.

Q. That is simply because if you get trap failure, even if it is short-term trap failure, in that scenario you will get rapid movement of contaminants?

A. Yes.

Q. Is that then another reason why it becomes important in your opinion to determine whether or not that unweathered till unit at Site D is indeed

have been the experience in the Sarnia area pursuant to the research of Mr. Ruland.

Am I correct that his team's investigations of the Sarnia clay plain extended to the creation of six test pits?

A. That is correct.

Q. They were put in at a variety of sites in the Sarnia area?

A. I believe a total of four different sites.

Q. It was based on putting in the test pits that visual observation, there was the opportunity for visual observation of the till units at each site to permit a determination as to whether or not fracturing existed?

A. That is correct.

Q. That of course we know has not been done to date at Site D?

A. That is also correct, yes.

Q. I understood you to tell Mr. Leitch a few moments ago that it was the same test pit mechanism that at the OWMC site in West Lincoln has led to information suggesting that the clay unit at that site is now fractured?

A. It is fractured to a depth of at

least five and a half to six and a half metres.

Q. It was pursuant to visual inspection conducted at the test pits?

A. That is correct, yes.

Q. Apart from putting in test pits, we have heard --

A. I might just comment on the OWMC site, there also had been some evidence of fracturing noted in vertical boreholes.

Q. Prior to the test pits?

A. Prior to the test pits.

Q. Apart from the Comcor borehole logs that you mentioned in your reply report to the Board, is there evidence at Site D of vertical fracturing in the borehole core samples that were taken from that site?

A. I don't believe there was any report of fracturing indicated on any of the Trow and Morrison Beatty boreholes, below the weathered zone of the till at approximately 4 metres.

Q. There were, as you pointed out in the Comcor borelogs?

A. Yes, there were.

Q. Apart from test pits, as I understand what took place pursuant to the

investigations of Mr. Ruland's team, there were a series of special piezometer nests put in in the Sarnia area, specifically for tritium testing at various locations; is that correct?

A. That's correct.

Q. Am I correct that there were some thirteen special piezometer nests in total used for that purpose?

A. I believe that number is correct.

Q. Am I correct that only one was installed and tested at Site D?

A. One piezometer nest was tested at Site D.

Q. You confirmed for Mr. Tidball this morning that as discussed at this hearing as to the merits or benefits to be derived from using angled boreholes to determine the existence of fracturing, that such boreholes were not put in at Site D?

A. That's right.

Q. And have not commonly in the province been used in the past?

A. I believe in 1985 when the investigations at Site D were performed, I don't believe there was a drill rig in the province capable of drilling angled boreholes.

Q. Is there now?

A. Yes, several firms have that capability.

Q. Is that another type of investigatory technique that could be employed to determine whether or not fractures exist in the unweathered upper till?

A. Yes.

Q. Finally, as I understood what you were saying in your report, the type of pumping tests you were referring to as being a possible investigatory technique at Site D was the type of test that Mr. Petrie described had been used by him in the Maryhill till situation?

A. That is correct, yes.

Q. We know that that type of test was not done at Site D?

A. That type of test was not performed at Site D.

Q. Are we then in this position, Mr. Feenstra, that there are various investigatory techniques that could be used to determine (a) if fracturing does exist in the unweathered upper till at Site D and secondly if so, how extensive it is but none of those investigatory techniques have to date been

employed at Site D?

A. That is correct, yes.

Q. Do I understand your opinion to the Board to be that those investigations at a minimum should be undertaken before landfilling is approved, if at all, at that site?

A. I am not sure that I said that. No, because I think if one looks at my decision tree, which was discussed earlier, that one could simply accept the hypothesis that significant fracturing does existing in the unweathered upper till at Site D and then work to modify the monitoring program and the design of the landfill itself to accommodate that possibility.

Q. Let me put the question to you this way, Mr. Feenstra. There is a basis on which Site D has been put before the Board for approval thus far. It does not extend, for example, to the pre-testing installation and design of a purge well system; that is not part of the proposal at the moment, right? I understand that to be your evidence and you have made recommendations in that regard, but do I have it that it is your opinion -- please correct me if I am wrong -- that as currently proposed before the Board, you would recommend that further investigations of the type

you discussed be done at Site D before it were approved, if at all, for landfilling?

A. Yes, I think that follows from my statement that on the basis of attachment 5 to my witness statement I feel that there is a reasonable possibility that fracturing does indeed exist in the unweathered upper till at Site D. I would not reject that hypothesis without further investigation or modification of the design and monitoring angles at Site D.

Q. The issue as to whether or not that till unit is fractured goes to the very integrity of Site D for a landfill site, would you agree, Mr. Feenstra, the very fundamental issue regarding the integrity of that site?

A. It's a very fundamental issue for the site and the monitoring program, as previously stated, yes.

Q. I understood at least by your inference,if not expressly, the suggestion made to you this morning by Mr. Tidball that perhaps these further investigations could be carried out as a required condition of any approval of Site D and coincident in point of time with other site preparation or investigation work.

Were that the approach, Mr. Feenstra, that some, were that the approached urged by some on the Board, would you agree with me that we can't tell in advance what the outcome of those further investigations might be?

A. We certainly can't tell in advance, but I think that depending on the nature of the preparatory work for operation of the site that if one could live with either conclusion or either finding, either of the investigative programs that in the case that the test program identifies that were was fracturing in the unweathered upper till, then depending on the nature of the site preparations, it may not be possible to implement option No. 3, that is the construction of a liner with purge wells. At that time you would certainly be able to implement option No. 2, which would be the installation of piped water to the surrounding residents after initial site preparations have begun.

Q. Perhaps I can suggest it to you this way, Mr.Feenstra. Is it correct that if this further, if these further investigations were undertaken that clearly you can't predict in advance how extensive the fracturing in the unweathered till unit might be if it is there at all? You can't tell

that in advance?

A. No, you can't tell that in advance, you have no information from the site itself.

Q. Nor can you tell the direction or the location in which that fracturing might exist?

A. That is also true, yes.

Q. Until that information is known, those who stand to be affected by the implications of contaminant migration at that site aren't really in a position to assess how their interests might be affected, wouldn't you agree?

A. For the site as designed at the present time, yes. That doesn't necessarily, that isn't the case, the scenario would be to do the investigation and then evaluate which one of these other alternatives might be appropriate.

Q. That assumes Mr. Feenstra, does it not, let us assume for the moment that the investigations, the further investigations undertaken showed that there was fracturing. That would trigger, what you are telling me is that that would trigger then a whole series of other events on your decision tree?

A. That is correct.

Q. I suppose what I am really suggesting to you is that approval today, both of a

further investigation program coupled with one or more of the proposals that you make on the decision tree to take place in the event that fracturing is discovered, assumes that those people or those persons whose interests stand to be affected by fracturing, would be content to accept, without further challenge or opportunity to challenge, that those proposals are adequate in the circumstances? It assumes that there would be no basis for those who would be affected by the fact of extensive fracturing, would be content with the proposals to respond to extensive fracturing that you suggested on the decision tree?

A. I think that assumption would be implicit in what you are indicating, yes.

Q. My point simply being this, Mr. Feenstra....

MR. HODGSON: I don't think he is finished.

