

CONSOLIDATED HEARINGS BOARD

IN THE MATTER OF Sections 2 and 3 and 6 (3) of the Consolidated Hearings Act, 1981, S.O. 1981, c.20;

— and —
IN THE MATTER OF Section 12(2) of the Environmental Assessment Act, R.S.O. 1980, c.140;

— and —
IN THE MATTER OF Sections 30, 35 and 38 of the Environmental Protection Act, R.S.O. 1980, c.141, as amended;

— and —
IN THE MATTER OF Sections 24 and 61 (2) of the Ontario Water Resources Act, R.S.O. 1980, c.361, as amended;

— and —
IN THE MATTER OF Section 28 (3) of, and Regulation 164 under, the Conservation Authorities Act, R.S.O. 1980, c.85, as amended;

— and —
IN THE MATTER OF Section 40(12) of the Planning Act, S.O. 1983, c.1, as amended; in connection with site plan control of the sanitary landfill site;

— and —
IN THE MATTER OF Section 22(1) of the Planning Act, 1983 in connection with a referral to this Board by the Honourable Bernard Grandmaitre, Minister of Municipal Affairs, on a request by the Regional Municipality of Halton to amend the Official Plan for the Town of Milton to redesignate a parcel of land comprising Part Lots 3 and 4, Concession 2 N.S. in the Town of Milton from "Agriculture" and "Conservation and Hazard Lands" to permit the construction, operation and maintenance of a landfill site, Minister's File No. 24-0P-0208-A01;

— and —
IN THE MATTER OF Section 34(11) of the Planning Act, 1983 in connection with an appeal to this Board by the Regional Municipality of Halton for an order directing an amendment to By-law 81-85 of the Town of Milton to rezone the lands situated at Lot 3 and part of Lot 4, Concession 2 N.S., in the Town of Milton from "Agriculture" to permit a regional sanitary landfill site and ancillary uses;

— and —
IN THE MATTER OF Section 15(1) of the Planning Act, R.S.O. 1980 ch.379 in connection with a referral by the Honourable Claude F. Bennett, Minister of Housing on a request by Tremaine Britannia Citizen's Group for consideration of part of the Official Plan for the Halton Planning Area with respect to Sections 1 to 5 inclusive, 7, 9 and 10 of Part III D3 Solid Waste Management, Minister's File No. OPC-0026;

— and —
IN THE MATTER OF Section 64 of the Ontario Municipal Board Act, R.S.O. 1980, c.347 as amended in connection with an application by the Regional Municipality of Halton for an order approving:

a) the acquisition of land for the construction, operation and maintenance of a sanitary landfill site to contain 7.96 million cubic metres of waste in the Regional Municipality of Halton and to do so by one of two alternative methods as follows:

- (i) landfilling at the site referred to in Halton's Environmental Assessment as Site F in the City of Burlington;
- (ii) landfilling at the site commonly referred to in Halton's Environmental Assessment as Site D in the Town of Milton

at an estimated cost of \$12,775,000.00, and the borrowing of money by way of temporary advances not exceeding in the aggregate such estimated cost pending the sale of debentures, and

(b) the issuance of necessary debentures to a maximum of \$12,775,000.00 for a term not to exceed fifteen years;

— and —
IN THE MATTER OF Section 193(5) and Paragraph 84 of Section 210 of the Municipal Act, R.S.O. 1980, c.302, as amended;

— and —
IN THE MATTER OF Sections 6, 7 and 8 of the Expropriations Act, R.S.O. 1980, c.148;

— and —
IN THE MATTER OF an undertaking of the Regional Municipality of Halton to provide facilities for the purpose of receiving, dumping and disposing of waste as required by section 137 of the REGIONAL MUNICIPALITY OF HALTON ACT, R.S.O. 1980, c.436, as amended, by acquiring the land for, constructing, operating and maintaining a landfill to contain 7.96 million cubic metres of waste in the Regional Municipality of Halton.

VOLUME: 22

HELD AT: Oakville, Ontario

DATE: Thursday, June 18, 1987

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I N D E X

WITNESSES:

SOBANSKI, Alfred A., resumed:

BEECHINOR, James, resumed:

Cross-examination by Mr. Tidball

5000

E X H I B I T S

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BEFORE:	H. H. Lancaster, Q.C.	-	Chairman
	Dr. D.J. Kingham	-	Member
	S. Tanner	-	Member



Nethercut & Co. Ltd.

Toronto, Ontario

Hearing conducted at The Oakville
Granary Commercial Centre, 105 Robinson
Street, Oakville, Ontario, on Thursday,
June 18, 1987.

VOLUME 22

APPEARANCES:

T.R. Lederer and
H.D. Hodgson

for the Regional
Municipality of Halton
(Proponent)

J.R. Tidball

for the Ministry of the
Environment

T. Vigod
J.F. Castrilli

for the West Burlington
Citizens Group

D. Estrin,
F.E. Leitch and
H. Dahme

for the Corporation of the
Town of Milton

S.R. Garrod and
A. Nurvo

for the Milton Area Citizens
Coalition and several
affected Milton area
landowners

R.B. Tuer, Q.C.
E.A. Cronk and
F. Perrier

for National Sewer Pipe
Limited

L.F. Longo

for Azova Investments
Limited

M.J. McQuaid, Q.C.
and C.J. Tzekas

for the City of Burlington

C. Mansfield

for the Ministry of Natural
Resources

P. Renaud

for Cumis



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Toronto, Ontario

APPEARANCES (Cont'd):

1	C. Stevenson	for Framgard Holdings,
2	P. Hancock	Fosseri Investments
3		Limited, Seriphos
4		Investments Limited and
5		Topic Investments
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J.H. Olah

for the Halton Region
Conservation Authority

* * * * *

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185 Richmond St. W.
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Per: C.F. Nethercut, C.V.R.



Oakville, Ontario.
Thursday, June 18, 1987.

--- Upon commencing at 9:30 a.m.

THE CHAIRMAN: Good morning. Thank you.
Please be seated. I think, Mr. Lederer, you had
concluded your examination-in-chief?

MR.LEDERER: I had indeed, but before
I relinquish Mr.Sobanski to Mr. Tidball and others,
I did undertake to file with the Board Gartner,
Lee's delineation study and I don't think we reserved
a spot for it.

THE CHAIRMAN: H-83. Was that
number not open?

MR. LEDERER: I don't recall that,
but,if so, it would seem appropriate.

--- EXHIBIT No. H-83: Report by Gartner, Lee.

ALFRED A. SOBANSKI, resumed:

JAMES BEECHINOR, resumed:

CROSS-EXAMINATION BY MR.TIDBALL:

Q. Good morning, Mr.Sobanski
and Mr. Beechinor.

MR.SOBANSKI: A. Good morning.

Q. Before I start, I will try
and let you know where I am going and hopefully I



1 will be through my cross-examination today and leave
2 you to the rest of the Board, and you will be here
3 for many weeks to come.

4 MR.LEDERER: I have never known
5 Mr. Tidball to become a prophet before.

6 MR. TIDBALL: Q. As you know, the
7 interest of the Ministry of the Environment in these
8 matters and on this particular evidence is on the
9 environmental acceptability of both sites, and for
10 that reason I won't be asking you any questions
11 about what we have been calling the environmental
12 assessment portion, 2A, 2B and 2C, and I will be
13 questioning you entirely on the technical studies,
14 so you really have to have in front of you Exhibits
15 39 and 40 and the appendices that go with them and
16 the numerous overheads and large blow-ups I will
17 have to come to as we go through it.

18 I am not quite sure who to address
19 either question to or any question to, so I thought
20 I might invite either of you to answer the questions
21 as you see fit, unless I specifically ask, but
22 really I think it should be up to you to answer
23 as you see fit.

24 The first area I want to deal with
25 has to do with the Ministry's reasonable use



1 policy. I wonder if you could get out E-154, Mr.
2 Sobanski, since you are on your feet.

3 While people are getting that out,
4 I didn't get up on Monday when this was made an ex-
5 hibit but I will advise you I will be calling a witness
6 who will speak to this policy and I thought I might
7 take a moment to explain what it is you have before
8 you, because it is not that clear on its face.

9 The first five pages before the first
10 blue page is an excerpt from the Ministry policy
11 manual and it is sort of an omnibus policy on water
12 management goals and objectives and things like that
13 and it actually forms the first number of pages of
14 what is called the blue book, and I meant to bring
15 my copy down, but it's a small blue book and the
16 Ministry, and anyone who has anything to do with
17 the Ministry, knows it as the blue book and it has
18 to do with water management.

19 If you refer specifically to the
20 fourth page of this, of this first section under
21 Groundwater Quality Management, you will see that
22 under the first policy it says:

23 "Policy 1, regulated sources of
24 contamination,"

25 and the second sentence:



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"As a general policy,
water quality degradation will be
controlled in order to protect
reasonable uses, existing or proposed
of both ground and surface waters."

Out of that flows the next excerpt

found after the first blue page and it simply says
all right, that is a concept known as reasonable use
and there is a specific policy about it and all this
policy does, it's a one-page thing, it simply
incorporates the biggest chunk of the document,
which is after the next blue page, which is a document
describing the policy and the concept really and how
it is to be applied in the assessment of lots of
things including landfills.

~~Mr. Sobanski,~~ in chief I think you
said you are relatively familiar with this, and we
can call it a policy though I am not sure this
actual document is the policy, but let's as a
general rule call it the policy?

MR.SOBANSKI: A. Yes, I have some
familiarity with it, Mr. Tidball, and in fact in
its published form it has been available fairly
recently, but I do have some familiarity with it.

Q. I am correct, am I not, that



1 you in fact have used the notion of setting boundary
2 criteria in other studies you have worked on and
3 in fact you have used that concept before, before
4 the Joint Board in the past, have you not?

5 A . Yes, we have.

6 The concepts aren't new, and at one
7 time they were sort of criteria guidelines that
8 hydrgeologic consultants were following and now they
9 have become a little bit firmer, as I understand it.

10 Q. Just for the purposes of all
11 of us understanding, I wonder if you can agree with
12 me on the basic approach, and I will try and refine
13 this down as far as I can and see if you can agree
14 with me that this policy really incorporates the
15 following approach, and there are three main points
16 and I will do them one at a time and if you can
17 agree, fine. (1)

18 The first thing I suggest the policy
19 does is it says the first step is to determine
20 what the reasonable present potential use of
21 groundwater off the site, and in this case it's
22 a. landfill site that is proposed, is?

23 A. Yes.

24 Q. That is the first. The second
25 thing we do is we try to establish boundary criteria?



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A. Yes.

Q. Within that second category,

can you confirm, and we will be leading evidence on this, but the primary rule of thumb is that there be no degradation in excess of 50 per cent of the difference between background water quality and water quality criteria or 25 per cent of their health-related parameters?

A. Correct.

Q. The third thing we do is simply assess the impacts or predict the impacts of contaminant migration against those boundary criteria?

A. Yes.

Q. Would you agree with me that the fundamental principle of this document is that an applicant for a Certificate of Approval for a landfill site should be able to demonstrate that a site will not impair the reasonable use of ground-water on adjacent property?

A. Yes.

Q. I understand, Mr. Sobanski, that you looked at this concept in assessing whether Sites D and F are acceptable for landfilling, and I am going to ask you specific questions about that as I go through the individual sites.



1 I am curious, Mr. Sobanski, about
2 what criteria you use as an expert in this area
3 to judge whether in your opinion a proposed
4 landfill is acceptable from a hydrogeological sense
5 for landfilling, and I want to give you a full
6 opportunity for you to tell me what you think the criteria
7 are, but I would like to put three criteria to you
8 and ask you whether you can agree with those
9 criteria and if you want to add anything after that,
10 I would invite you to do so.

11 First of all, would you agree that
12 one criterion for assessing a proposed landfill is
13 that leachate migrating from the landfill should (1)
14 not impair the reasonable use of groundwater on
15 adjacent property?

16 A. In general, yes.

17 Q. Would you agree that it
18 should be a criterion that you should be able to (2)
19 develop a monitoring program which should be
20 capable of identifying the movement of landfill-
21 derived contaminants?

22 A. Yes.

23 Q. Would you agree that feasible
24 contingency measures must be available to mitigate
25 or in fact prevent any impact on adjacent property



1 which is identified by the monitoring program?

2 A. Yes, I would.

3 Q. I said I would give you an
4 opportunity to add anything to that, and are there
5 any other criteria you use in coming to an opinion
6 as an expert that a site is hydrogeologically
7 acceptable?

8 A. I think these general criteria
9 incorporate a lot of principles. Leachate, for
10 instance, leachate should not impair reasonable
11 use of groundwater on adjacent property; I think
12 anybody must say that that is reasonable and that,
13 Mr.Chairman, leads to a lot of other areas, how
14 you select a site in terms of its attenuating
15 capability, et cetera.

16 As I said, the large landfills
17 meet that type of criteria and we agree with
18 that type of criteria, which means that large
19 landfills have to be engineered and it is impossible
20 usually in Ontario with its short flow systems to
21 develop large landfills that would not contaminate
22 property boundaries, given the Ministry's reasonable
23 use criteria, which are not zero criteria as they
24 have been interpreted at some times in the past,
25 but they approach zero in terms of some contaminants.



1 Indeed monitoring programs do have to be developed
2 to assess whether or not the site meets its design
3 criteria, whether it performs as predicted and
4 certainly it has been a policy of the Ministry for
5 a considerable period of time that contingency
6 measures must be available to mitigate any unwarranted
7 impacts that may occur in the event there are failures
8 in the system.

9 So, overall, without elaborating
10 too much, the three basic criteria are what we
11 look for.

12 Q. Just on that, on the first
13 point you mentioned that in your opinion the effect
14 of saying that you should not impair the reasonable
15 use of groundwater on adjacent property is that in
16 Ontario we must engineer most sites. I wonder if
17 you could comment -- and I was going to ask you
18 later, but this seems to be the appropriate time,
19 but I take it that means when we are engineering
20 a landfill site, we have to look at the sort of
21 life of those engineering systems when we are
22 assessing the impact?

23 A. Yes.

24 Q. Would it be your opinion that
25 when we design engineering features they have to be



1 designed so that they are going to -- let's talk
2 about leachate underdrains, leachate underdrains
3 will collect leachate for enough of the portion of
4 the life of the site that the strongest leachate
5 is collected?

6 A. I think that that would be.
7 reasonable, yes, but then you do have contingencies
8 backing that up.

9 Q. I think perhaps I will come
10 back to that later, as we come down to the Site D
11 material.

12 I would now like to talk about Site
13 D and specifically Exhibit 39 and 39-A, the
14 technical study. I wanted to start right in with
15 the whole area of impact assessment and ask you
16 some questions, both for our purposes and for the
17 purposes of expanding on your evidence for the Board,
18 but some questions about your assessment of
19 contaminant migration at that site.

20 First of all, I wanted to ask about
21 the water balances, Figure 3 on page 56, and perhaps
22 you have it on an overhead somewhere, I believe
23 you did. This is Figure 3 and there are several
24 figures which look the same. Perhaps I could ask
25 you a question on this and also Mr. Beechinor might



1 get out that Figure 7 as I will be asking questions
2 on that.

3 Mr. Sobanski, this is the water balance
4 for Site D as it now exists and I take it that the
5 column which is expressed to be 575 metres by 530
6 metres is the actual area of the landfill?

7 A. I believe that that was
8 approximate at the time this was prepared, yes.

9 Q. I wanted to ask you specifically
10 about that column on the lefthand side; and as I
11 understood this figure, Q_R is the amount of recharge
12 that goes in the top of the system, if you will,
13 that will go down?

14 A. Yes.

15 Q. That is 9.6 millimetres?

16 A. Yes.

17 Q. Down at the very bottom Q_B
18 is the amount or flux of that recharge getting to
19 bedrock?

20 A. Yes.

21 Q. 6.9 millimetres?

22 A. Yes.

23 Q. You might have to accept my
24 word for this, but I think it actually comes right
25 from the text, but just so we all understand it,



1 you are saying that 72 per cent, approximately, of
2 the amount of recharge going into the top is actually
3 getting to the shale bedrock?

4 A. Yes, in that order.

5 Q. It's obviously not exact, but
6 in that order. I wonder if you could put up Figure 7.
7 On Figure 7, you show the various contaminant
8 pathways and in fact you show at the bottom lateral
9 migration through the shale bedrock?

10 A. Yes.

11 Q. Am I right if I read these
12 two figures together, when you speak of the lateral
13 migration to the shale bedrock, we are talking
14 about 72 per cent of the recharge coming from
15 the top and going down?

16 A. Yes.

17 Q. Given that, and I want to pick
18 up on something you said in chief, and I think it
19 is inherent in the document, but I think you stated
20 we shouldn't have to be concerned or shouldn't be
21 concerned about migration downward to the bedrock
22 and laterally through that bedrock and I am wondering
23 if you could tell us why we shouldn't be concerned
24 if in fact we are talking about 72 per cent of the
25 recharge?



1 A. If I could just have a moment.
2 I can't find it instantly, but the reason we weren't
3 concerned was because of the timeframe of the arrival
4 times which were in the order of hundreds of years.

5 Q. I think it's 360?

6 A. That's right; it's quite a
7 long period of time. In any event, it was proposed
8 within the report that the shale unit would be
9 monitored if we wanted to monitor it for 360 years.

10 Q. As I understand it, the way
11 you did the impact assessment was you used the Ogata-
12 Banks equation and came up with impacts along various
13 pathways, but you chose not -- when you came to
14 couple them all together and then apply a declining
15 source of chloride, when you did that, you didn't
16 couple it down to the shale bedrock, you simply were
17 concerned about the granular units?

18 A. We didn't at this time, but
19 we have since.

20 Q. I wonder if you can tell me
21 if you have done it, what kinds of impacts you are
22 predicting along the bedrock pathway?

23 A. It was something I decided
24 to try relatively recently, and my understanding is
25 that essentially there is no peak at the bedrock.



1 It slowly rises to the 100 milligram per litre background
2 and stays there, so there was no peak involved in
3 chloride impact on the bedrock.

4 Q. Is there an explanation for
5 that?

6 A. Just diffusion and the way
7 the system works. In other words, if we were to
8 plot the concentration versus time, it rises to the
9 100 milligrams per litre we assumed is going to be
10 leached from the landfill for a considerable period
11 of time and then just stays there. It doesn't come
12 up apparently in a peak like so (indicating).

13 Q. I am looking, for example, at
14 Figure 19, which is the chloride concentration at
15 the boundary in the granular units using declining
16 chloride, and you don't get that kind of graph?

17 A. Apparently not. I have not
18 seen the actual drawings and I have been advised
19 verbally.

20 Q. Mr. Beechinor has put up
21 Figure 19.

22 A. My understanding is we don't
23 get that peak, but rather it rises starting at about
24 360 years or so and then it comes up to the background
25 level we have assumed is going to be produced for



1 ever from the site, which it won't be either, but it
2 slowly rises to that value and stays flat. We
3 can provide that.

4 Q. Can you provide it? I don't
5 think we need it, but I think simply for the purposes
6 of completing the record.

7 MR. LEDERER: We will provide it,
8 Mr. Chairman.

9 MR. TIDBALL: Q. I want to ask you
10 specifically about the upper granular unit because
11 it is the upper and lower granular units you are
12 most concerned about in terms of contaminant
13 pathways?

14 MR. SOBANSKI: A. That's right.

15 Q. Can we deal first with the
16 upper unit. Could you put up drawing 18. That is
17 described as local potentiometric contour map,
18 upper granular unit, and it's the one which shows
19 the upper granular unit in plan view. I suspect
20 you will both be very adept at this after a while?

21 A. It's like an obstacle course
22 up here.

23 Q. As I understood this figure,
24 and it's very difficult to see, but the area marked
25 with the solid black line sort of in -- with an open



1 end on the lefthand side, that is what you are
2 defining in plan view as the upper extent of the
3 upper granular unit?

4 A. In general, yes.

5 Q. Could I ask you some questions
6 about that because we were wondering if the boundaries
7 perhaps should not be a little bit different.

8 First of all, can you confirm for
9 me that for HC 2-85, the one in the upper right
10 of that unit, the second piezometer is in the upper
11 granular unit and I think you can confirm that on
12 drawing 8, which is cross-section D-D? I see
13 Mr. Beechinor has it.

14 A. If you could just bear with
15 me for one second, Mr. Tidball.

16 Q. If it helps, I think this is
17 the one you used to show draw-down in the pumping
18 tests?

19 A. You will have to pardon me a
20 moment because finding your way through this report
21 is not always too easy.

22 Q. I sympathize. I think everyone
23 does.

24 A. Okay, Mr. Tidball.

25 Q. I think that was the easy one.



1 HC 2-85, the second piezometer, and can we call that
2 piezometer 2 or OW-2; what would you like to call it?

3 MR. BEECHINOR: Piezometer 2.

4 Q. That is in the upper granular
5 unit. I want to ask about ~~HC 3-85~~ which on that plan
6 you show outside of the upper granular unit to the
7 south, and it looks to be almost on the Ford farm
8 or very close to the Ford farm. Perhaps you could
9 show the Board?

10 MR. SOBANSKI: HC 3-86?

11 Q. HC 3-85. It is outside of the
12 boundaries you show.

13 MR. BEECHINOR: Southwest.

14 MR. SOBANSKI: I see it.

15 Q. Would you show it to the
16 Board?

17 A. It's located at the farm on
18 the southwest corner of the site.

19 Q. I am looking at drawing 10,
20 which is cross-section F-F, which I think goes
21 laterally through the site, and HC 3-85 is actually
22 on the far lefthand side of that drawing and it's
23 the second one from the left actually?

24 A. Oh yes.

25 Q. Have you got that cross-section?



1 A. I do.

2 Q. We are under the impression
3 that from that cross-section, piezometer 2 of
4 HC 3-85 is also in the upper granular unit and
5 I wonder if you can tell me in your opinion whether
6 it is or isn't. Are you checking the borehole log?

7 A. I am just checking to make
8 sure on the elevation.

9 What I am checking is the record
10 of where that well is located and I am going back
11 to the geologic cross-section and it doesn't
12 appear, regardless of what the section says, but
13 someone has projected .6 metres or 6 centimetres
14 as a two-inch thick layer as potentially part of that zone,
15 /but the piezometer itself, which has an elevation of
16 according to the report --the tip elevation is
17 171.4 and going back to the borehole logs, it is
18 in fact in the sandy silt till.

19 Q. For the purposes of the record,
20 are you at the borehole log that is called BH 3-85?

21 A. I am.

22 Q. You are looking at the second
23 page of that, of that borehole log?

24 A. Yes.

25 Q. Part-way down I see silt



1 layer 170.66 to 170.60 -- is that the 6 centimetres?

2 A. That would appear....

3 Q. We are going a bit fast.

4 We are in H-39-A and they aren't sequentially
5 numbered, but the main part of this document is
6 borehole logs and probably a quarter of an inch
7 in where you will see a series numbered BH 1
8 and then BH 2 and this is BH 3-85.

9 DR. KINGHAM: BH which?

10 MR.TIDBALL: BH 3-85 and it's the
11 second page of that particular log.

12 MR. SOBANSKI: A. If I can assist,
13 we started the '86 boreholes backward and worked down
14 through the ages.

15 Q. It's made more confusing
16 because it's called BH, but on the maps you call
17 it HC. It did take me a while. If everyone is on
18 that page, you are saying that silt layer isn't it
19 because that is not where the piezometer screen is?

20 A. The piezometer screen is set
21 according to the record, which is further on in
22 Appendix 4 and on HC 3-85, No. 2, we say the
23 tip elevation of the piezometer is 171.4, which
24 would put us into a nondescript little layer called
25 silty fine sand layer, which is not even defined



1 in terms of its thickness, so I presume it's not
2 even a centimetre thick, but in terms of the cross-
3 section, someone has shown some possibility of an
4 extension through there, and it's shown as wider
5 than it should be, and I would like to think what
6 happened is when we came back to finally map this
7 unit, we realized we didn't see anything there that
8 we felt was significant enough to call that unit
9 and we took it off that drawing which was prepared
10 later, but we didn't get around to changing it
11 on the cross-section.

12 Q. That is very helpful. So, you
13 are saying that the cross-section F-F is in error
14 in the sense that that unit should not extend that
15 far?

16 A. There is a fine silt layer
17 there and it's defined as a silty fine sand layer,
18 which is not even defined in terms of thickness and
19 I don't imagine it's too significant, but it occurs
20 at approximately the same elevation as that unit.
21 In any event, I believe in a lot of our calculations
22 we have assumed that the layers would be continuous
23 throughout the area. We have tried to define this
24 in terms of how we feel about it. For instance
25 with HC 5-84, we had no evidence of it, but we have



1 drawn it in, so if we miss perhaps a sliver of
2 something that's a centimetre thick or less
3 somewhere else, then it could extend there, but
4 my feeling is that if that is that unit, it is not
5 very significant.

6 Q. Thank you. While we are over
7 there and if you have the same cross-section we just
8 had up and if you go to the left there is a well
9 denoted MB(IN)OW-2 and that is one of the OWMC
10 wells?

11 A. Yes.

12 Q. On the cross-section you don't
13 show the existence of the upper granular unit?

14 A. That's right.

15 Q. I take it from the borehole
16 logs -- I take it the borehole logs aren't really
17 of much assistance on these particular wells?

18 A. Not very much.

19 Q. The Morrison Beatty logs are
20 fairly general?

21 A. Yes, that's right, and that
22 log which is located toward the back of that section
23 says a clayey silt down to about 6.1/2 metres and
24 then till, silty sand to about 12 metres followed
25 by shale. On some of their other logs they did



1 call for stratified drift within some of the sections
2 such as OW-1 and in OW-3 they call for a couple of
3 zones of stratified drift and in OW-4 as well.
4 However, in that particular log, OW-2, they did not
5 mention any stratified drift in that particular well.

6 Q. If we keep going off to the
7 left, and in fact I think it was probably just to the
8 left or the very boundary of Section F-F, there is
9 a private well denoted on one of your other maps,
10 the map that shows all the private wells, as 35-GL,
11 which I think means Gartner, Lee checked it?

12 A. Yes, I see it.

13 Q. I wonder if we could go to
14 Appendix 9, which is the water well inventory,
15 Appendix 9 in Exhibit H-39-A and go in, and it's
16 fairly easy to follow because they are simply numbered
17 sequentially, but go to No. 35, which is about, say,
18 ten pages in and we wondered whether this well doesn't
19 appear to be screened in the upper unit.

20 MR. ESTRIN: I'm sorry, which well?

21 MR. TIDBALL: 35 and it's described
22 as Warren C #5111.

23 MR. SOBANSKI: The Warren well....

24 MR. BEECHINOR: There is something
25 different here. When GL is denoted, 35 GL, you have



1 to go to the water well inventory prepared by the
2 Ontario Waste Management Corporation to get that
3 information.

4 MR. TIDBALL: Q. Do we have that
5 here?

6 MR. BEECHINOR: A. We have it
7 upstairs and I can get it at the break.

8 Q. I was reading the information
9 off here.

10 A. There is a 35 we would have investigated
11 on this drawing too somewhere.

12 Q. I apologise. You were saying
13 this 35 is somewhere else entirely?

14 MR. SOBANSKI: A. But I should point
15 out on the No. 35 I have that we are talking about,
16 is it screened in something — 35 itself in our well
17 inventory didn't have any log associated with it at
18 all.

19 Q. I was looking more at where
20 they found water?

21 MR. BEECHINOR: A. I would point out
22 that at that location, I recall from the Gartner,
23 Lee inventory, that that well was probably into sand,
24 the upper granular....

25 MS. CRONK: We can't hear you.



1 MR. BEECHINOR: We'll check that.
2 MS. CRONK: Can we hear what you said?
3 MR. TIDBALL: Q. You said as you
4 remember you think that that well was screened in one
5 of those two units?
6 MR. BEECHINOR: A. That's right.
7 Q. Could you check that at the
8 break and we can ask you after the break?
9 A. Certainly.
10 MR. ESTRIN: So we are clear, when
11 he says he thinks this well, he is referring to well
12 35?
13 MR. TIDBALL: 35 GL.
14 MR. ESTRIN: A GL number.
15 MR. TIDBALL: Q. Just one more on
16 this, Mr. Sobanski. I was curious about HC 6-85
17 which is right on the south boundary or the east
18 boundary, depending upon which way you turn the
19 map, of the site in the middle.
20 MR. SOBANSKI: That is referring
21 to drawing 18, HC 6-85, which is located about
22 the middle of the field on the south side of the
23 property.
24 Q. Could you go to D-D, because
25 it includes that well on the very far righthand side.