THE WITNESS: I will let her finish the question.

MS CRONK: No finish.

THE WITNESS: I would like to hear the rest of the question.

MS CRONK: Q. What I am getting at is this and perhaps I am stating it awkwardly, but we

don't know in advance if fracturing exists, how extensive it is, where it may be and therefore, whose interests might stands to be affected if it's there?

A. Would you repeat that, please. I am really having difficulty with that.

Q. We don't know in advance of carrying out the kinds of investigations that you describe whether fracturing does exist, how extensive it might be or where it might be, we don't know that in advance?

A. You don't know that in advance, that's correct.

Q. Your response to me when I suggested that that meant that approval of Site D without the investigations being undertaken was inappropriate was to say yes, Ms. Cronk, we can live with either event, we can live with fracturing, the fact that fracturing was discovered or live with the determination that there was no fracturing because I have set out certain things that should be done on my decision tree if fracturing is discovered. That's what I thought you were saying to me. Have I got it right?

A. Yes.

Q. My point to you is this, let us assume we go in and these investigations are conducted

and fracturing is discovered, that in your evidence would trigger further actions to be taken; am I correct?

A. That is correct, yes.

Q. Then there are the three or one or more of the three set out in your decision tree under the testing scenario under fracturing, the three you have outlined in that column?

A. That is correct.

Q. The only point I am making to you is that if the Board were so inclined at the end of the day to approve Site D on that basis, that this investigative program should be undertaken and if fracturing was found, these further things should be done, that would deny, would it not, the persons affected and the persons who stand to be affected by the existence of those fractures from any further opportunity to challenge the results of the investigation program, to really test them at all or to challenge that what you recommend is adequate to respond to the fracturing risk in the circumstances. That couldn't take place?

A. I am not really familiar with all the avenues that the affected people might be able to pursue. It would certainly be my expectation, however,

that the implementation of any of these other alternatives as a condition of the investigations or as an outcome of the investigations would certainly be subject to the review and approval of the director of the Ministry of the Environment.

As I indicated, I don't know precisely what avenues individuals would have to challenge, review or comment on those decisions.

Q. Let us take a look then at the three scenarios you have put out in your decision tree. If I could ask you just to look at it, dealing with the rejection scenario of the hypothesis, you have already told Mr. Leitch and Mr. Tidball that that is not the course of action you would recommend to the Board?

A. That is not what I would recommend.

Q. I take it that that is so because to take that route with respect to this whole issue of the possibility of fracturing is essentially to gamble that they are not there at all?

A. That is correct.

Q. In that scenario, what you are really gambling with is public health and safety, isn't that so?

A. At this particular site, yes.

Q. Then of the two remaining ones, the

acceptance of the hypothesis or the testing of the hypothesis, you indicated to Mr. Tidball you had some difficulty as a scientist in recognizing in your own mind which was the preferable course?

A. That is also true.

Q. As a hydrogeologist and a hydrogeochemist, testing now before the Board based on everything that you know, what is your recommendation to the Board with respect to your hypothesis as to which they should do? Should they accept your hypothesis and plan accordingly or should they be testing it before making any further decision with respect to Site D?

A. I think, as I indicated, that is probably not a hydrogeological question, or a hydrogeological issue, because one could take into account the presence of fractures, whether we know they are there or not, with these alternatives that I have suggested. I am not suggesting that the three alternatives listed are the only alternatives, there may be other alternatives equally applicable. I think one has to consider the time element involved with respect to a landfill for the Region of Halton. That might be to accept the hypothesis and go along and design Site F accordingly, if a delay of a half or one

year is significant with respect to the approval of the site. If it was possible for the Board or the Board ruled that the site could be approved on the condition that the testing be conducted at the same time as the preliminary development of the site and based on the actual stage of site preparation and the findings of this investigation then some other alternative could be implemented at that time. I don't actually have a preference between the two. There are other non-hydrogeological issues involved.

Q. Those being both the time factor and the cost?

A. The time factor and the cost, that's right.

Q. Under the testing scenario, that's an area in particular as opposed to the acceptance scenario, that involves both time and increased costs, whereas the acceptance scenario involves just costs?

A. That is correct.

Q. Just dealing with the testing route then, as a response to your hypothesis, you explained to Mr. Tidball what technically was involved in each of the suggested responses that you identified in the event that fracturing was discovered. I am referring now to items 1, 2 and 3. I understood you to say that

there were really alternate solutions, not a composite solution to the problem of fracturing?

A. That is correct.

Q. Can we look at the first one for a moment. That is detailed monitoring with purge wells as a primary engineering feature. Would you agree with me, Mr. Feenstra, that there is nothing under that option that I called option No. 1 that is preventive in nature. That response or that solution is really remedial or reactive. It doesn't prevent the spread of contamination?

A. That is true, it is reactive to deal with the possible rate of movement of contaminants into the underlying geological units at a much faster rate than was previously expected or determined due to fracturing in the unweathered upper till.

Q. The point simply being then that nothing under that option or that solution, if I can put it that way, will prevent the contamination of existing water sources at Site D. It simply reacts in the event of contamination, isn't that so, to curtail it?

A. The objective of that detailed monitoring and the pre-installation of the purge well system would be to prevent offsite movement of

contaminants. It won't prevent contamination of the underlying units, but the intention would be to keep that contamination restricted to the site itself.

Q. And under option No. 2, that is to bring in a piped water supply as a response to the possibility of contamination of the existing water supply, would you agree with again that nothing under that option prevents contamination, it is a reactive measure, a remedial measure?

A. It is also a reactive measure because monitoring would still be required to ensure that offsite contamination would not occur and affect other receptors like more distant groundwater users. One would implement purge wells to prevent that offsite movement.

Q. I suppose the distinction I am getting at is really this, Mr. Feenstra, looking at this option, the piping in of water with purge wells, that option may have the effect of minimizing the impact of contamination but it won't prevent it. It does nothing to preserve the integrity of the existing water source at Site D?

A. That is true.

Q. That is essentially true with option No. 1 as well, isn't that so?

A. That is also true.

Q. It is only when we get to option No. 3, I suggest and that is the suggestion of a liner with purge wells, that there is any preventive aspect at all associated with the option, would you agree?

A. That is true. Option No. 3, the construction of a liner would actually act to prevent or reduce contamination of the groundwater underlying the site. Strictly speaking, I am not sure that the groundwater underlying the site is relevant with respect to the reasonable use policy of the Ministry of the Environment. In reality I think you can impact the groundwater on your own site, but the only concern is when it goes offsite.

Q. Let us deal just with the concept of option No. 3 for the moment. Even with that one, I suggest, and that is introducing a liner, would you agree with me that does not prevent indefinitely contamination of existing water supply if fracturing does exist?

A. If....

Q. It does not prevent for ever contamination of existing water supply?

A. It does not prevent for ever the contamination of the existing water supply, whether

there are fractures or whether there are no fractures.

Q. Just dealing with the scenario where we are assuming there are fractures because that is where you have the liner option set out, it will not have that effect.