1 Perhaps this is the same question as HC 3, but that
2 cross-section shows that particular well intersecting
3 the upper granular unit, and if that's the case,
4 that would put it down near the border of the site.
5 Are we on the right cross-section?

6 A. Yes, and I am looking at it
7 to see what they had pointed out there. I guess
8 they felt this could be an extension of the granular
9 unit, but I would like to read this into the record
10 what it says, "Silt interbedded with clay and
11 minor pebbles, could be reworked" so they have taken,
12 since it was at the same elevation and to show it
13 as a possible extension of the zone, but in terms of
14 water yielding capability, it would not be
15 significant. It is silt and clay.

16 Q. So, I wonder for the bottom
17 line, in your opinion does it form an extension of
18 the upper granular unit?

19 A. Possibly because of its
20 elevation, but it isn't significant in terms of
21 water-bearing capability.

22 DR. KINGHAM: I am wondering if
23 Mr. Sobanski could clarify the terms for us as he
24 reports them to us. In this one you just read
25 into the record, silt.



1 MR. SOBANSKI: Silt interbedded
2 with clay.

3 DR. KINGHAM: On the previous borehole
4 log you referred to it showed that very narrow
5 layer and you talked about silt, but on these cross-
6 sections when we talk about upper granular layer,
7 it talks about predominantly sand and gravel and are
8 we talking about the same thing?

9 MR. SOBANSKI: In terms of water-
10 yielding ability, no. We have interpreted on this
11 map No. 18 where we feel the more permeable sections
12 of that unit are.

13 For example, when we test-pumped
14 well No. 2, we believe we interfered with HC 2-86
15 in this area to the southwest. We know we have
16 some wells that appear to also terminate within that
17 unit. We have picked these and our geologists in
18 defining these layers find a change at that area,
19 but silt and clay is not a type of unit that is
20 going to yield water.

21 DR. KINGHAM: I just wanted to know
22 whether we, the Board, were hearing or looking at
23 the right parts of your cross-sections when we
24 look at upper granular unit predominantly sand and
25 gravel and here you have described in the well holes



1 the silt or silty clay and so on, but we are talking
2 about that same strip?

3 MR. SOBANSKI: That is correct, but
4 what we have done here is try to outline on this map
5 where we feel it is significant.

6 MR.TIDBALL: Q. Just so I understand
7 the evidence, for the purposes of the record, where
8 you read that silt interbedded with clay, minor
9 pebbles is on the second page of the borehole log for
10 BH 6-85?

11 MR. SOBANSKI: A. It is, at
12 elevation 173 to 172.7, roughly.

13 Q. 30 centimetres?

14 A. A thin layer of about 30
15 centimetres. It is silt and clay.

16 Q. As I understood your evidence,
17 it is possible that could be an extension of that
18 upper granular unit but in your opinion it's not
19 significant because it wouldn't bear much water?

20 A. That is what I would say, yes.

21 Q. Just so we understand, and I
22 will tell you I guess our confusion was simply in
23 the differences between the cross-sections and
24 the plan view, but in your opinion you are telling
25 us that drawing 18 is the relevant part of the upper



1 granular unit for the purposes of it being a water-
2 bearing zone?

3 A. We believe so.

4 Q. I wanted to ask you -- you
5 referred a second ago to the pumping test you did
6 on that unit. I wanted to ask you particularly
7 about the permeability value you got from that
8 pumping test versus the permeability value you got
9 from the rising head test. Can you confirm for me
10 that the hydraulic conductivity you calculated for
11 piezometer 2 of HC 2-85, the one we talked about first
12 up in the upper righthand corner of that unit, that
13 the hydraulic conductivity you calculated based on
14 rising head was 1.1×10^{-6} centimetres per second,
15 and you may have to refer to Appendix 12?

16 A. Could you repeat the
17 piezometer number?

18 Q. HC 2-85, and if you go to
19 Appendix 12, that is piezometer 2, and it is screened
20 /directly
21 in the upper unit and you are getting a K of 1.1×10^{-6}
based on the Hvorslev.

22 A. Based on the Hvorslev, yes.

23 Q. Can you confirm for me that
24 the hydraulic conductivity value you got from the
25 pumping test, and before we get to that perhaps you



1 could indicate on drawing 18, if it is possible for
2 the Board to see it, where the pumping test occurred
3 vis-à-vis HC 2-85?

4 A. It is located fairly close
5 to pump well No. 2.

6 Q. And you measured draw-down in
7 that particular well, did you not?

8 A. Yes, we did.

9 Q. Can you confirm for me that
10 the hydraulic conductivity value you calculated from
11 that pumping test was 8.2×10^{-3} ?

12 A. Could you refer me to a
13 drawing?

14 Q. Table 6 on page 46 of Exhibit 39 which
15 summarizes -- of the main report, which summarizes
16 the conductivities you calculated based on the
17 pumping?

18 A. Yes, that is correct.

19 Q. Am I right that that is a range
20 of value you are giving that is about four orders
21 of magnitude different?

22 A. That is correct.

23 Q. Can you assist us and can you
24 assist the Board in explaining why you are getting
25 that range of values?

A. One of the problems we have I guess is that it's not uncommon in sandy units that might have some silt in them, ~~to measure~~ fairly low Hvorslev values and in some cases the wells aren't properly developed and you have to realize these are relatively small diameter holes and, as we have come through the till above, we may smear and drag material from the clayey tills above down into these units and so consequently it is not uncommon in my experience, and it has happened to me in other places where we look at sand and gravel units, the Hvorslev tends to give us a smaller or much lower value than say a pumping test would. Mississauga was a case where we were drilling in 10^{-2} sands and we knew it was a good aquifer material and yet we came up with 10^{-6} on Hvorslev. I don't have a truly satisfactory explanation other than it may be silt plugging up the screens and under-development of the wells which leads to this, but Gartner, Lee found in one of their boreholes that they did some development on their monitors and after a couple of developments on one of their monitors they increased the permeability and changed the hydraulic conductivity by about three orders of magnitude as well. When we find a difference like



1 that, Hvorslev is a slug test and you pull some
2 water out of a hole or put some water in and what
3 you are measuring is that area right around the
4 borehole, whereas if you run a pumping test where
5 you develop and construct wells and then pump them
6 for long periods of time, we are looking at the
7 bigger picture and we are seeing a cone of depression
8 spread out through the zone that has the hydraulic
conductivity and then we are able to judge it on
a fairer basis than the Hvorslev test, because
the Hvorslev tests are something carried out but looking
at a fairly localized zone around the well as
opposed to pumping tests which we are dealing with
now on table 6, where we spent some time developing
the wells and now we test pump them and see what
the response is over a much broader area.

17 Q. So I understand the import
18 of this evidence, you put more weight on the pumping
19 test?

20 A. I would, yes.

21 Q. Before we leave the upper
22 granular unit, I wanted to explore another area of
23 it with you. If you could look at drawing 18, you
24 show -- perhaps you could explain it for the Board,
25 but the dotted lines that go across the lateral

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1 extent of that unit, there is dotted lines with
2 181.6 and 181.8 and are those equipotential lines?

3 A. They are.

4 Q. You were showing a falling
5 head, if you will, across that unit and it is really
6 west to east, is it not?

7 A. Yes.

8 Q. The arrows superimposed
9 perpendicular to those dotted lines, they show the
10 direction of the flow, is that right?

11 A. Yes, that is correct.

12 Q. I wonder if you could explain
13 for us exactly how we read this because I look at
14 it I guess as a layman and I say to myself, it
15 looks like it's all flowing from west to east and
16 yet we see a boundary there and I guess the
17 simplistic question is what happens at the boundary?

18 A. First of all, the gradient
19 across that area is very, very low. It is very
20 low and we are dropping .6 and .7 of a metre in a
21 distance of-- if I can see the scale here -- about
22 600 metres. So, we have a very, very low drop in
23 head over this unit. It is mentioned in the report
24 that we feel we have slow, sluggish groundwater flow
25 systems here. I said the same thing and I asked



1 myself the same question when I saw this information,
2 but we believe those wells are developed in that same
3 unit and those are the equipotential lines and groundwater
4 moves at right angles to the equipotential lines, but
5 the gradients are in the order of .001 or about a
6 tenth of what we normally see. I can only think -- we
7 find that in all the units, very low gradients, and
8 with the predominant down-gradient into the under-
9 lying materials. My feeling is that, as I say,
10 it's a slow, slugging system and although this does
11 not extend anywhere, it may well be moving into the
12 till and part of this slow, overall, sluggish system.
13 We have a silty till thus encasing this unit and
14 with the very low and slow groundwater velocities,
15 maybe they can take it -- I haven't calculated that
16 on just how much water could flow through that unit,
17 but the rates we are talking about are fairly low
18 in all of these units.

19 Q. In that particular unit, does
20 the vertical -- does the vertical flow predominate?

21 A. Yes, it does. The vertical flow
22 predominates over most of the site.

23 Q. I guess....

24 A. We will come back to the
25 balance which we say that roughly 70 per cent is



1 getting to the rock and only 30 per cent is moving
2 laterally.

3 Q. I don't know how to get at
4 this because there is nothing like this in any of
5 your diagrams, but what we are really talking about
6 is a flow that doesn't go straight down and straight
7 laterally. You are talking about bends in flow
8 paths and things that tend to bend a little?

9 A. We talked about groundwater
10 being a three-dimensional movement and some is
11 moving laterally and some is moving vertically, but
12 in fact you are dealing with vectors.

13 Q. Would you agree with me that
14 really what's happening, talking about the upper
15 granular unit, what is really happening is the
16 equipotential lines of the whole system are being
17 more or less deflected?

18 A. "Deflected"?

19 Q. Let's say the flow lines are
20 being deflected, so if you had a flow line coming
21 straight down and hitting that unit, it would sort
22 of head off at an angle as it went through the unit
23 and then go straight down again, or is that too
24 simplistic?

25 A. I am not sure I quite understand.



1 Q. I wonder if you could put up
2 cross-section D-D and perhaps you can help me with
3 this? I don't think you need to draw anything but
4 perhaps you could indicate with your pointer, but
5 water infiltrates or as water infiltrates down, it
6 goes downward?

7 A. Yes.

8 Q. When it hits that upper
9 granular unit, what does it do? That's the simple
10 question.

11 A. The upper granular unit will
12 change the shape of the system and it quite often
13 changes the shape of the system but I don't have
14 enough data to draw what the shape may be, but a
15 portion of it will move laterally and some will
16 still move vertically, but there will still be some
17 lateral movement and just saying it is moving that
18 way through the unit, that's not quite right
19 either, because there is a horizontal component to
20 the flow and the unit does move some water
21 laterally, but it moves down from unit to unit, being
22 deflected in some cases by the permeability of the
23 various zones and ultimately to arrive at the rock.

24 Q. That was the question and
25 could you explain that, because you say it moves



1 downward from unit to unit and can be deflected by
2 the permeability?

3 A. It can be deflected by the
4 permeability of the unit if it is a continuous type
5 of unit. If it's encased within the till,
6 totally encased within till, it may not have any
7 significant effect on the flow system.

8 Q. Why is that?

9 A. Because it would respond much
10 like the till because what goes in comes out at a
11 steady state and while there may be some changes
12 in the head within the unit, if I have a massive
13 block of clay and I have a little sand unit it,
14 it isn't controlling any of the flow really, because
15 the lump of clay controls how the flow goes.

16 Q. Is that more or less the
17 difference between what we call a lense and a layer?

18 A. Yes.

19 Q. Just so I understand this, let's
20 say you had clay or some kind of material that is
21 predominantly 10^{-6} and if you had within it a small
22 area that was totally encased of 10^{-2} or 10^{-3}
23 you are saying the 10^{-6} stuff is what controls the
24 whole system?

25 A. Yes.



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Q. One last question on the upper granular unit, and I want to make sure I understand it and the Board understands what your evidence is in this regard.

How many drinking water wells are you saying are in that upper unit and could you show us where they are exactly?

MR. BEECHINOR: A. For the ones we could identify during our field survey, the field survey of all the rock drillers and collecting information from the residents about their wells, for the wells we know anything about, we identified, I believe, and I can check this to be more specific when I look at my file, but we found three or four -- we felt that three or four of the wells along First Line could be on or taking water from either the upper granular unit or the lower granular unit on the west side of the site.

Q. Is that a specific issue?

A. What more do you want at this point?

Q. We have been referring to drawing 18, the plan view, and I guess we don't know how far that upper granular unit goes off to the west?



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A. Yes.

Q. Because you don't have any data from over there?

A. Yes.

Q. As I look at that, I see two houses on the west side of First Line and I think those are wells 15 and 16, are they not?

A. I would say specifically wells 16 HC and 15 HC get water from the granular units. I also believe that 17 HC could also be collecting water from a granular unit as well.

Q. Which is 17 HC?

A. It is also along First Line. I believe, and in fact I can check this at the break, but I believe the Gartner, Lee well denoted 35 GL could also be collecting water from the granular units.

Q. I was more concerned about whether it is possible to break it down and say which gets water from which unit. Let me tell you why I am asking the question. If you look at cross-section B-B, which is one of the little ones, drawing 7 with the two cross-sections on one page?

A. B-B or D-D?

Q. B-B, the cross-section that



1 goes almost directly down the First Line.
2 B-B is the one at the bottom and perhaps you could
3 confirm for me whether this is accurate. You seem
4 to be showing well 16 HC drawing water from the lower
5 unit and well 15 HC drawing water from the upper
6 unit?

7 A. That is what it is depicting,
8 yes.

9 Q. Do you agree with that?

10 A. I would believe that our
11 interpretation shows that those two wells are
12 obtaining water from granular units, either the upper
13 granular unit or the lower granular unit.

14 Q. Let me understand that. If
15 you can't be specific, that's fine, but according
16 to that cross-section, the lower granular unit
17 doesn't seem to extent over to 15?

18 A. That's right.

19 Q. So really what you are telling
20 us is that 15 is getting water from the upper
21 granular unit?

22 A. That is what we show, yes.

23 Q. Thank you, Mr. Beechinor.

24 MR. SOBANSKI: Mr. Tidball, if I
25 could just come back to your question, because I was



1 looking back at these sections and I want to throw
2 something else in. If I may on this flow system,
3 drawing 18, I have given you the best explanation I
4 have and another is possible and there always is
5 in hydrogeology, but it is possible there may be
6 an extension of this upper unit into some area we
7 don't know about on the south side of the property.
8 In other words, could there be an extension of the
9 upper granular unit perhaps in towards the southeast?
10 We looked at that very carefully because the flow
11 system, indeed we recognised the flow system was
12 in this direction and we examined in considerable
13 detail, and we have continuously sampled holes in
14 the '85 and '86 series which didn't indicate
15 anything significant. We had one in the '84 series
16 which was a well which was sampled prior to the
17 availability of continuous coring equipment and it
18 was sampled at five-foot intervals, the normal type of
19 split spoon sampling intervals, and we looked
20 carefully again at that log and we looked at the
21 samples again. We did this in several cases to see
22 whether there was any indication at all of any
23 sand smear on the cores, reports of a lot of water
24 encountered or anything like that which would
25 indicate that HC 8 might have had a continuous unit



1 through it, but we didn't find it, I don't believe,
2 in what we saw and in terms of that type of a flow
3 system, and perhaps another explanation is that there
4 is some extension that these three holes have missed.
5 We didn't see it in what we looked at.

6 Q. So really what you are telling
7 us....

8 MR. SOBANSKI: A. But monitoring
9 is set up for this side of the property in any event
10 and I would hope that there would be wells going in
11 on the side of the property and if there is such a
12 unit as that, I trust that it would be found.

13 Q. What you are telling us is
14 that in your best professional judgment that is
15 the important unit, the upper granular unit?

16 A. I am sorry, my learned friend
17 here was also talking to me, I'm sorry.

18 Q. You are telling us, to sum that
19 up, you are saying that what you show as the upper
20 granular unit, you are confident that that is where
21 that exists?

22 A. That is where it exists, yes,
23 but, No. 2, Mr. Beechinor reminded me that in our
24 analysis of the unit, we assumed that it was every-
25 where and for calculation purposes we used this type



1 of an outline for some reason and in terms of where
2 we would place purge wells to capture fluids, but I
3 am not arguing that there is some continuity to these
4 two zones. We are assuming the worst case and that
5 there is.

6 Q. That is helpful. Just one
7 more question on that. You have given us the opinion
8 that the well denoted 15 HC, one of the private
9 wells directly opposite the proposed landfill on
10 First Line, is in fact in that upper unit. I wonder
11 if you could give us your opinion on whether you
12 would be concerned about that well, given the
13 direction of flow in that unit?

14 A. Well, we are putting a landfill
15 in here and in spite of the direction of flow, I
16 would be concerned about any wells near the site in
17 that unit, even though the flow is shown as being
18 away from them, and in our modelling we have assumed
19 it isn't, and we have assumed it is straight toward
20 them.

21 Q. That gets back to the worst-
22 case type of scenario?

23 A. Yes. I think it was important
24 for me to point this out in terms that it does
25 not appear -- they don't appear to be extending their



1 cones of influence on the site, but I won't worry about
2 that, that is simply scientific discussion, that that is
3 the situation, and it gives us a bit more comfort
4 that the wells won't be affected, but in terms of
5 our modelling, we have considered the flow will be
6 towards the wells and that they might be impacted.

7 MR. TIDBALL: I was about to move on
8 to the lower granular unit and this would be a
9 convenient time for the mid-morning break.

10 THE CHAIRMAN: All right.

11

12 --- Recess

13

14 THE CHAIRMAN: Please be seated.

15 MR. TIDBALL: Q. Mr. Beechinor, at
16 the break you were going to check about well 35 GL?

17 MR. BEECHINOR: A. I have.

18 Before me I have the results of the walk and talk
19 survey conducted by the Ontario Waste Management
20 Corporation or conducted by Gartner, Lee for the
21 Ontario Waste Management Corporation, and the record
22 indicates for that well, denoted 35 G....

23 Q. Could you show us where that
24 is and perhaps use the plan view map we were using
25 before, drawing 18. I get it just to the left of



1 MB (IN) OW-2?

2 A. To the west of that well, correct.

3 Q. At the bottom lefthand corner
4 of the drawing?

5 A. Yes.

6 Q. The information in this record
7 indicates there are two wells at that location, dug
8 and bored wells, and the overall depth of the wells,
9 or at least one of the wells is 17 metres and, based
10 on our scaling, that well could be in the rock at
11 that location. The water supply is used for domestic
12 and livestock purposes and the water quality is good
13 and there are two ponds on the property. That is
14 the information we have on that well.

15 Q. From that we could conclude it
16 was a bedrock well?

17 A. It appears that way. I could
18 also point out, I think you are asking for a bit
19 more specific information with respect to the two
20 wells denoted 15 HC and 16 HC. I believe we said
21 that we show that well 15 HC is in the upper granular
22 unit and our records show that that well depth is
23 38 feet below ground surface. So, the well denoted
24 16 HC has a depth of 46 feet below ground surface
25 and that is the deeper of the two wells and so we



1 interpreted that well location to be in the lower
2 granular unit.

3 Q. Thank you, that is very
4 helpful. One other question on those. Would I be
5 right that wells 15 and 16 would be relatively new,
6 simply going on the basis that the houses are
7 relatively new, or do you know?

8 A. I don't have specific dates, but
9 they would be relatively new.

10 Based on -- I don't have specific
11 dates, but I would assume they are relatively new
12 houses, yes.

13 Q. For the purposes of the Board,
14 if they want to see where you are getting this data,
15 we can look at the water well inventory in Appendix 9
16 and in fact they are logged fairly extensively, are
17 they not, by the drillers?

18 A. That is right.

19 Q. One other question on the upper
20 granular unit before we move onto the lower granular
21 unit. Mr. Sobanski, could you show us on drawing 18
22 which is up there, where HC 5-84 is and could you
23 indicate with your pointer for the Board, I think
24 it's right in the centre, in the centre right of
25 where you are showing the upper granular unit?



1 MR. SOBANSKI: A. Yes, we have it
2 shown here.

3 Q. That is HC 5-84. Can you
4 confirm for me, as I asked you to get out cross-
5 section E-E, which of course you have put down
6 again, but can you confirm for me that you are showing
7 the upper granular unit or are showing that well
8 HC 5-84 intersecting the upper granular unit?

9 A. Yes, we have it shown as
10 being there.

11 Q. Could you refer to the borehole
12 log for HC 5-84 and tell me where there is any
13 evidence in the borehole log on that unit?

14 A. No, it doesn't appear to be other
15 than something being very wet and compact.

16 Q. If I am looking at the second
17 page of the borehole log for HC 5-84, if that upper
18 unit is there, we should find it somewhere in the
19 top half of the page where it is marked as silty
20 sand till and that is where you were referring to
21 wet and compact, between elevation 174.80 and 169.40?

22 A. That's correct.

23 Q. It should be in there somewhere?

24 A. It should be there and it's
25 probably based on the silt laminations they have



1 thrown something in.

2 Q. Based on what you see there,
3 do you accept the fact that there is an upper granular
4 unit in that area?

5 A. It certainly doesn't appear to
6 be a major upper granular unit, but, as we have said,
7 we have extended it in terms of our concepts even
8 beyond this.

9 Q. That is simply another example
10 of your conservative approach to this?

11 A. I suppose so.

12 Q. I would like to ask some
13 questions about the lower granular unit. The first
14 question is I wonder if it is possible for you to
15 tell us where the lateral extent of that unit is,
16 as you have shown for the upper granular unit on
17 drawing 18?

18 A. We did not prepare a map of
19 that unit. From our cross-sections, we can see
20 that it doesn't extend everywhere. For example, on
21 drawing 11, G-G, we interpreted it to occur --
22 actually we find that in fact this section, and
23 there may be some occurrence of it in Morrision
24 Beatty OW-4, but we show that it has limited extent
25 but for the purposes of conceptualization,



1 we have assumed it is a fairly continuous fairly
2 unit or a relatively continuous unit over the whole
3 site and extending off the property boundary in all
4 directions.

5 Q. I guess that that's fine, but
6 I am wondering if it is possible to draw any kind
7 of a boundary. You just referred to cross-section
8 G-G and am I right in saying that you are saying
9 it may or may not be in the Morrison Beatty OW-4
10 well?

11 A. Sorry?

12 Q. You said there may be some
13 evidence in Morrison Beatty's OW-4?

14 A. Yes, there was, and as we
15 reviewed this just the other day again and found
16 that the lower granular unit may extend into
17 Morrison Beatty OW-4.

18 Q. If we look at cross-section
19 F-F, and I am sorry to keep flipping cross-sections
20 on you, can you confirm for me that you have it
21 ending somewhere between HC 2-86 and HC 4-85?

22 A. Yes, that is correct.

23 Q. I take it that would be
24 confirmed by the fact that you are not seeing it
25 in borehole HC 2-86?



1 A. Yes, that would be the case,
2 yes.

3 Q. While we are on that cross-
4 section, you also don't show it on HC 3-85, which on
5 F-F is farther to the left?

6 A. Yes, it would appear to be that
7 way unless there is something here that is 4 centi-
8 metres thick, described as a thin silt layer bedded,
9 down at about elevation 175, but we interpreted
10 it not to be there.

11 Q. That is HC 3-85?

12 A. Yes.

13 Q. The silt layer down at 170?

14 A. 175.39 to 175.35 and there is
15 a thin silt layer that is 4 centimetres thick, or a
16 little over an inch.

17 Q. Isn't that thin silt layer
18 the silt layer you denote as marking the boundary
19 between the two sheets of till?

20 A. Bear with me for a second.
21 I may be in the wrong place on the log. Yes, I
22 am, I'm sorry. The layer that we are showing is a
23 silt layer, again a very fine layer, that is 6
24 centimetres thick and that is this little zone in
25 HC-3.



1 Q. That is the zone we already
2 talked about on the upper unit?

3 A. Yes, and I suppose it's a
4 question of interpretation as to whether it's the
5 upper or lower unit extension. It's so thin it
6 is really difficult to interpret.

7 Q. All right.

8 A. We have shown it as being a
9 very thin layer within the upper unit.

10 Q. Just so it's clear for the Board,
11 you have shown it as a very thin layer for the upper
12 unit in the cross-section but not for the purposes
13 of the plan view on drawing 18?

14 A. Yes, that's right, because it
15 is so thin.

16 Q. Based on that, Mr. Sobanski,
17 and I know again you have used a conservative
18 approach and have assumed that it has lateral
19 continuity throughout the site, but would you agree
20 with me that it looks on the face of it like there
21 is a section of the site, perhaps what we might call
22 the bottom left quarter of it, if you can divide
23 the actual site itself, that sort of whole corner
24 in there where the lower granular unit does not
25 seem to occur?



1 A. I guess that is what we are
2 showing right now, yes.

3 Q. All right. Just to be clear,
4 you are showing it, and I think Mr. Beechinor told
5 us, he concluded that the domestic well 16 HC is
6 in that unit, is it not, and we talked about that
7 two minutes ago?

8 MR. BEECHINOR: A. 16 is in the
9 lower granular unit.

10 Q. And can you show to the Board
11 that is the northerly of those two houses?

12 A. Yes.

13 Q. Mr. Sobanski, I want to ask you
14 a couple of questions about the pumping test in that
15 lower unit. First of all, could you show again on
16 drawing 18 where the pumping well was or is located,
17 as I assume it's still there?

18 MR. SOBANSKI: A. Pumping well 1 is
19 located near HC 4-86.

20 Q. I take it the configuration
21 of your pumping test was there was a pumping well
22 and then an observation well which you denoted to be
23 observation well 1 and then -- I am sorry, observation
24 well 1 is in fact HC 4-85, is it not?

25 Could you just confirm for me that



1 when you did your pumping test on the lower granular
2 unit you had pumping well No. 1 and I guess to be
3 simple, to the west of that three metres I think,
4 is what you called OW-1, which is HC 4-85?

5 MR. BEECHINOR: A. That's right.

6 Q. A further 9 plus metres to the
7 west of that is OW-2?

8 A. That's right.

9 Q. OW-2 was a special well you
10 drilled?

11 A. It was another pumping well
12 which penetrates the lower granular unit at that
13 location.

14 Q. Could you assist us. Do
15 the pumping test results provide any information to
16 you regarding the lateral extent of the unit?

17 A. Yes. I believe that we
18 interpreted the pumping test results at that time
19 as a result of a 24-hour pumping test conducted on
20 the lower granular unit, and we could not spread
21 the cone to any extent, and I can't recall what
22 the distance was, but we interpreted that to mean
23 that at that location the lower granular unit was
24 either getting thinner with distance from the pumping
25 well or the grain size of the lower granular unit



1 was diminishing from the pumping well.

2 Q. Could you interpret it as you
3 did I believe in the pumping test in the upper unit
4 to mean there is some kind of a boundary in there,
5 an end?

6 A. I don't think you could interpret
7 necessarily that there is an end. There is a change
8 or a gradation from a certain permeability in the
9 lower granular unit around the pumping well and it
10 changes at distance from the well or thins and that
11 could reflect a boundary condition.

12 Q. Is that what you are telling
13 us, and we didn't go through this, but it's in
14 the text, but that is what you are saying about
15 the upper granular unit in the pumping test you did
16 there. You did a pump test and used some technique
17 derived from the U.S. Department of the Exterior to
18 calculate -- I thought you said you were hitting
19 a boundary about three metres away or 30 metres
20 away, sorry?

21 A. I think there was a boundary
22 we were interpreting at pumping well 2, which tested
23 the hydraulic parameters in the upper granular unit
24 to occur at 30 metres east of that pumping well and
25 that was the interpretation.



1 Q. My question is simple. Can you
2 draw that same kind of interpretation out of the
3 data from pumping well 1 which is in the lower unit?