A. Excuse me, could you repeat the question?

Q. We are dealing with the scenario that we are assuming the investigations have shown that there are fractures?

A. Right.

Q. I am suggesting to you that the option of putting in a liner at Site D does not have the effect of preventing contamination long-term?

A. In the event of failure of the hydraulic trap, no it does not.

Q. It carries with it a considerable price tag in financial terms, does it not?

A. It does. In the event of the failure of the hydraulic trap, the liner will simply act like the unweathered upper till. It is going to buy you time to be able to detect the failure with your monitoring program and implement, the time to implement an effective contingency to deal with that.

Q. You raised a few moments ago the

suggestion buying you time to deal with contamination programs, but as well the suggestion that so long as you didn't contaminate on site, that might somehow be acceptable as distinct from allowing contamination offsite. You made that comment in context of the reasonable use policy?

A. That's correct.

Q. Looking at option No. 2, the suggestion you bring in piped water with purge wells, that in itself as a proposed solution to this problem fracturing doesn't prevent contamination on site, would you agree, or offsite?

A. Simply bringing in piped water does not prevent offsite migration of contaminants, that's right.

Q. And it is only option No. 3 that carries with it that potential, albeit for a limited period of time, the liner?

A. For a limited period of time.

MS. CRONK: I expect to be another twenty minutes or half an hour. Would you be content to break now or do you wish me to carry on?

MR. LANCASTER: Yes, we will break now until 2:00 o'clock.

--- Luncheon Adjournment (12:45 p.m.)

--- Upon resuming at 2:00 p.m.

MR. LANCASTER: Please be seated.

MR. HODGSON: The court reporter spoke to me over the lunch break and I have to, with some embarrassment, retract my statement that Nethercut & Company had been "chintzy." It appears that my colleague, Mr. Lederer expedited a transcript in March and received his expedited transcript, at which point Nethercut as a matter of course sent out a copy to everybody else which means that poor Mr. Lederer had paid for the expedite and everyone else had the advantage of it. Tom raised such a fuss with Nethercut that they didn't do it this time. I am not in a position to criticize Nethercut, since it is clearly and obviously the Region's counsel that have caused this.

DR. KINGHAM: I have been in touch with the hearings registrar who assures me that a copy for the Board is on its way out here right now.

MS. CRONK: Q. Mr.Feenstra, we discussed this morning your opinions with respect to the possibility of depletion of the recharge in the area of recharge in the area of Site D caused by a number of potential events; do you recall that?

A. That's right, yes.

Q. One of the further investigations or matters you dealt with in your reply report concerns the more rigorous examination of recharge conditions at Site D, am I right?

A. More rigorous monitoring of water levels in the underlying geological units, yes.

Q. Can I take you to page 6 of your reply report, paragraph 15. I direct your attention to the third full sentence in paragraph 15, Mr. Feenstra, beginning:

> "The effect of the landfill itself on the groundwater levels beneath the site is difficult to quantify without a computer model and a good understanding of the areal extent of the units, the existing recharge and discharge areas and the groundwater flow patterns. A more detailed understanding of the groundwater flow system would be required before a rigorous evaluation of the effect of the landfill on groundwater levels beneath the landfill can be made."

Now, stopping there, would I be interpreting your comments in that paragraph correctly

if I took from it the suggestion that further examination of the groundwater flow system is required before what you have referred to as a rigorous evaluation of the effect of landfilling could be assessed in terms of the impact on groundwater levels beneath the landfill?

A. That is correct.

Q. Would you agree with me, Mr. Feenstra, if that type of examination of the groundwater flow system at Site D were undertaken, it is possible at least that it could disclose that the recharge conditions were such that there would be insufficient recharge to maintain the hydraulic trap once the landfill is introduced; that is a possible result?

A. That might be possible, yes.

Q. Insofar as that is a possibility, that is a result, I suggest, that could not be lived with insofar as the design of Site D is premised on the maintenance and continued maintenance of a hydraulic trap?

A. Unless the mechanism by which the groundwater levels in the underlying geological units could be recharged or surcharged artificially, that is correct.

Q. Then in the context of your having told me this morning that you could live, I don't mean you personally, but one could safely live with the results of further investigations, whatever the result, this would be an exception?

A. I don't quite understand.

Q. Perhaps you could put your decision tree back up.

A. Okay.

Q. Dealing with the testing scenario set out under your decision tree, Mr. Feenstra, the middle column as distinct from the rejection of your hypothesis or the acceptance of your hypothesis, I understood you this morning to be suggesting to me, let me back up, I was suggesting to you that approval on any terms of Site D without further investigation, given the concerns you have expressed, would be imprudent because further investigation would produce new information which would then be evaluated. I understood you to reply to me by suggesting that one could safely live with the results to be generated by those further investigations, whatever they were, because one could plan now how to deal with either result, that is prove the existence of fracturing or prove that fracturing did not exist. Am I correct, so

far?

A. Correct, so far.

Q. What I am suggesting to you, sir, is that if part of the further investigations to be undertaken included those suggested by you with respect to the groundwater flow system at Site D, and if those further investigations proved that there was insufficient recharge to maintain the hydraulic trap, that is not a result. At this stage one would have to find out first if that was the case before one could decide whether Site D was approvable subject to conditions or not?

A. In that event that would imply that basically the hydraulic trap could not be maintained for any significant, for a significant proportion of the life of the landfill.

Q. Exactly.

A. In that case one could consider the installation of the purge well system and operation of the purge well system at some point during the operation of the landfill as part of the primary engineering design.

Q. Wouldn't it mean, Mr. Feenstra that the very viability of the hydraulic trap were in issue if it required that design?

A. It would certainly mean that the hydraulic trap was not the key principle for the operation of the site, that is correct.

Q. Wouldn't that entail an entirely different design proposal?

A. It would certainly require a different design, either in terms of containment of offsite migration by the purge well system or the construction of a liner at the site.

Q. And the proposals of that design are not fully before the Board at this stage?

A. The proposals for that design, no.

Q. With respect, generally to the further investigations that we spoke about this morning, I had some difficulty with our exchange and I wanted briefly to come at it and make sure I understood what you were telling me.

What I wish to suggest to you, Mr. Feenstra, is that if the further investigations you have outlined are undertaken, clearly they will result in the generation of fresh data, fresh data not presently available?

A. That's correct.

Q. To the extent that fresh information and fresh data is generated, that could

well lead to conclusions different from those at Site D that have to date been put before the Board?

A. That is correct, yes.

Q. Those new conclusions, it follows, could apply to any number of things. They could apply to interpretation of the groundwater flow system at the site, they could apply to appropriate contingencies, they could apply to design issues to a whole myriad of things, do you agree?

A. That is correct.

Q. Now, in those circumstances none of those details are before the Board because one can't predict in advance what those new conclusions might be, not knowing what the new information might be, it follows one from the other, doesn't it?

A. That is true, yes.

Q. Can I come back then to your suggested solutions and your scenarios on the decision tree. Let us still deal still with the testing scenario. You have really followed through the testing scenario by saying one of two circumstances is going to result through further investigation. Either my hypothesis of fracturing of the unweathered till is going to be borne out or it is not, is that correct?

A. That's correct.

Q. If borne out, you proposed three options, any one of which could be introduced to respond to the fracturing problem?

A. That is correct.

Q. Those are the same three options that would apply were the Board simply to accept it, your hypothesis, without authorizing or requiring any further investigation?

A. That is correct.

Q. The second possibility if those further investigations are conducted is that the hypothesis of fracturing in the unweathered upper till unit would not be borne out and would not be demonstrated, correct?

A. That is correct.

Q. That leads you then, based on your decision tree or flow chart, to a second hypothesis, does it not, and that is the possibility of the landfill itself inducing fractures.

A. I guess you could regard that as a second hypothesis, that is true.

Q. We will just test that suggestion and move over to the rejection scenario. If the Board were to reject today your main hypothesis that fractures exist in the upper weathered till unit they

would still then, or they would -- a hydrogeologist and in particular you would recommend to the Board that there still be an evaluation as to whether the landfill itself would induce fractures; isn't that so, aren't there two issues to be considered?

A. I believe in reality that is probably the case. If one considered that, if one didn't consider that the hypothesis of significant fracturing existed in the unweathered upper till, had no merit and rejected that hypothesis, to some degree it is likely that such a decision would also be consistent with the decision that it is unlikely that the construction of the landfill will induce fracturing in the unweathered upper till. I think part of the rationale that one might suggest for rejecting the first hypothesis, that is that fracturing exists, is the feeling that lateral and various subsurface stresses will actually act to close fractures or that these fractures, although discontinuities and things may be observable in the unweathered upper till, don't transmit any water. I think if one subscribed to those types of opinions, it wouldn't surprise me if one would also subscribe to the opinion that it is unlikely that the landfill would either open any fractures that were there in the first place or induce them in the future.

But, on the other hand I think to be complete, as I have drawn this chart, a likely, it would probably be appropriate to take this second hypothesis to evaluate the possibility of landfill-induced fractures and put that below the rejected decision for the first hypothesis also.

Q. Shall we just draw a line in from that side of the decision coming down into the evaluation level? My approach, Mr. Feenstra, was perhaps a little more simplistic rather than the detailed perspective you have outlined. When I looked at the main hypothesis at the top of page, that really concerns whether or not fracturing exists today?

A. That is correct.

Q. Whereas if you look at what I am calling the evaluation box further down the chart, that concerns the possibility that fracture might be induced in the future, by virtue not of natural conditions but by the nature of the landfill itself?

A. That's correct.

Q. Clearly two types of fracture scenarios?

A. I think one of the main issues with respect to evaluation of landfill induced fractures is the degree to which any fractures would open during

construction of the landfill or created during excavation of the landfill would in turn be closed when the landfill is actually constructed and completed and many of the stresses that were in effect originally were reapplied.

Q. So even if the Board were persuaded to reject the hypothesis that fracturing currently exists in that unit, would it then be your recommendation that an evaluation should still be made as to whether subsequently-introduced fractures was a realistic possibility?

A. I think it would be reasonable to make that recommendation, yes.

Q. Is that the one you are making?

A. I would agree with this amendment to the tree here showing a connection between the rejection choice for hypothesis No. 1 to the box leading to the evaluation of possibility of landfill-induced fractures.

Q. If a result of that evaluation showed that it was likely, to use your words, that fractures could be induced by the introduction of a landfill, one then has to consider all of the three options that you previously outlined, is that fair?

A. That is correct.

Q. Similarly if it is unlikely, there the matter ends and routine monitoring could be carried out?

A. That's right.

Q. Could we go back to option No. 1 that we spoke about this morning. You explained to Mr. Tidball that that was comprised of first detailed monitoring which you described as being monthly?

A. It could be monthly, yes.

Q. And purge wells as a primary engineering feature and you explained that that was both pre-installed, designed and tested?

A. That is correct.

Q. Could I direct you as well back to your reply report to page 4, to the bottom of paragraph 9. It is in this paragraph, Mr. Feenstra, that you are discussing these various options and I direct your attention to the last two sentences appearing on page 4:

> "During the installation and testing of the purge well system, information can be gathered with regard to the continuity of the granular units westward towards the First Line and beneath the site. In addition, detailed

pumping tests of the type discussed by Mr. Estrin and Mr.Petrie could be conducted to assess the presence of fractures in the unweathered upper till. This information can be used effectively to design the final groundwater monitoring program."

I took that to mean, Mr. Feenstra, that with respect to the first option, you are suggesting that those pumping tests as well should be undertaken. Is that an accurate reading of what you recommended?

A. Not pumping tests, not the type of pumping tests described in the last sentence on page 4. I believe the pumping tests conducted in conjunction with the installation, the design and installation and testing of the monitoring well system might be somewhat different, mainly because it would be conducted to examine the lateral continuity of the granular units, not necessarily the presence of fracturing in the overlying unweathered upper till. Those tests might be of quite a different nature.

Q. Sorry, I understood the report at the bottom of page 4 to be suggesting that the pumping tests there described, would be conducted specifically to assess the presence of fractures?

come up with a final estimate at the conclusion that it is very unrealistic to the final conclusion.

Q. Let us make it specific then. In the instance of Site D, would you agree with me that the worst case scenario in hydrogeological terms is that the hydraulic trap will fail and that the unweathered upper till unit is fractured? That is the worst scenario for that site?

A. That certainly would be a worst-case scenario.

Q. Then with respect to Site D, would you agree with me that it would be prudent to both plan and design a landfill facility for that site which took into account that worst-case scenario?

A. I think one should try to design a landfill that would avoid that worst-case scenario, Ms. Cronk.

Q. Are you agreeing with me that it should be designed in such a way as to take that into account?

A. Yes.

Q. As I have heard your evidence, Mr. Feenstra, it is your opinion today, based on all that you know of the sites and all the information that has been adduced before the Board that Site F is suitable

for landfilling on the terms currently proposed to the Board; is that correct?

A. Were you asking whether that was my opinion?

Q. Yes?

A. With the exception of the construction of a perimeter drain, I believe that is correct.

Q. Taking into account the adjustments to the perimeter drain you discussed with Mr. Tidball this morning?

A. The adjustment of deepening the perimeter drain to capture the shallow groundwater flowing through the upper part of the shale.

Q. Could I ask you to go to page 17 of your final report then. It is in paragraph 50, is it not, that you express the opinion to the Board that Site F is suitable for landfilling?

A. That is correct.

Q. Am I correct that that was also your opinion last fall when you first testified before the Board?

A. Yes, it was.

Q. In restating that opinion to the Board, have you taken into account all of the

hydrogeological evidence that has been adduced before the Board since the time that you last testified?

A. I believe I have, yes.

Q. I direct your attention to paragraph 51, in which you express your opinions concern Site D and it is in particular the first sentence in which you indicate:

"It is my opinion that Site D can be made suitable for landfilling."

Stopping there, are we to take it from that that it is your opinion that Site D as currently proposed before the Board is not today suitable, but with the changes that you have outlined and discussed, it could be?

A. That is correct.

Q. That opinion, I take it, is based, as was the case with respect to Site F, on all the information available to you today?

A. That is also correct.

Q. Are we then in this situation that your opinion with respect to Site F and its suitability for landfilling remains unchanged from the opinion you held last fall but with respect to Site D, it has changed in the manner outlined in paragraph 51?