4 MR. SOBANSKI: A. There is a decrease
5 and the pumping test itself shows that we have
6 boundaries occurring around that well of some sort
7 and it can be interpreted in several ways. I would
8 tend to agree with Mr. Beechinor in that it may be
9 indicating rather than boundaries, it may be
10 indicating changes in grain size and I say this
11 because, first of all, in a material of this size that
12 is this fine grained, you can't spread a very large
13 cone of depression through it, as it has relatively low
14 transmissivity and you will essentially stabilize
15 the cone in a short order of time and if you over-
16 pump the well, it will pump down and run dry and
17 the cone will spread a bit, but it takes for ever
18 in these fairly tight materials and one could, I
19 suppose, say yes, that is an interpretation that it
20 is bounded and you are in some sort of a pocket,
21 but we have to consider what we have seen in the
22 other wells that this unit does occur in quite a
23 few wells in the area and I think it would be a far
24 more conservative approach as opposed to saying that
25 we are at a boundary, but to rather say there are



1 grain-size changes with distance which are affecting
2 our pumping test as opposed to saying we are in some
3 sort of a lenticular type of system that we are
4 starting to pump dry. If we assume it's a lense
5 bounded on all sides, then we are not being too
6 conservative because we feel from what we can see
7 that some wells do bottom in this material and we
8 can see it in several of our observation wells and so
9 I would prefer to interpret that type of a curve
10 more conservatively and say it doesn't indicate a
11 boundary to us, it is more indicative of grain size
12 changes away from the well.

13 Q. When you say you wouldn't
14 interpret that kind of curve, what kind of curve
15 are you talking about?

16 A. We are talking about a curve
17 that with increasing time, the rate of draw-down
18 increases. But, even on that curve as you look at
19 it....

20 Q. Which curve?

21 A. I'm sorry.

22 Q. That is a simple question.

23 A. If we look at Appendix 10.

24 Q. Which page of the appendix?

25 A. It will be the second graph.



1 Q. This is the Jacob approximation?

2 A. Yes.

3 We could use either of these curves,
4 either page 1 or page 2, but I am looking more at
5 the Jacob approximation on the second page because
6 it is a little easier to see. We can see that we are
7 projecting two draw-down trends in the well and one
8 starts with -- or a relatively straight line portion
9 starts at about 20 minutes and it falls away at a
10 fairly constant rate until we hit a time about
11 300 minutes and then we have a new portion to the
12 curve and we can see it's falling away at a faster
13 rate. On the other hand, the last point is not
14 falling on the curve, indicating there may be some
15 tendency for it to flatten, but the way you can
16 interpret these types of curves is that you can
17 interpret them as a change of permeability with
18 distance, hydraulic conductivity, you can say
19 there is a thinning of the material with distance
20 because you are measuring transmissivity, which is
21 hydraulic conductivity times thickness, or you
22 could interpret it to say that there are grain-
23 size changes with distance.

24 Now, the Theis curve on the previous page
25 shows much the same thing and where we have the



1 Theis curve, we have a standard match on a Theis
2 curve with a standard curve below as our first match
3 point, and then we see we have divergence from that
4 which occurs again in the order of about 20 to 25
5 minutes and you will see the curve starts to swing
6 up and this again indicates boundaries on a Theis
7 curve, but perhaps I am going too far. The point I
8 am trying to make is that one interpretation is that
9 we are running into a boundary condition and another
10 interpretation is that we are seeing grain size
11 changes with distance and I would prefer to take
12 the more conservative approach, it is a grain size
13 change. We see this unit in quite a few wells and I
14 am reluctant to say that if we pump it and find it
15 here, to say that is a bounded zone, that is merely
16 a lense we are pumping dry and I would prefer to say
17 it is extensive and we must deal with it in our
18 design and monitoring and in your contingency system.

19 Q. Fine. That's helpful, but could
20 we back up one step because it took me a very long
21 time to try and understand Theis-type curves and
22 Jacob approximations and I'm afraid that lots of
23 other people, including the Board, may not be
24 following it exactly. Could we go to the first
25 page, the Theis type curve, and there's a very simple



1 question.

2 Just confirm for me the curve you
3 actually show here, the solid line, that is a line,
4 an expected line and that is curve is what you should
5 see given certain conditions?

6 A. Yes, it is given absolutely
7 ideal conditions and it's homegenous, isotropic,
8 uniform and infinite aerial extent.

9 Q. If you had that kind of an
10 environment, you in fact would find all your dots
11 following that curve?

12 A. Yes.

13 Q. But in this case, after you
14 get out about, and I'm not sure what the time is,
15 but it starts to go above the curve?

16 A. Yes.

17 Q. You are saying one interpretation
18 is that you are hitting some kind of boundary or end
19 to the unit, but you are saying that for your
20 purposes and being conservative, you didn't assume
21 that was it, you assumed....

22 A. We are seeing changes in the
23 structure itself, in the sandy silt unit itself.

24 Q. To continue with that on the
25 next page, that is the Jacob approximation and that



1 is just another and is another different way to
2 calculate the same thing, is it not?

3 A. Yes. What we have on the first
4 page, we have a log plot and we are plotting the
5 logarithm of draw-down and we are plotting both
6 time and draw-down on logarithmic scales. When we come
7 to Jacob, which as an engineer I like to use,
8 on the lefthand side where we are plotting the draw-
9 down, we are now plotting it on a linear scale and
10 we are plotting time again as a logarithm of time,
11 but this is in some ways a little easier to see
12 some of the changes in the curves and if we compare
13 the two, the two graphs, we can see that because
14 we are compressing the draw-down on the Theis, it
15 isn't quite as easy to see the changes that are
16 occurring, as you do on the Jacob method where we
17 are not compressing the draw-down any more but just
18 using it on a linear scale and we can see these
19 changes in slopes far easier on the Jacob curve.

20 Q. Just to assist us a bit further,
21 the Jacob curve should be a relatively straight line
22 in an ideal situation and I realize "should" isn't
23 the right word?

24 A. It would be a relatively
25 straight line and in an ideal case under ideal



1 conditions, it would follow the dark curve we saw
2 on the previous page.

3 Q. The two straight lines you have
4 drawn through the points you have plotted indicate
5 that at some point it actually changes and you actually
6 have two lines and again one interpretation of that
7 is a boundary but you choose not to use that
8 interpretation and assume it simply means some
9 changes within that unit itself?

10 A. It is difficult for me to
11 assume that it is a boundary, given that we do
12 have continuity to the unit in most cases. The one
13 problem we have again is that this particular
14 pumping test, and when you test pump a unit that
15 has a relatively low hydraulic conductivity like
16 this, you are not spreading your cone very far
17 and you are looking at what happens within 50 feet
18 of the well, so it is difficult to start talking
19 boundaries and how big they are and then we come
20 back to stratigraphy and say how extensive is it
21 and what is it best to assume in terms of the
22 distribution of the unit.

23 Q. Just so I am absolutely crystal
24 clear, you are suggesting that if you are finding
25 in your opinion it's a change in permeability, finer



1 grained materials, so you are actually hitting a zone
2 of lower permeability. Just for the record.

3 A. Let me say that that is the
4 way I have chosen to interpret it.

5 Q. I want to be clear you are
6 talking about lower rather than higher and that I
7 think may be obvious.

8 A. Yes.

9 Q. Based on the borehole logs,
10 and we have been through this already, and the fact
11 that that lower zone doesn't seem to be showing in
12 HC 3-85, and I forget what the other ones were, it
13 seems to be ending somewhere between HC 2-86 and
14 HC 4-85, and are you comfortable trying to draw
15 a kind of edge or a boundary to that unit?

16 A. In the lower unit?

17 Q. In the lower unit.

18 A. I wouldn't base it on the
19 pumping test. We haven't prepared that map obviously
20 and instead we just chose to say that let's assume
21 it's everywhere.

22 Q. Just for the purposes of
23 understanding exactly, would it be possible for
24 you to take some kind of coloured pen and mark on
25 drawing 18 an approximation boundary to that unit



1 based on the information and if you are not
2 comfortable doing that, I can accept that and we
3 can move on?

4 A. We could do it, but it will
5 take a bit of time.

6 Q. Perhaps you could do it over
7 lunch?

8 A. All right.

9 Q. While we are on that, and again
10 with the upper granular unit, you showed equipotential
11 lines and the direction of flow as being predominantly
12 to the east. Did you do that for the lower unit?
13 I don't seem to find it, but I wonder if you could
14 tell us if you didn't what the direction of flow is?

15 MR. BEECHINOR: A. We attempted to do that and we do
16 have limited information from wells which penetrate the lower
17 /granular unit. We did prepare a sketch that I have at the
18 office, in fact, and it showed that the direction
19 of groundwater movement in that lower granular unit
20 pretty much was represented by what we contoured in
21 the upper granular unit, so therefore we felt
22 that groundwater movement in the two granular units
23 generally moved in the same direction at the very
24 low gradients, as Mr. Sobanski has pointed out.

25 Q. That for the purposes of the



1 record is generally trending in a west to east
2 direction?

3 A. That's right.

4 Q. I don't want to go through
5 the same discussion we went through on the upper
6 unit, but would it have the same kinds of effects?
7 We are not talking about a straight lateral flow,
8 but a predominantly downward flow with a component
9 going off in this case to the east?

10 A. That's right.

11 Q. Are you agreeing with that?

12 A. Yes.

13 Q. That's all I wanted to ask
14 you about the two granular units.

15 I wonder if I could come now to your
16 use of the reasonable use concept at Site D. If
17 we might go through the steps we went through very
18 early this morning, the first step is determining
19 reasonable use and I assume it is rather obvious
20 your evidence would be that the reasonable use
21 of groundwater on adjacent properties or in fact
22 anywhere off-site is for domestic and agricultural
23 use?

24 MR. SOBANSKI: A. Yes, that is
25 correct.



1 Q. As I understood your evidence
2 in-chief on Monday, when you came back to Site D
3 on this, and please correct me if I am wrong, but
4 I understood your evidence in-chief to be that the
5 background water quality data that we do have shows
6 us that the quaity is relatively close to MOE
7 drinking water criteria; is that right?

8 A. Yes. Actually I don't believe
9 we had a sample in the granular units. We have it
10 above and below and certainly in terms of sulphate
11 it is relative high and higher -- not always because we
12 have variations and we have areas where it seems
13 to be of little better quality and others where
14 it is of poorer quality, but some of the wells
15 exceed the Ministry's drinking water quality criteria.

16 Q. For the purposes of putting
17 your mind to the whole concept, you assumed it was
18 close to background and therefore there is no area
19 where you can allow degradation, is that right?

20 A. Not beyond the property
21 boundaries.

22 Q. Am I correct that your evidence
23 is that your boundary criteria, if we can put it in
24 those terms, are really the drinking water criteria
25 or approximately that?



1 A. Yes, because groundwater is
2 being used in this area and there is a present use
3 and we have to take that into account in considering
4 it.

5 Q. That doesn't cause you any
6 particular concern, as I understand it, because
7 the design you are putting forward, and in fact
8 the design Mr. Hiraishi has taken forward, is a design
9 that allows no contaminant migration?

10 A. That is correct and with the
11 proviso there is also a contingency system to fall
12 behind the basic design.

13 Q. We will get to that in a
14 minute. I wonder if I could refer to Appendix 11 in
15 Exhibit H-39-A, that is the chemistry, groundwater
16 chemistry data, and I would particularly refer to
17 the third page in. This is H-39-A, Appendix 11,
18 which occurs near the back, nearly a quarter of an
19 inch from the back, a fairly narrow appendix and
20 it comes after all the pumping test data. Can you
21 go to the page, Mr. Sobanski, that says Detailed
22 Chemistry-Groundwater?

23 A. Yes.

24 MR. TIDBALL: That's on the third
25 page in on that appendix. On this page and the two



1 pages which follow, because I think these are all
2 different parameters, but this is your background
3 water quality data?

4 A. It is.

5 Q. Which you have taken in three
6 wells on the site?

7 A. Yes, that's correct, three
8 locations at ten depths, so ten wells.

9 Q. Just so we understand it,
10 would I be right that for OW-1 or piezometer 1 for
11 each of these wells, they would be in the bedrock?

12 A. At the bedrock contact.

13 Q. In all cases, the fourth
14 piezometer, the one designated 4 in all cases is
15 in the upper till because that would be your
16 standpipe?

17 A. Yes, that's right. It would
18 be the shallowest one and would be about 15 feet
19 or around 15 feet.

20 Q. The ones in the middle, the
21 ones under HC 1 designated 2 and 3 and the other
22 designated piezometer 2 are in the lower till
23 and I may not be right on that. Let's look at
24 HC 1-85. Would you agree that observation well 2
25 is in the lower till and in fact could be in the



1 lower granular unit, and there may be some disagreement
2 because I think you told us a moment ago that you
3 didn't have any of the data from any of the granular
4 units?

5 A. Yes, I see your point. According
6 to the observation well construction details in
7 Appendix 4, piezometer 2 of that nest is reported
8 to be in the lower granular unit.

9 Q. So in fact you do have some
10 data from that unit?

11 A. Yes. I believe it's the upper
12 one we don't have any for.

13 Q. I think you told us in-chief
14 that in your opinion, the high chloride levels and
15 high conductivity, and I don't know what else and
16 perhaps you could tell me, in HC 1-85, and I am
17 looking at 1030 and 991 in OW-3 and 4, but in your
18 opinion that could be related to road salt?

19 A. I was thinking more of the No. 4
20 well as being related to road salt. It's 1000 at
21 very shallow depth and the others I wouldn't be sure
22 of and I am really not sure, but to explain such
23 high concentrations at shallow depths, I would expect
24 that. The lower may well be in situ and we can see
25 there is considerable variation in all of this



1 chemistry at this site.

2 Q. That is because OW -- HC 1-85
3 is on the road allowance isn't it?

4 A. Yes, it's right on the road
5 allowance.

6 Q. I assume, Mr. Sobanski, that
7 for the purposes of monitoring this site, we are
8 going to need or we would need fairly extensive
9 background monitoring data?

10 A. Yes. We would install wells,
11 and I think we would look over a period of time
12 as we have at other sites and at fluctuations in
13 the chemistry to determine what the background is.
14 This isn't the only site I have had which had
15 variations in the background chemistry, and normally
16 we would end up probably installing instrumentation
17 in advance of landfilling and to start to develop
18 a data base for it and actually carry on. What
19 would happen in a case like this is because the
20 groundwater velocities are relatively low, even
21 your monitoring that is ongoing through the early
22 phases of your monitoring program, you can use that
23 to indicate what the background groundwater quality
24 is and because contaminants don't move instantly
25 and because the water must be saturated up by the



1 garbage and start to move, but we normally instrument
2 these sites ahead of time. For instance, the information
3 here already serves as a background point for water
4 quality on the site and that is the kind of
5 information that would be collected.

6 Q. But we would agree there needs
7 to be much more extensive background work done?

8 A. Any well or observation well
9 that goes in must have background established on it.

10 Q. If this Board were to approve
11 Site D and if a Certificate of Approval were to be
12 issued, I assume that at the very early time of the
13 landfilling and before the landfill is even
14 established, you would do the background quality work?

15 A. Background quality work would
16 be started as soon as you put in your instrumentation.
17 You must be careful in how you do this because
18 you will also be working the area, so you have to
19 try and put the wells in areas where they won't
20 be knocked out by construction equipment.

21 Q. I understand that.

22 A. But there are other wells and
23 indeed there are other wells on the site at the
24 present time that weren't sampled during the survey
25 which could also serve as background monitors,



1 such as HC 3. There are numerous wells already in
2 place that could be used to establish background
3 quality more certainly.

4 Q. Am I right. it would be your
5 intention to nail down background as closely as you
6 can so we would have something to base triggering
7 the contingency plan on?

8 A. Yes.

9 Q. Is that really what you are
10 heading for?

11 A. That's right.

12 Q. Have you given any thought at
13 all to what kind of a trigger you would be looking
14 for and if in fact it is confirmed you were pretty
15 close to drinking water criteria?

16 A. We would probably work it on
17 many of these parameters to determine whether or not
18 quality changes are occurring, and in terms of a
19 trigger, one could use organics or one could
20 use DOC, dissolved organic carbon, to see if there
21 are changes or chloride. I think you have to
22 establish some sort of a level that looks realistic
23 and it would seem to me and one thought I had on
24 this site was, considering we may not be allowed
25 to exceed any boundary or have any boundary criteria,



1 and given that the water quality is fairly poor,
2 we must still establish whether or not we have to
3 implement a contingency.

4 Q. You want to establish if you
5 are having an impact?

6 A. If you are having an impact,
7 so you can't measure a part per million chloride
8 as it won't be too important, and what I would
9 suggest or what I thought of for this type of site
10 where you are close to this position where you are
11 nearly at the Ministry criteria, if you found wells
12 for example that were below the Ministry's criteria
13 and you found a problem with them, I suppose one
14 could use the reasonable use criteria for the 25 or
15 50 per cent increase, but if we looked at it from the
16 point of view that some of the wells may be exceeding
17 the criteria, then the reasonable use concept does
18 not allow us to change the water quality at all.
19 The way I would think of it would be in terms of
20 looking at something like chloride and establishing
21 what the background range is and then setting some
22 sort of limit above that and say if we had three
23 nests of piezometers strung out from the site, one
24 near the site and another perhaps 50 metres from
25 the site and another at the property boundary, but



2A

1 to look at it from the point of view of we will allow
2 some change in that first nest or second nest of
3 piezometers to establish the trend is there, that
4 is a trend, and you may say something to the effect
5 that if background happened to be of chlorides, maybe
6 500, then you might allow a 20 or 25 per cent increase to
7 be sure there was something wrong with the landfill
8 and then if you are projecting that that is increasing,
9 and may be affecting the boundary, then you would
10 implement your contingency. You have to have some
11 sort of trigger, because to implement those con-
12 tingencies is expensive and you have to make sure
13 the contingency is required and you are not seeing
14 some other effects -- perhaps a change in background.
15 It has to be something consistent, and monitoring
16 is a study of trends and you establish a background
17 and watch if there is an increase in trends because
18 individual -- sometimes we get spurious data and
19 we don't know why it occurred and whether it's an error
20 in sampling, a mislabeled bottle, an error in the lab
21 or whatever, so if we see one bad result, we don't get
22 that concerned but look at the next one to see
23 if there is a trend and then we start to put our
24 hats on and perhaps even do additional drilling to
25 find out if we have a problem or not.



1 Q. You have told us that it is
2 your opinion that Site D can be engineered to prevent
3 any off-site migration?

4 A. Yes.

5 Q. If in fact you didn't engineer
6 it, you would get impacts along the lines of what
7 you show in Figures 19 or 20 or any of those where
8 you have that peak?

9 A. Yes, we could have that problem.

10 Q. We talked about this earlier
11 this morning, but I want to come back to it. I think
12 you told me that at some point a leachate collection system
13 might -- I'll use the word fail, but use it in
14 the sense that it would simply stop functioning.
15 Do we have to assume that?

16 A. No, we don't have to assume
17 that the system would fail. Mr. Hiraishi I think
18 can speak better to the longevity of systems and
19 that, but we were concerned here in terms of
20 failure, in all likelihood of a tile plugging somewhere
21 in the system and in building up a head that may
22 perhaps overcome the hydraulic trap in some area
23 and perhaps we would have to correct that.

24 I don't see from talking total
25 systems failure -- I haven't seen a total systems



1 failure yet, but highly engineered sites are fairly
2 new in the province, and so we don't have a long
3 history of longevity of some of the components and
4 in fact your people could probably speak better to
5 it than I can because they see all the systems in
6 the province and we only see the ones we deal with.

7 However, that is the type of failure
8 I allude to, rather than a total systems failure,
9 and to have everything fail at once, I don't see
10 how it would happen.

11 Q. You have designed landfills,
12 have you not?

13 A. Yes.

14 Q. Much like Mr. Hiraishi has
15 done in this case, and I don't mean this particular
16 site.

17 A. Not as complicated as this one,
18 but I have worked on some smaller sites.

19 Q. You are an engineer and I
20 understand that in engineering terms there is
21 something called design life and what would the
22 design life of something like this system be?

23 A. I would prefer to defer that
24 to Mr. Hiraishi who designed the system and who is
25 familiar with what he has installed in it.



1 Q. Thank you. I wonder -- the
2 question is really aimed at this. Could you look at
3 Figure 15 at page 110 of Exhibit 39, the declining
4 chloride profile. Figure 15 at page 110?

5 A. Yes.

6 Q. I see Mr. Beechinor has put
7 it up. This is the curve and I think your evidence
8 is you think this is reasonable, given your
9 experience at other landfills?

10 A. This is based on data we
11 obtained from a variety of fills in the province
12 and it includes the Burlington site as well on it,
13 the Bayview site is included on this, the Oakville
14 site, and we have taken a sort of high range on
15 where it may be and the average curve would fall
16 below what we are portraying here.

17 This is sort of on the high average
18 side.

19 Q. Looking at this figure, and
20 I wondered if you had put your mind to it and if
21 you need more time we can come back to it, but based
22 on the figure, are you able to give any kind of
23 opinion on how long the leachate collection system
24 at Site D would have to last in order -- if it
25 did in fact fail you wouldn't get the kind of



1 impacts you are predicting in the later figures that
2 come subsequent to this?

3 A. I think I'd have to think about
4 that a bit, Mr. Tidball. I would have to compare
5 these with the curves prepared for the model, et
6 cetera. The fact is that when it degrades, the peaks
7 on our curve, and I am giving you my thought process,
8 the peaks in our curves are caused by these very
9 high initial values we have and in fact, from the
10 curve, and let's assume first of all it's a reasonable
11 model in terms of the curve. If we look at the bulk
12 of the contaminant being taken out in a period
13 of in the order of 20 years, and after a period of
14 about 20 years, most of the material, most of the
15 readily leachable material, is away and into your
16 sewers. So, if you wanted to look at a failed system,
17 you might start looking at the impacts, if you
18 started to integrate a curve, starting at the order
19 of about 250 or 200 milligrams per litre, which would
20 take that peak curve down by nearly an order of
21 magnitude and if you had predicted an impact of
22 about 300, your impact would now be around 30.

23 It seems to me that if we assume
24 this is reasonable and everyone will jump on me
25 eventually about this one anyway, but if we assume



1 that it leaches out in a period of twenty to thirty
2 years, then that's really how long the system has
3 to last in terms of collecting the chlorides and
4 these sort of traces, and its that kind of time
5 period I think, and as I think about it, I don't
6 think by going back to the curves I can improve on
7 that very much.

8 Q. That is very helpful.

9 One last thing about Site D, and that
10 is your contingency plan. You are postulating, I
11 believe, that you would need two purge wells in the
12 upper unit?

13 A. Do you have a page number for me?

14 Q. Page 133 of H-39.

15 If I can read from the middle of the
16 first paragraph:

17 ".... calculations indicate that only
18 2 purge wells would be required to
19 control contaminant migration in
20 the UGU, one on the east side of
21 the site and the other on the west
22 side of the site."

23 A. Yes, that is what we have said.

24 Q. When you say "calculations
25 indicate" would I be right that you have calculated



1 cones of capture?

2 A. If I could just read this
3 please.

4 Q. Sure.

5 A. Yes.

6 Q. It's cones of capture?

7 A. Yes.

8 Q. Is it possible to show that
9 on any of the drawings, how in fact you calculate
10 that in the broad sense?

11 A. Actually, I am trying to
12 remember how I did it and there might be something
13 I might also want to check at the break if you don't
14 mind.

15 As I said, Mr. Tidball, I would like
16 to check my notes on the exact calculation I did
17 because it isn't exactly clear to me, but the
18 concept is that leakage takes place in a failed
19 system, if one had to capture every one and we looked
20 at the worst case which might be a total failed
21 system, but leakage would then occur into the
22 upper granular unit and you would pump perimeter
23 wells and create cones of depression that would
24 reduce the hydraulic head in the upper granular
25 unit, if we can just exaggerate it, and then force



1 any water or any leachate contaminated water that
2 is getting into the upper granular unit to come to
3 the wells and be taken off to a sewage treatment
4 plant for treatment.

5 We don't know, as we say in this
6 case the exact number, and it is based on the
7 conditions we found at OW-2. In fact, if we had
8 pumped that well long enough, which is the northern
9 well, it may be that it in itself can serve as a
10 single pumping well and, as we mentioned before, we
11 were able to spread a cone we felt from PW 2 out
12 to HC 2-85, or HC 2-86 and it may be that pumping
13 one well would serve to induce the capture of the
14 water that comes under this site because the leakage
15 through the till is not all that great and it may be in
16 fact we may only need one well, but what we have
17 said for the time being, until we know more about
18 that zone, and we require more information from
19 observation wells about that zone, but there may
20 be one on the east side and there may be one also
21 on the west side of the site, but from what we
22 have seen so far, it may be just a single well
23 located on this side of the site could do
24 the job. We just don't have enough information on
25 that zone yet to design a system, and that is in the report,



1 that those types of contingencies would have to be
2 looked at in more detail and a system designed for
3 the site.

4 Q. As it stands right now, and I
5 think this is right out of the report, but you are
6 calculating that a pumping rate of two wells pumping
7 at 6.3 litres per minute, you will exhibit an
8 effect on domestic wells to the west and I assume,
9 Mr. Beechinor, that would be 15 HC because that's
10 the one we identified before?

11 MR. BEECHINOR: A. That's right.

12 Q. You are postulating the effect
13 on that well would be to lower the level in the well
14 by 1.7 metres? That's right at the bottom of page
15 133?

16 MR. SOBANSKI: A. Yes, that's what
17 this says.

18 Q. If you pumped it at higher
19 rate than what you are suggesting, I assume you
20 would get an even bigger draw-down?

21 A. Possibly. Again we would have
22 to see what conditions are specifically on that
23 side of the site and we are projecting from pumping
24 well 2 and saying that that is representative of
25 conditions and we have already been discussing this



1 morning whether the zone may even exist in some areas,
2 and we would have to actually find out what it is in
3 those areas and what the hydraulic conductivity is
4 and then the numbers would have to be adjusted so we
5 didn't have an adverse impact on the wells.

6 Q. You are suggesting you could
7 put purge wells in both the upper granular unit
8 and the lower granular unit. I am wondering, and
9 perhaps this is something you would consider more fully
10 if in fact something happened, but would it be
11 your intention to in fact pump both units?

12 A. If it was required. The upper
13 granular unit, and if we assume for the moment that
14 the upper granular unit -- if it is roughly as
15 is shown -- and if we assume for instance that the
16 upper granular unit occurs at HC 3 as we discussed,
17 HC 3-86, we can't obviously construct a well in
18 what was described in that unit. So, with the upper
19 granular unit, we can control most of the site, but
20 in areas where it doesn't occur, then you will have
21 to either deal with the lower granular unit and
22 pump it if it exists again, or you will have to deal
23 with the bedrock itself if that is the zone you have
24 to worry about. We don't think we have to worry
25 about the bedrock, but in areas where the upper



1 granular unit exists, we feel we can control any
2 migration from the site using that unit, it's the
3 more permeable unit, and if it doesn't exist in the
4 northern area, then we would have to use the lower
5 granular unit for a purge well system. Again we
6 don't know the number of wells until we get into
7 a finer level of detail. I really don't feel at
8 this stage it is warranted to go to that kind of
9 expense, not knowing whether a site would be approved or
10 how the hearing would go. It's a costly operation to
11 design this system.

12 Q. I think that's all the questions
13 I had on Site D and now I propose to move to Site F.

14 THE CHAIRMAN: Do you wish to hold
15 F for the time being as it's a good time to break
16 for lunch. It is a bit early, but then we could
17 go to Site F.

18 MR. TIDBALL: There is one thing I
19 could ask which would require a bit of work over
20 lunch time and I might ask just one thing.

21 Q. I mentioned this to you
22 earlier, but I might as well mention it on the
23 record so everyone knows what I am going to ask you
24 to do. I would like you to take drawing 7 out of
25 the Site F report, Exhibit 40, which is cross-



1 section B-B, and which I believe goes through the
2 centre of the site directly down to the lake, very
3 much in a north-south direction.