A. That is correct.

Q. Then in the second sentence of paragraph 51, you have indicated:

"For conditions when the hydraulic trap is functioning, there will be no leakage of leachate from the landfill."

Just stopping there, Mr. Feenstra, I was somewhat troubled by that when I read it. You, I take it, have heard the evidence given by others that there will in fact be some diffusion of leachate from the trap even if working properly at Site D?

A. That is correct.

Q. It is then, I suggest, not strictly accurate to suggest there will be no leakage of leachate. There will be some by virtue of the diffusion process?

A. Through the diffusion process and should not reach the granular unit underlying the site.

Q. The Board has heard evidence, as you are aware, from a series of witnesses, but in particular the Board has heard evidence since you last testified from a number of hydrogeologists. Mr. Petrie and Mr. Crutcher testified before the Board that in their opinion Site F was suitable for landfilling if a liner was part of the proposed design for the site. Mr. Sobanski disagreed with that and you have said in

your reply report, as well as in your evidence last fall, that you disagree with that. Dr. Charlesworth and Dr. Rowe disagree.

I would like your opinion, if you are in a position to give it, Mr. Feenstra, based on all of the information available to you and all of the data that you have looked at as to which of the two sites, Site D or Site F is, in your opinion, more likely to require a liner?

A. Okay. Well, I would have to say that Site D would be more likely to require a liner. A liner at Site F would certainly reduce the amount of seepage or exfiltration from the landfill into the underlying shale. It would be my estimate that the amount of exfiltration from the landfill at Site F would be something in the order of 10 to 20 millimetres per year. That is for an unlined Site F.

For a lined Site F, the estimate of leakage through the liner is approximately eight millimetres a year under normal operating conditions.

So the construction of a liner would only, would indeed reduce the amount of exfiltration, but only by a rate of approximately 20 to 60 per cent and in the event that exfiltration, or when exfiltration does actually leave the landfill and enter

fracturing in the unweathered upper till unit, but it were, after investigation, thought reasonably likely that the landfill itself would induce fractures, I take the liner scenario is one of the three responses you would suggest in those circumstances?

A. The liner option would be another response that could be considered.

Q. Mr. Feenstra, just two other matters very briefly. When you were last here last fall,you and I had a discussion concerning certain of the characteristics at Site F in comparison to Site D, the comparative merits of those two sites for landfilling. That led subsequently to discussions between you and my friend, Mr. McQuaid and Ms. Vigod and Mr. Hodgson. There is one aspect of the discussion that we had that I would like to take you back to and ask you whether, based on all of the information now available to you, your opinion has changed in any respect? Perhaps I could just read it to you and if you wish to see the transcript, by all means I will provide it to you. It is from Volume 44, Mr. Chairman, at page 10033, commencing at line 7 and the question to you, Mr. Feenstra was this.

"Q. Without taking you back to it, Mr. Feenstra, in light of the review and

analysis which you have done of both Sites F and D, and in light of your specific expertise, which of the two sites, F or D, do you regard as being preferable for landfilling?

A. On the basis of the evaluation of contaminant migration, it is my opinion that the attenuation capability exhibited by the geological materials at Site F would be superior to those at Site D and irrespective of engineering or the planned contingency measures. Obviously with the contingency measures that have been described and discussed with respect to Site D and Site F, offsite migration could be prevented if it was evidenced in the future.

Q. As was the case with Domtar..."

Parenthetically we discussed the work you had been involved in at the Domtar site:

"...I suggest in the case of Site F you need not be concerned about adverse impact from any possible contamination below Site F?

A. I would agree with that.

A. That is a very significant difference between Site F and Site D. Even in the event that the interpretation of Site F isn't exactly as I have suggested, there will be no groundwater supplies that are endangered, so no human health and safety directly affected by the contamination of the groundwater supplies.

Q. To use the language I once used with you before, that is an enormous advantage of Site F over Site D?

A. Yes, it is.

Q. Finally then one further aspect of the matter, Mr. Feenstra. You discussed with Mr. Tidball this morning certain aspects of the monitoring program at Site F. My recollection was that last fall when you testified you were asked to indicate with reference to the monitoring program that Mr. Sobanski had recommended for Site F where you would place monitoring wells at Site F and I apologize, I have looked for that exhibit, as have others, and its number now escapes me totally, but what I can provide to you, in short I haven't been able to find it....

A. I looked and I couldn't find it either.

Q. What I can give you is drawing No.

22, which is from Exhibit H-40. This is Mr. Tidball's copy and it deals with the monitoring system at Site F. There are a number of well locations marked in red. I confess I don't now recall whether those were your suggestions or whether they were those of Mr. Sobanski?

A. I believe it is Mr. Sobanski because I don't recognize the handwriting.

Q. The handwriting may be that of Mr. Tidball.

A. Okay. I don't believe I actually drew numbers on a map to show monitoring well locations. I might have been asked to comment on those identified by Mr. Sobanski.

Q. Either way, could I ask you now to look at that drawing No. 22 and with particular reference to, the legend indicates that the full black dots shown on that drawing are the location of on site monitoring wells I take it today as they exist today, or are those are proposed?

A. Those are as proposed.

Q. Taking those into account together with the ones circled in red, would you agree in light of the information now available to you, that those are suitable locations for monitoring wells in the vicinity of Site F?

A. Those are certainly suitable locations along the southern boundary of Site F. I would suggest that based on the subsequent evaluation of the zone of active flow in the shallow shale, as reflected by the tritium and chloride concentrations and the lack of an active flow zone in the shale in the vicinity of HC-8 on the southern portion of the site, one should also probably have groundwater monitors along the western margin of the site and on the eastern margin of the site, some of which are noted on this figure on the eastern margin, but I think you would probably want one or two more locations on that side to take into account the eventuality of a diversion of flow around the area around HC-8.

Q. Do I take it then that the monitoring wells on the western side of Site F that you have just described and the few more that you have suggested on the eastern side are additional to those shown on drawing 22?

A. That is correct, yes.

Q. I direct your attention to the triangle of land immediately to the south of the southern boundary at Site F?

A. You mean this section immediately south of the site?

Q. You are pointing to the triangle with the North Service Road and south of the black southern boundary line on drawing 22, there are a number of monitoring wells located in that triangle?

A. That is correct.

Q. Those lands are currently owned by NSP, are they not?

A. That's my understanding.

Q. Am I also correct that they do not as currently before the Board, form part of the area of the undertaking that the Region is proposing for Site F?

A. That is also my understanding.

Q. Would you agree with me that if the Region is to be required to conduct ongoing monitoring in that area, with respect to Site F, should it receive approval and be required to maintain monitoring, that it would be prudent for the Region to have assured access to those lands for those purposes?

A. Certainly monitoring would require assured and continuous access to those lands, that is correct.

Q. Similarly, look to the east, Mr. Feenstra, to the monitoring well locations now identified on drawing 22, those additional ones that

you have recommended. Some of those extend further to the east, do they not, than the area of the undertaking as currently proposed before the Board, although originally they were in the area of undertaking in the proposal before the Board?

A. That is also my understanding, yes.

Q. Once again, Mr. Feenstra, would you agree with me that if the Region is to be responsible in the future, assuming for the moment, were this Board to approve Site F and assuming that the Board required in the future the Region were to be required in the future to monitor on a continuing basis at those locations, would you agree with me it would be prudent for the Region to have assured right of access to those lands for those purposes?

A. Obviously to undertake continued monitoring of wells in those locations one would need continued access to those locations.

Q. With respect to the triangle to the south, that is immediately north of the North Service Road, as I understand the concern that you have identified there is that because there is no evidence of an active flow zone in the vicinity of HC-8, that there could actually be flow laterally to the west at that location?

A. That is correct, yes.

Q. If one were to move directly west form HC-8, that in fact goes on to NSP land, being that triangle, does it not?

A. Yes, it does.

Q. Similarly on the eastern side of the site, were there to be lateral flow in that direction, that as well would flow onto NSP lands immediately south of Bayview Park, isn't that so?

A. That is also correct, yes.

Q. In hydrogeological terms and given the recommendations you made to the Board as to proper monitoring of the site, Mr. Feenstra, would you agree with me that both of those locations should be monitored in the future if Site F is approved?

A. I agree they should be monitored, yes.

Q. On an ongoing basis?

A. On an ongoing basis.

MS. CRONK: Thank you very much. Mr. Chairman, those are my questions.

MR. LANCASTER: Mr. Garrod.

CROSS-EXAMINATION BY MR. GARROD:

Q. Mr. Feenstra, I expect I will be quite brief, I have more pages crossed out than I have

If I could turn then to the next issue we wish to address; that is what we have termed the task of weighing conflicting opinion evidence, the general principles. As I indicated earlier, Mr. Chairman and Dr. Kingham, and indeed it need not in any way come from me, but it is quite clear that there were very extensive challenges to credibility made in this case. I give you by way of example the cross-examination that occurred of Mr. Sobanski by the City of Burlington and the Burlington ratepayers. I give you the cross-examination of Mr. Feenstra by the same group. I give you the cross-examination of Mr. Petrie by the Town of Milton and by myself to a lesser extent. It is clear that there are on the issues before you conflicting expert opinions and legally that requires the weighing of those opinions in accordance with generally established principles and the assessment of which of those opinions in the circumstances you should prefer.

In our submission the question of conflicting evidence arises in two different ways in the context of the hydrogeological evidence and I will address myself to that in a moment. First with respect to Site F, it arises squarely on the issue of the need for a liner. You have opinions from experts who have

testified before you that a liner is not needed, and you have the evidence and the opinion from Mr. Petrie, and, no doubt, as Ms. Vigod would have it and Mr. Hodgson would not have it, from Mr. Bowen, that a liner would be required. That opinion by Mr. Petrie of CRA must be assessed in light of the fact you have received opinions from other informed qualified experts that a liner is not necessary. I would refer to Mr. Sobanski, I would refer to Mr. Beechinor, I refer to Dr. Charlesworth, Dr. Rowe and Mr. Feenstra. That is the first evidence that requires this kind of a weighing exercise.

The second issue is broader in nature in my submission, and that is whether the Site D undertaking as presented to you by the Region in its current form can and should be approved for the purposes of landfilling at that site. It has been suggested to you that this is a question of whether Site D can be designed so as to be safe for landfilling. In our respectful submission that is far too narrow a characterization of the issue, but rather the issue is whether on the hydrogeological and design evidence now before the Board the site is suitable for landfilling on the state of the evidence that you have and should be approved for landfilling or whether it is

premature to do so.

The evidence before you from the experts on this issue is again divergent. Mr. Hodgson would have it that the site can be approved subject to certain design and testing conditions and he points to the evidence of Mr. Feenstra in this regard and the three options put forward by Mr. Feenstra to address the problems raised by his hypotheses that fracturing and decline in water levels in the granular units and the possible inducement of fracturing upon the introduction of the landfill. Mr. Hodgson has suggested that no hydrogeologist who testified before you said that Site D could not be made suitable for landfilling without any adverse effect on public health and safety. He described the position of Drs. Charlesworth and Rowe as being "less optimistic." In our submission, the proper characterization of the evidence on Site D suggests and establishes that there are a group of experts who regard the approval of Site D as currently proposed before you as premature. In our submission, that is the express evidence of Drs. Charlesworth and Rowe and implicitly the evidence of Mr. Feenstra. It is the conflict in the evidence on this issue that gives rise to the second weighing exercise on the conflict of expert opinion evidence.

Mr. Chairman and Dr. Kingham, we are certainly aware and are quick to acknowledge that the general principles involved in the weighing of conflicting expert opinion evidence are matters with which this Board is familiar. This has been a very long hearing and it is our hope, sir, that by very briefly dealing with those general principles as they have developed in the case law, it may ultimately prove to be of some assistance to you when you come to reach your decision in this matter. We have prepared a case book for that purpose and I propose to refer to it only very briefly and indeed there are only three cases which I will ask you to go to directly and perhaps that could be distributed. I should say as well, Mr. Chairman, that the size of the case book should not be interpreted as reflective of the time which will be spent on the principles. I am mindful of the discussion which took place the other day and one half of this book is one case that is two hundred and forty odd pages, and rather than give you two pages and run the risk of a battle with Mr. Lederer, I have decided to give you the whole case. I appear to be one short.

The essential governing principles may be summarized in our submission as follows: first, in assessing credibility the law makes no distinction

between professional witnesses and other witnesses. The evidence of experts must be appreciated like that of others, and the trier of fact is bound to examine it and to weigh it as any other evidence given in the case, and I would refer you, for proof of that proposition, to the case appearing under the first tab in your case book, and we have taken the liberty of highlighting in yellow the relevant portions from each case that support the proposition that I am putting to you.

The second general principle, Mr. Chairman, in our submission, is that it is clear that the obligation of a tribunal in considering the evidence of experts is not restricted to assessing their credibility and qualifications, but rather it is the duty of the tribunal to do more than that. The obligation has been described in the following language, and I would suggest if you wish to go to tab 2, which is the case of Gallant et al v. F.W. Woolworth Company Limited et al, a decision of the Saskatchewan Court of Appeal in 1970, and I would refer you to page 252 and to the marked passage in which the Court is referring to the approach taken by the trial Judge in assessing the evidence of experts on a particular issue in that case. In my submission, all these cases are

different fact situations and they are not environmental assessment or Joint Board hearings, but the principles are the same, although the facts be different.

In that case the Court indicated:

"Expert witnesses, because of their special qualifications and experience, are allowed to give opinions and theories which may assist or guide the Court. The trial Judge, however, is not relieved of the responsibility of forming his own opinion based on all of the evidence."

The third general principle, Mr. Chairman and Dr. Kingham, is that I suggest the obligation to weigh conflicting evidence involves an evaluation of credibility. The concept of credibility, it has been suggested, "escapes exact definition." Sopinka and Lederman in their text on The Law of Evidence in Civil Cases, and you will recall there has been reference to this textbook several times at this hearing, have suggested at tab 3:

"Two witnesses may be worthy of credit, but in varying degrees, with the result that on points of contradiction, the

evidence of one will be preferred to the evidence of the other."

and still later:

"The demeanour of the witness, his manner of expression and other personality-related aspects of his testimony, although not necessarily determinative, are relevant."