4 MR.SOBANSKI: B-B?

5 Q. B-B. Perhaps we could talk
6 about it over the lunch break and you may or may not
7 want to mark up your good exhibit and perhaps we
8 could use another one, it really doesn't matter,
9 but I would like you to colour in and we have some
10 coloured pens here, but I would like you to colour
11 in the hydrostratigraphic units that you show in
12 Figure 2 and several other figures, but you show
13 it schematically, and in fact I think you show on
14 some of the schematic exhibits you prepared for this
15 hearing, but I want you to colour them in as best
16 you can on cross-section B-B and, if you could, I
17 would like you to write in the hydraulic conductivity
18 values you got from the rising head tests for each
19 of HC 4, 5, 8 and 14. Those are the wells along the
20 middle of the cross-section.

21 A. You want that this lunch hour?

22 Q. 4, 5, 8 and 14.

23 A. HC 4?

24 Q. Running along the cross-section, 5,
25 8 and 14. They are the four wells in the middle of



1 that cross-section and the one final thing that
2 probably comes up with the hydrostratigraphic units
3 because you marked the discharge zone, but the
4 discharge zone till and so that would show us
5 exactly where it is.

6 Now if that's going to be a major
7 task, I don't know, we didn't think it was and we
8 are certainly prepared to assist because we think
9 we have them drawn as well.

10 THE CHAIRMAN: Would an hour and a
11 half at lunch be sufficient for that or would you
12 like a bit more time?

13 MR. SOBANSKI: It might take a bit
14 longer and I would appreciate having a chance to
15 take at least a bite of lunch.

16 THE CHAIRMAN: We appreciate that.

17 We will adjourn until 2:00 o'clock.

18

19 ---Luncheon Adjournment (12:17 p.m.)

20

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

22 THE CHAIRMAN: Thank you, be seated.

23 MRS.TANNER: Do you want to talk?

24 MR.LEDERER: I love to talk.

25

I want to indicate to the Board if



1 I may that this afternoon and throughout the course
2 of this cross-examination, I will have to absent
3 myself from time to time and I mean no disrespect
4 to the Board.

5 MR. TIDBALL: Q. Mr. Sobanski, are
6 we ready to go?

7 MR. SOBANSKI: A. Pardon me, but
8 my colleague had put together the map and I am looking
9 at the data he has on it.

10 Q. We assumed this was a relatively
11 simple matter but it turned out to be something
12 more complicated than we anticipated and I think
13 Mr. Beechinor and Mr. Sobanski are trying to do some
14 final checking.

15 Are you satisfied that the bell
16 work has been completed?

17 MR. SOBANSKI: A. Which work?

18 Q. Bell work. We used to call
19 this work people did before school started or before
20 the bell rings.

21 Mr. Beechinor, could you put up
22 Figure 2 from the Site F report, the overhead I
23 believe, at the same time and perhaps we can go
24 through this. Not drawing 2, but Figure 2,
25 which is basically that in schematic.



1 Over the lunch hour I asked you to
2 attempt to colour on drawing 7, which is cross-
3 section B-B, I have asked you to colour in your
4 categorization of the Queenston shale at Site F
5 based on what you have in Figure 2, and I believe it
6 is based on a lot more information, but could you
7 explain, there are three different colours on
8 cross-section B-B and could you explain, with whatever
9 qualifications you think are necessary, what those
10 different colours represent and perhaps cross-
11 reference it to Figure 2 so we all know what we are
12 talking about it here?

13 MR.SOBANSKI: A. I wish we would
14 have had a little more time to transpose this, but
15 I will certainly look at it in more detail as well,
16 but the blue, the blue on the figure, is the weakly
17 fractured massive shale and the yellowly colour
18 would be the highly fractured shale and the pink
19 is the discharge zone till.

20 Q. We are showing the discharge zone
21 till as being in cross-section and it is south of well
22 HC 14 and extending down to the area of the CNR
23 tracks? ↑

24 A. In that general area, yes.

25 Q. I take it from Figure 2 that



1 in fact there are two other zones you have identified
2 and we haven't bothered to colour them because they
3 occur above and below the two zones marked on?

4 A. That is correct. Above the
5 blue and what has not been coloured is the zone
6 called the moderately fractured and weathered shale
7 and below the yellow zone we have the moderately
8 fractured shale, the so-called massive shale unit.

9 Q. I believe you have attempted to
10 define some end point to the highly fractured shale
11 on the north and I believe you have calculated that
12 it pinches out, if I can use that expression, I think
13 you said around the mid-point of the site, and
14 that is shown there?

15 A. Yes, it is.

16 Q. Does the same hold true for
17 the massive shale shown in blue or is that the
18 limit of your information?

19 A. That is basically -- just one
20 second while I check with my colleague here. Yes,
21 that is correct, yes. (We are interpreting that to
22 be our interpretation that that is about the northern
23 end, and we have extended in the model the massive
24 shale overlying it, extending back further into the
25 site, but we don't have any holes that extend into



1 it.

2 Q. There was some confusion about
3 what you just said?

4 A. Sorry.

5 Q. The first thing you said is
6 where you are showing it is where you interpreted
7 the highly fractured shale to end?

8 A. Yes.

9 Q. And you are saying that the
10 massive shale, and for the purposes of the computer
11 model you have it going back continuously through to
12 the back of the site?

13 A. Yes.

14 Q. I understand we did this over
15 the lunch hour and we thought it wasn't that complex,
16 and Mr. Sobanski has tried to indicate that they
17 would like some time to really have a look at it
18 and, for my purposes, I am going to use it for illustrative
19 purposes and ask some questions, but the exact
20 actual boundaries I don't think are absolutely
21 critical and if Mr. Sobanski and Mr. Beechinor
22 want to go away over the weekend or whatever and
23 look at it, that would be fine. Does that suit
24 you, Mr. Sobanski?

25 THE CHAIRMAN: I think you caused



1 some confusion with the Board, or at least myself,
2 by referring to the blue as the massive shale because
3 it's the weakly fractured shale.

4 MR. TIDBALL: I am using the terms
5 interchangeably.

6 Q. Is it proper to call that the
7 weakly fractured or massive shale?

8 MR.SOBANSKI: A. We are calling it
9 both.

10 Q. Can we call it one or the
11 other?

12 A. The problem is the record and
13 I think we should refer to it as the weakly fractured
14 massive shale that overlies the more permeable zone,
15 the highly fractured shale.

16 I am sorry, I think the record will
17 have to be corrected.

18 Q. Can you go into the vicinity
19 of HC 4 and for the purposes of the record go from
20 top to bottom and indicate what we are going to call
21 each of those units?

22 A. In HC 4?

23 Q. In that vicinity.

24 A. Above the blue is the
25 moderately fractured and weathered shale. The



1 blue is the weakly fractured massive shale. The
2 yellow is the highly fractured shale and, finally,
3 below that, the moderately fractured shale.

4 Q. And the pink to the right of
5 all of that is showing the area of the discharge
6 zone?

7 A. The discharge zone, yes.

8 Q. Mr. Sobanski and Mr. Beechinor,
9 I guess we have quite a few questions with respect
10 to the interpretation we have got up there and I want
11 to sort of go through it, sort of a piece of
12 information at a time.

13 The first thing I wanted to ask you
14 about is to refer to Figure 2, which you have
15 up on the overhead, and it's really just a question
16 of assisting all of us in interpreting what this
17 figure means. Can you tell me what the white areas repre-
18 sent in each of the boreholes? I looked at the
19 boreholes and there is a series of shaded parts and
20 there are other things depicted on the legend as
21 being various features, but what do the white areas
22 themselves represent?

23 A. Just one second please. I have
24 asked for some assistance and it appears that one
25 or other of us have misheard the question or both.



1 Q. Looking at Figure 2 and going
2 down any of the boreholes, there is a kind of legend
3 depicted at the bottom but the legend doesn't tell
4 us what the white areas represent?

5 A. The white areas are areas where
6 we found essentially no fractures.

7 Q. All right. Now, the shaded
8 areas are depicted on the legend at the bottom and
9 what appears on the legend is it says Fractures
10 Joints, and I didn't understand. Are you saying
11 fractures and joints or is it an area of fractures
12 and is that what we are talking about?

13 MR. BEECHINOR: A. They represent any
14 discontinuities found in the core sample itself,
15 fractures, joints, mud seams, anything that
16 indicates that the rock is not as competent as the
17 area, the clear area or the white area.

18 Q. Where I see a little -- perhaps
19 that part that is a quarter of an inch thick, in that
20 area there is a series of fractures and other
21 features that shows discontinuity?

22 A. Could I have that again?

23 Q. Where I see a little section,
24 say a quarter of an inch long, that's what it's
25 telling me?



1 A. Yes, and this one might represent
2 a half a metre or something like that, of discontinuity
3 within that specific core sample.

4 Q. How many fractures does it
5 have to have to sort of make it to that kind of
6 description?

7 A. If you look at the core in the
8 field, it is very evident and you have zones where
9 you will essentially see rock with a very tight
10 matrix, very competent rock that essentially has
11 no fracturing or mud seams or discontinuities, and
12 then you see zones as depicted here, say in HC 8
13 at a depth below 115 metres elevation, and you will
14 see zones within the core that are almost breakeated
15 or broken rock, mud seams, so it's a relative thing.
16 You see zones of no fractures and zones of greater
17 fracturing, joints and that sort of thing.

18 Q. I'm interested in the process
19 you went through to arrive at Figure 2. I guess
20 to arrive at the cross-section we have coloured,
21 although I appreciate you just coloured it
22 now, but I am interested in the process you went
23 through to define the geographic units, the
24 categorization of the shale. My understanding
25 is that the biggest thing from your point of view



1 was the frequency and pattern of fractures, is that
2 right, and to actually define it. I am looking at
3 Figure 2 and seeing where you have the weakly
4 fractured shale defined and you have areas of
5 no fractures?

6 A. Well, maybe I can put it in
7 my words.

8 Q. Please do.

9 A. That's probably the best thing
10 to do here. What we did, for instance, to develop
11 this section in Figure 2, we examined the cores
12 both in the field and then examined them later in
13 the lab and we were able to denote general zones....

14 MR. HODGSON: Could the witness put
15 the microphone up closer and speak a bit more
16 clearly.

17 MR. BEECHINOR: I'm sorry, I'll
18 clip it on.

19 We were able to distinguish lumps
20 of rock, if you will, that had no fracturing, no
21 discontinuities, and we were able to identify the
22 lumps or rock or core that had considerable amounts
23 of fracturing and discontinuity within in and, in
24 fact, what we considered moderate levels of
25 fracture on a relative scale and what we did was we



1 said for instance in HC 4, in a core of this
2 distance, the distance defined as the weathered or
3 moderately fractured shale, we drew a line where
4 we considered the end of that particular unit and
5 from there we saw a length of core that had
6 essentially no fracturing or discontinuities. Now,
7 that's not to say that within the fractured, or
8 moderately weathered shale there could also be some
9 zones of very competent rock.

10 Q. That is what you are showing?

11 A. That is what we show here in
12 fact, but we made a decision to help us understand
13 the stratigraphy and interpretation and we said
14 generally there is more fracturing from here to
15 here and so let's draw a line there and then we saw
16 a section of core where there was no fracturing,
17 and let's draw a line and another line there, and
18 then we saw again at HC 4 at an elevation below
19 115 and above 105 metres, we saw another zone
20 of breakeated or discontinuity of fractured rock,
21 so we drew another line there and there is a
22 difference in texture or fracturing in this zone
23 as compared to this zone and that is what we did
24 with all of these cores.

25 Q. Thank you for the explanation.



1 Really what I was trying to get at, and I think you
2 explained it, but you really based it on the
3 existence of fractures within the cores, did you
4 not?

5 A. I call them discontinuities.

6 Q. Whatever, but coming to Figure
7 2, that's what you did it on?

8 A. That's right.

9 Q. At this time you had not done
10 the pumping test and perhaps some other things?

11 A. I think that's right. I believe
12 that's right. I'd have to remember the ordering of
13 it all.

14 Q. Could I take you, Mr. Sobanski
15 or Mr. Beechinor to the core logs which are found in
16 Exhibit H-40-A, and this is in H-40-A and just
17 as we looked at borehole logs for Site D, there are
18 borehole and core logs for Site F and they occur
19 throughout the first half of this volume, this
20 exhibit.

21 THE CHAIRMAN: You are referring to
22 the core logs now?

23 MR. TIDBALL: Yes.

24 Q. Mr. Sobanski, could we look at
25 the core log for HC 8-25?



1 THE CHAIRMAN: Which one was it?

2 MR. TIDBALL: HC 8-85; in about a
3 half an inch.

4 MR. SOBANSKI: A. Yes.

5 Q. For the purposes of the Board,
6 Mr. Sobanski, each of these wells starts with a
7 borehole log which identifies the overburden and
8 then you flip the page and get into the core log,
9 which is actually the core of the rock?

10 A. Yes.

11 Q. HC 8-85 is found on both of
12 the things we have up here now; it's on Figure 2
13 if you look behind you?

14 A. Yes.

15 Q. And it's also on the cross-
16 section B-B we have up behind you there?

17 A. Yes.

18 Q. I want to use this for
19 illustrative purposes and then ask you something
20 about this one in particular. I wonder if you
21 could help us all in interpreting how we read these
22 things and tell me if I am wrong.

23 Mr. Beechinor has told me that the
24 key is, and he prefers not to say fractures he
25 prefers discontinuities, which is fine, but it's



1 the characteristics of the shale in the cores, and
2 I take it that what this is meant to portray is
3 the characteristics of the shale in the cores, all
4 this information?

5 A. Yes.

6 Q. Now, I am looking particularly
7 at the column which is numbered 14, Fracture
8 Frequency?

9 A. Yes.

10 Q. I take this, or at least I have
11 had it explained to me and I hope I have it right,
12 but I took this to be sort of a general way of
13 depicting the frequency of fractures within that
14 core?

15 A. Yes, that's right.

16 Q. Am I correct that the more
17 black I see under column 14, and it's a bit
18 difficult because it sort of melts to the other
19 two columns, but the more black I see, the higher
20 the frequency of fractures?