That is at tab 3. There is as well another reference from the evidence text which may be of assistance to you and this is not in the textbook before you, but it is from Phipson On Evidence, the 11th edition, in which the author suggests the following:

"The credibility of a witness depends upon his knowledge of the facts, his intelligence, his disinterestedness, his integrity, his veracity. Proportioned to these is the degree of credit his testimony deserves from the Court or jury. Amongst the more obvious matters affecting the weight of a witness' evidence may be classed his means of knowledge, opportunities of observation, reasons for recollection or belief, experience, powers of memory and

perception and any special circumstances affecting his competency to speak to the particular case, all of which may be inquired into, either in direct examination to enhance or in cross-examination to impeach the value of his testimony."

The fifth general principle to which I would invite your consideration is this; that fundamental to the task of weighing conflicting opinion evidence is the principle that, absent extenuating circumstances, the testimony of disinterested witnesses should prevail over that of persons who are or may be interested in the result. That is a quote, Mr. Chairman, and I am referring to the case which appears at tab 4 of your book, a very old authority, and the principle has stood, in my submission, the weight of time and I would ask you to go as well to the bottom of page 210 of that case, in which it is said:

"Considering that when the evidence of an important fact is contradictory, as it is in the present case, the Court must weigh the motives of the witnesses, their relationship or friendship with the parties, their attitude and

demeanour in the box, the way in which they gave evidence, the probability of the facts sworn to, and come to a conclusion regarding the version which should be taken as the true one."

The Supreme Court of Canada also dealt with this issue in a number of cases and I suggest that the sixth relevant general principle is set out in the case of White v. The King at tab 5 of your textbook, or of your brief of authorities, and if I could refer you to the following passage:

"The issue of credibility is one of fact and cannot be determined by following a set of rules that it is suggested have the force of law..."

Mr. Justice Anglin, in speaking of credibility stated:

"By that I understand not merely the appreciation of the witnesses' desire to be truthful but also of their opportunities of knowledge and powers of observation, judgment and memory -- in a word, the trustworthiness of their testimony, which may have depended very largely on their demeanour in the

witness box and their manner in giving evidence."

That was a reference to an earlier case decided by the Supreme Court in 1919, the Raymond case, and then in White v. The King, the Supreme Court of Canada continued as follows, referring to the earlier case:

> "The foregoing is a general statement and does not purport to be exhaustive. Eminent Judges have from time to time indicated certain guides that have been of the greatest assistance but so far as I have been able to find there has never been an effort made to indicate all the possible factors that might enter into the determination. It is a matter in which so many human characteristics, both the strong and the weak, must be taken into consideration. The general integrity and intelligence of the witness, his power to observe, his capacity to remember and his accuracy in statement are important. It is also important to determine whether he is honestly endeavouring to tell the truth,

whether he is sincere and frank or whether he is biased, reticent and evasive. All these questions and others may be answered from the observation of the witness' general conduct and demeanour in determining the question of credibility."

That appears under tab 5. It is also important to recall, in my submission, the general principle that a witness, including an expert witness, may testify as to what he or she sincerely believes to be true, but he might be quite honestly mistaken. The Courts have consistently held that it is the duty of the trier of fact to assess the evidence of witnesses in accordance with the preponderance of probabilities in the case in an effort to determine on the evidence what contested facts have a very high degree of probability, and for that authority I refer you to the Faryna v. Chorny case at tab 6.

I would ask you very briefly -- there are three cases to which I wish to refer directly, and if I could ask you firstly to go to tab 7, if you will, Mr. Chairman. That is the case of Regina v. Baribeau, a decision of the Ontario County Court in March of 1983. The reason I am requesting you go to these

authorities directly is because they are more recent and represent, in my submission, a re-confirmation of the general principles I have outlined to you. This was a criminal case, a dangerous driving case again, and the factual circumstances of the case and the fact that it was a courtroom, in my submission, make no difference whatsoever to the articulation of the general legal principle. I would ask you to go to page 74 of that case if you would, and I would direct your attention to the passage highlighted in the fifth full paragraph which reads:

> "The next matter for consideration is the evidence of the four engineers. As trier of fact, I may believe all, none or part of what any witness has said and that includes the evidence of experts. Of course, the uncontradicted evidence of an expert witness is not to be lightly disregarded. Where the evidence of experts is contradictory, as it was in this case, that evidence must be appreciated and weighed in the same manner as that of any other witness. I must also take into consideration the factual basis for their opinions or lack

thereof, their qualifications, their fairness or objectivity and the possibility of an unconscious bias in favour of the party calling them."

It will be my submission later in the course of our argument, Mr. Chairman and Dr. Kingham, that the principles enunciated in this case have a direct bearing on the task before you of weighing conflicting opinion evidence.

Could I ask you to go as well to tab 10, and this is the case which consumes the bulk of the book, and again the factual circumstances in my submission are irrelevant, but the general principles are germane. It is a 1985 decision emanating from Saskatchewan and I would ask you to go to page 124. So often it is easier stated, the principles are easier stated than applied, and so often it is said that this is a matter of credibility, this is a matter of weight. It seems to me, or at least it is our hope that it will be of some assistance afforded to the Board by approaching that actual task in practical terms by this case and the one which follows it.

At page 124, referring to the second full paragraph, there is again confirmation that "There is no distinction (at law) between evidence given by

experts and that given by ordinary or lay witnesses," and the Court indicates:

> "The evidence of experts must be appreciated and weighed in the same manner as that of any other witness. In determining the weight of expert evidence, the Court considers the usual rules of testing credibility. The weight, value and effect of expert evidence is entirely a question for the determination of the court trying a question of fact, in light of all the circumstances and in connection with all the other evidence. It is not conclusive, controlling or binding, even though uncontradicted or undisputed. All or part of an expert's opinion may generally be accepted or rejected as appeals to the judgment of the court. Of course, the uncontradicted evidence of an expert witness is not to be lightly disregarded. A conclusion of law has no probative force."

and he goes on to speak about what happens when an expert purports to give an opinion as to matters of law

when they are not legally trained to do so.

I would then refer you to the last paragraph at page 124:

> "Certain authorities have been helpful in assessing expert evidence which is in conflict. In Gallant v. F. W. Woolworth Co.,..."

and you will recall that is, I believe, the second tab of your book, yes, the second tab, it was said by the Saskatchewan Court of Appeal:

> "In the instant case, having found the experts equally credible and qualified, the trial judge should have considered all of the other evidence accepted by him and adopted that theory which was most consistent with that evidence and, therefore, more probable."

And then there is the particular passage I would commend for your consideration, beginning at the second full paragraph on page 125:

> "I have given careful consideration to the testimony of all expert witnesses. The evidence of a number of experts is a major issue in this case. I have looked at, inter alia, the following:

(1) The manner in which they presented their evidence and their attitude on the stand, watching for any indication that anyone was arrogant, argumentative, an advocate, overreaching, overly technical or forced to retreat or retract;

(2) Conflict between them;

(3) Conflict between expert evidence and lay evidence;

(4) The extent to which expert evidence was consistent with probability and reason;

(5) The extent to which expert evidence was contrary to physical facts or scientific principle;

(6) The lack of partisanship of a witness;

(7) The effectiveness of testing equipment and procedures;

(8) The manner in which they met cross-examination.

Of course, there was a variety of other considerations. Problems are more acute when, as here, there is a marked

attempting to assess that evidence, which will usually relate to a discipline of which he will have very little knowledge. I have found useful guidance in two authorities. The first of these is Re Warwicker, McLeod v. Toronto General Hospital...."

and then he proceeds to quote the test suggested in that case.

"When a case is complicated by the introduction of opinion evidence, particularly in cases of a medical nature, where doctors invariably disagree, it is, I think, the duty of the judge to arrive at his own opinion after carefully weighing and considering the evidence of the experts, and availing himself of all the assistance they are able to give him, and himself to determine the question of fact in the light of that evidence, and it is not enough for him to say, 'I doubt and cannot resolve the doubt, because an expert says "I doubt".'

The appropriate approach to be taken by

the trail judge is set out in Southern Canada Power Co. v. R.,... 'In my view the trial judge approached the evidence, and I think rightly, in this manner: Having carefully reviewed and considered the evidence of all the expert witnesses and finding marked differences of opinion among them, he turned to the great mass of lay evidence and then accepted the theory of these experts that was consistent with the evidence of those lay witnesses whose evidence he accepted because of their practical experience and credibility'."

That then is the first suggested approach and that is in the face of conflicting opinion evidence to relate the theory of the opinion evidence to lay evidence that is otherwise in your opinion and judgment considered to be credible. There is a difficulty in this case in that regard, because most of the evidence you have heard is apprised of opinion evidence and not lay witness evidence, but there is some and I suggest to the extent that that evidence is available to you, that correlation can be made.

However, the more compelling and

appropriate approach in my submission is the alternative approach set out at page 25 of this case, and I would ask you to go to page 25, paragraph 106. At page 25, paragraph 106, where the Court indicates, and they are referring again to a lack of unanimity among experts on the technical issue that was important in that case:

> "When faced with such professional dichotomy, what is the court to do? On the one hand, it may take the approach indicated in the Southern Canada Power case, supra, turn to lay evidence, and accept the expert theory which is the more consistent with the evidence of lay witnesses whose practical experience in the matters in issue renders them credible. This option is not available here, since the court has no such lay evidence which is credible and convincing on the critical issue, which is not, of course, to say that it might not be credible and convincing on other aspects."

Stopping there parenthetically, Mr. Chairman and Dr. Kingham, on the critical issue of

whether Site D is suitable for landfilling on the state of the evidence before you and on the critical issue of whether Site F requires a liner, in my submission the lay evidence does not assist you. Could I ask you to go to paragraph 107 for the alternate approach which in my submission should apply to this case:

> "Or, on the other hand, it may take the approach indicated to be the appropriate one, in the absence of such lay evidence, in Cie F. X. Drolet v. London & Lancashire Guarantee and Accident Co.,... McDougall, J.:
>
> 'In this case, as in others, the experts have differed... Where a Court is in doubt as between conflicting statements of so-called expert witnesses it is well to remember the words of Lord Sumner in The Australia v. The Nautilus, (1927) A.C. 145:
>
> "If, as may happen, a judge cannot decide in his own mind whether or not the advice he receives is sound, his position is simply that the point is not proven, and the loss falls on the party who bears the burden of proof in the

my submission, to demonstrate for the assistance ultimately of the Board, the kinds of principles I have outlined to you and where there are issues to be taken specifically into account with respect to certain witnesses. That is not to suggest that any expert who came before you did not honestly express an opinion genuinely held. That is very different from suggesting that the opinion was an accurate one.

If I could turn to the Site F hydrogeology evidence and design and operations deal with the matters outlined in our index, starting first with the hydrogeological interpretation at Site F.

There has, of course, Mr. Chairman, been much evidence at this hearing regarding the hydrogeologic conditions at Site F, and concerning the most reliable way in which to characterize the hydrogeological environment at that site. You have heard from Mr. Hodgson in his final submissions to you with respect to that issue and as well from Mr. Estrin and Mr. Garrod. The relevance of this evidence, in our submission, is that it goes directly to the issue of risk assessment and therefore directly to the issue of suitability for approval of landfilling. Mr. Hodgson has already reviewed in detail the evidence of the various hydrogeologists concerning their

so in the form of a witness statement, not an affidavit. The type of motion Mr. McQuaid was bringing was supported by a witness statement, not affidavit material.

On the issue of who is asking you to do this, whether it is the Town of Milton or National Sewer Pipe, not all counsel in the room, perhaps this is the best way I can put it, were aware of these facts at the points in time that have been referred to by Mr. Leitch and by Mr. McQuaid and what Mr. McQuaid has characterized as opportunities to bring this evidence before you.

As the Board certainly knows, I represent the only private party before this Board and have done so since the commencement of this hearing. At the time I conducted my cross-examination of Mr. Feenstra on his reply evidence, I was unaware of the existence of this evidence and the facts and implications of it. It would be imprudent of me to suggest what might have been done had I known, suffice it to say, I didn't know and I now do.

From my client's perspective, Mr. Chairman, Dr. Kingham, there can be no doubt that this evidence is relevant to the Board's determinations. Indeed, I will be making submissions to you on the main

---- Upon resuming at 2:35 p.m.

MR. LANCASTER: Thank you, please be seated.

It has been suggested a number of times throughout this hearing that the purpose of the Environmental Assessment Act is to ensure that the Board hearing an application has all the information necessary to make its decision on behalf of all parties concerned.

Mr. Garrod re-emphasized that purpose this morning when he suggested that this forum should not be a dispute between parties. In this case, between municipalities ~~and~~ in Halton. In gathering this information we understand that the Regional Municipality of Halton has acted in the spirit of the Act and in particular with respect to hydrogeology, they allowed for observations and participation by the other parties to the hearing. This helped the Board to have a clear understanding of the evidence brought before us.

The Board now understands that additional hydrogeological studies were undertaken on April 6th and 7th of this year. With the exception of the Milton parties, other parties were not informed of the test and this result and were not invited to

participate in it. Within 30 hours the T-shaped hole, more than eight metres deep had been dug, examined and filled in again. In subsequent days, particularly on April 12th, 1988, counsel for the party on whose behalf the test pit had been dug was cross-examining a witness on the hypothetical existence of fractures in clay tills across southern Ontario. The witness stated that he had no evidence to support such a hypothesis, but that "If evidence were provided by yourself or the proponent, one would have to consider that fracturing with respect to assessing site suitability."

It was not suggested to the Board at that time or at any time since then that such evidence was available. When the expert witness for the proponent, Mr. Feenstra, proposed an hypothesis about fracturing in such tills, he also stated that he had no data to support such a hypothesis in the vicinity of Site D. Again, it was not suggested to the Board that such data might exist. When cross-examined about his hypothesis by counsel for the City of Burlington about the extent of the testing necessary to prove his hypothesis, Mr. Feenstra gave evidence that conclusive evidence could not be assured with even five test pits.

Additional tests of a different kind would be needed to clearly support or refute that