21 A. Yes, that's correct.

22 Q. And conversely the more white
23 I see, the more massive or unfractured the material
24 is?

25 A. Yes.



1 Q. Is there any kind of direct
2 relationship between fracture frequency and permeability?
3 A. Yes, there may be. I am just
4 looking at this, and Mr. Beechinor in some ways is
5 better able to talk to this than I am because he
6 supervised that drilling program, but yes, there
7 could be. I am not sure whether our people,
8 exactly what they are logging here, and Mr. Beechinor
9 may have to speak to that, but there are times when
10 you break a piece of shale and it may break along
11 a bedding plane which may or may not be recorded
12 by the logger, depending upon whether he feels it
13 is significant or not, but the material where it
14 isn't cemented in this tight unit does break
15 along some of the bedding planes and one then has
16 to make a decision, was it actually a fracture or
17 is the rock broken in the core barrel and in
18 rotating it's a common problem. Consequently,
19 some of these fracture frequencies, the way they
20 are shown, they may be misleading, but Mr. Beechinor
21 can speak to that better than I can, and I believe
22 a lot of the work done on these drawings was done
23 more on the descriptive part under the general
24 description as opposed to this blackened-out area.

25 Q. Let's look at the general



1 description because that's the next thing I was
2 going to ask you. That column on general
3 description seems to apply to the whole log, does
4 it not, and it's sort of telling us generally
5 over that whole core what we are finding, and if you
6 go to the third paragraph, it tells us there
7 are dipping joints and perhaps you could tell me
8 what those are in a minute, but at 9 to 10.4 metres and
9 then it tells us where the vertical joints are
10 and below that it tells us where the fracture
11 zones are?

12 A. Yes. I must say that these are
13 interpretive as to whether or not -- there is
14 some interpretation as to whether or not they have
15 been damaged during drilling.

16 Q. I understand that.

17 A. But yes, that is what this is
18 saying.

19 Q. If we look quite particularly
20 at HC 8 and how it relates to the information we
21 have on Figure 2 and on cross-section B-B before
22 us, my understanding, and I don't want you to feel
23 confined to the exact numbers, but my understanding
24 would be that someone in your firm interpreted
25 the core log from HC 8 to mean that the highly



1 fractured zone, which you show on Figure 2 and which
2 we have now coloured in, that the highly fractured
3 zone actually extends from the top of this core
4 log down to a depth of 17.5 metres and in fact it's
5 the entire first two pages of the core log and then
6 you went into some other kind -- you are calling
7 it the moderately fractured?

8 A. Yes, that is how it has been
9 interpreted.

10 Q. That's how it has been
11 interpreted. The question I have is that if we look
12 at fracture frequency, I wonder how it is any
13 different or how the first two pages of this core
14 log are any different from the last three pages.
15 If you look at the bar graph for fracture
16 frequency....

17 A. Everything is consolidated,
18 everything from all the pages is consolidated on
19 the first page.

20 Q. In the general description?

21 A. Yes.

22 Q. Perhaps if Mr. Beechinor....

23 A. One moment. Pardon me, but
24 we do have to consult from time to time.

25 Q. Perhaps Mr. Beechinor is the



1 logical one to answer, as that is fine. If he's
2 the one who interpreted them -- by way of example,
3 I am trying to understand what it is off this log
4 which leads him to conclude that there is some
5 difference, there is some change in the characteristics
6 of the shale that happens around 17.1/2 metres
7 below the surface or below the start of the bedrock?

8 . A. From here down?

9 Q. Actually the middle portion.

10 A. I'm sorry.

11 Q. As I understand this log,
12 the first two pages refer to the area that you have
13 now called the highly fractured shale and then
14 below that it then goes into what you call the
15 moderately fractured shale, and I am wondering if
16 you can help me understand?

17 A. I am sorry, that's not what
18 happens. The first page is overburden.

19 Q. Past the first page?

20 A. We come into overburden and
21 we are saying our interpretation is that first we
22 hit the weakly fractured massive shale near the top
23 and then we go into the bottom unit, which is the
24 more highly fractured shale, and that is based on
25 the distribution of the various fracture patterns



1 that we see here.

2 Q. Perhaps it's a bit confusing
3 but I gather at that point the weakly fractured
4 massive shale is fairly thin?

5 A. Yes, it is, and our inter-
6 pretation is that it is thin.

7 Q. I am just asking to help us
8 all understand it, Mr. Sobanski. How do we read
9 this? I wonder how you went through the process
10 of saying at some point there is a division and
11 at some point we found a zone of what we call
12 highly fractured shale which we tie to zones
13 in other boreholes and determine that there is
14 in fact a whole zone?

15 A. I think Mr. Beechinor said
16 it, it is interpretation and we were led to these
17 interpretations after the pumping tests, I believe,
18 which indicated some parallelism to the features,
19 and these zones paralleled other units within the
20 shale sequences in the other holes and we interpreted
21 them to extend laterally. It is an interpretation.

22 Q. I understand....

23 A. We have two holes here with
24 the weakly fractured massive shale, it was very
25 dominant and it was very distinct, and we have a



1 truncation here, a truncation being a surface
2 caused by the overburden, where the overburden contacts
3 the rock, and we have interpreted that to continue
4 over, but here we started finding a reasonable
5 frequency of fractures within the rock and we
6 called it the way we have and we pinched it out
7 in that area. That is our interpretation of what
8 happens.

9 MR. BEECHINOR: A. I might add it's
10 more than fractures, which may be the confusion,
11 and you can't simply go from the bar graph which
12 shows the fracture frequency to develop this
13 configuration of the stratigraphy. What has been
14 done there and you will see it in summary for
15 core log HC 8-85, and such information as dipping
16 joints were plotted on a cross-section, a very
17 refined cross-section to come up with this analysis
18 and vertical joints plotted and that is why I said
19 discontinuity, and we had mud seams, slicken sides,
20 vugs and anything else that led us to believe there
21 was a natural disturbance of the rock, the rock
22 wasn't competent, and for whatever reason the rock
23 was incompetent at that point, that led us to
24 believe that that could be a zone of permeability.
25 It's not just simply fractures.



1 Now, from that, for instance, when
2 we laid the cores out, as I have already indicated,
3 we saw zones with essentially no fractures and they
4 are what we call the competent ones and we
5 delineated that zone and called that the weakly
6 fractured shale unit and again, looking at HC 8,
7 if you plot up all the discontinuities from this
8 borehole, represented by the core we have in the
9 laboratory, you will see there are greater
10 concentrations of the discontinuities in this zone
11 than this zone and so we drew a line delineating what
12 we considered to be the highly fractured shale,
13 and maybe the highly fractured shale is not enough
14 to describe a zone of broken rock, if you will,
15 but which occurs literally as shown here and which
16 is overlaid by another zone of shale that has
17 somewhat less frequency of these breakeated rock
18 features and this is how this relationship was
19 developed.

20 If you look at these cores in the
21 laboratory and look at them very carefully, you
22 can actually stand back and see them, this relation-
23 ship.

24 Q. I think I understand that,
25 Mr. Beechinor, and really what I was asking, and



1 maybe you have answered it by telling me that
2 the visual inspection is the key to all of this,
3 but really what I was asking was, could anybody
4 else picking up your core log for HC 8 say
5 "Ah-ha, there's where we see the zones," and I am asking
6 how we get the distinct zones and it may be
7 relatively simple?

8 A. I don't know if anyone could
9 just pick it up and say "Ah-ha", but I am saying to
10 you that once we put this information, and we had
11 several geologists do this, myself included,
12 but we were able to see a relationship by using the
13 information in this borehole log and largely the
14 information summarized in the first part of the borehole
15 log, and we were able to interpret the relationship
16 you see here and we feel fairly comfortable with
17 that.

18 Q. Can you help me with one
19 other thing on HC-8. What kind of importance
20 can we give to the bar graph for fracture
21 frequency?

22 A. I wouldn't give a lot of
23 importance to that. As I mentioned, that's only
24 some of the information that was used to develop
25 this geologic relationship. It's not enough to do



1 it and you wouldn't be able to do it if that was
2 the only information you were looking at.

3 Q. Could we go to the core log
4 for HC 6-85, which is perhaps twenty pages before
5 that, or fifteen pages. HC 6-85, and could you
6 point that out on Figure 2?

7 A. Figure 2?

8 Q. The one on the wall.

9 A. Right here (indicating).

10 Q. Am I right that off this core
11 log or off the visual inspection, you have inter-
12 preted the zone of highly fractured rock to be
13 occurring from about 14.75 metres to about 19.75
14 metres?

15 A. I can't read the thickness
16 off there. You are talking about the borehole?

17 Q. I don't know if you can get
18 it off the core log?

19 A. I can't confirm that at this
20 moment, but I can confirm it.

21 Q. Subject to confirmation, if
22 you will take it for what it is, and if you will
23 agree with me for the moment, subject to your
24 checking, that the zone you show up there extends
25 from 14.3/4 metres from the top of the rock to



1 19.3/4 metres from the top of the rock, the highly
2 fractured zone; and I am wondering, can this core
3 log be of any assistance at all in helping us see
4 how you got that? Let me be more specific. I am
5 particularly looking at, on your general description,
6 where it tells us that fracture zones occur at 7.4
7 to 7.44 and another at 8.2 and then 8.6 and then it
8 goes on?

9 A. Without pulling out, and I
10 am not sure I have it here, but the basic rough
11 section used to develop this relationship, it might
12 be difficult for me to express myself at this
13 moment. As we did with HD 8 on a detailed cross-
14 section of the cores, we plotted all of this inform-
15 ation you see summarized for HC 6, vertical joints,
16 fracture joints, mud clay seams, slicken sides
17 and again we used that information to define
18 concentrations of these as opposed to areas that have
19 a lesser concentration and we used that to define
20 these units on Figure 2.

21 Q. I guess you have to understand
22 the problem that people who are reviewing this have
23 in trying to follow exactly how you got to where
24 you got?

25 A. I can appreciate that.



1 Q. I guess what you are telling
2 the Board is that you are saying it's an overall
3 process where you have to look at all the different
4 information?

5 A. It is and you must get down
6 to the very fine detail to get enough of it together
7 so you can look at it and make an interpretation and
8 it's not something that is easy to explain in a
9 form like this, but what I can do, if necessary,
10 is develop these into sections to show...

11 Q. Mr. McQuaid assures me he
12 is asking for it, so perhaps you could produce that.

13 Would you say, Mr. Beechinor, that
14 the visual analysis of the cores is the key to all
15 of this and actually laying them out before you?

16 A. I think this helps a lot in
17 seeing the relationship, yes.

18 Q. So we are clear, did you do
19 this kind of detailed analysis on all the cores.
20 I understand there are two levels of analysis, you
21 look at them when they come out of the drill, you
22 look at them in the field, and then you take them
23 back to the office or lab and look at them?

24 A. But keep in mind that in this
25 case, as Mr. Sobanski pointed out....



1 MR. LEDERER: Can I point out and
2 say that I think people are having difficulty
3 hearing Mr. Beechinor and he will have to use the
4 microphone.

5 MR. BEECHINOR: Sorry.

6 As Mr. Sobanski, pointed out,
7 because of disturbances that can take place in the
8 transporting of the core logs from the field to the office,
9 additional fracturing can occur and we rely
10 primarily on the logs prepared in the field by the
11 geologist. Essentially they are part of our
12 interpretation....

13 Q. Those are the logs we find
14 appended?

15 A. That's right and what we did
16 in the lab after we had gone through an analysis
17 of the coring records was we put them out on the
18 floor to see if we could observe or define a
19 relationship in terms of frequency of discontinuities
20 and with that, with the driller's log in hand or
21 the geologic log in hand and a visual inspection
22 in the lab, we came up with this interpretation.

23 Q. I wanted to ask you about your
24 calculation of hydraulic conductivities for the
25 various zones because, as I understand it, that is the

2B



1 key important input to the computer model, isn't it?

2 Am I right in that?

3 MR. SOBANSKI: A. It's one of
4 the key factors, yes.

5 Q. We will come to that in a
6 minute. I have asked you, one of the things we
7 did put on there which we didn't indicate to the
8 Board, I asked you to write on the calculated
9 hydraulic conductivities according to the rising
10 head test and is that Hvorslev?

11 A. Yes, that's correct.

12 Q. Using that method, the
13 calculated hydraulic conductivities of the piezometers
14 in each of the four boreholes in the centre of that
15 section, boreholes HC 4, HC 5, HC 8 and
16 HC 14?

17 A. That's correct.

18 Q. They are written on in black?

19 A. Yes.

20 Q. I don't think it's important
21 we go through them all exactly, but can we agree,
22 Mr. Sobanski, that the hydraulic conductivities you
23 calculated according to Hvorslev are pretty much
24 the same throughout the whole profile? They are
25 all in the 10^{-5} or 10^{-6} range?



1 A. I don't know if one would
2 call that in exactly the same range, 8×10^{-5} is
3 almost 10^{-4} , but they are within a couple of
4 orders of magnitude of each other.

5 Q. I guess this is the real point,
6 we aren't seeing any 10^{-2} or 10^{-3} . Is that fair?

7 A. On this, no.

8 Q. I will give you all the oppor-
9 tunities in the world to explain what the data means,
10 but can we agree that on its own, and no other
11 factors or no examination of the logs, nothing, but
12 looking at this data, it doesn't really demonstrate
13 the existence of discrete zones?

14 A. If you ignore all the other
15 data on the site and just look at that data, yes.

16 Q. In the pumping tests you did
17 in the highly fractured unit, you derived a K value
18 of 1.3×10^{-2} ?

19 A. Yes, I believe that's right.

20 Q. I believe this is a similar
21 question to what I asked you on Site D; is there
22 an explanation of 1.3×10^{-2} according to the pump
23 test versus the 10^{-5} or 10^{-6} values you are getting
24 for that same unit according to the rising head
25 test?



1 A. Yes, quite possibly. First of
2 all, the instrumentation was put in prior to our
3 finding the horizontal correlation we did when we
4 test pumped the wells a little further to the east.
5 We have a couple of other pieces of information that
6 the Board may be interested in.

7 In the Gartner, Lee report they
8 indicated developing their wells provided them with
9 a permeability increase of nearly three orders of
10 magnitude and they have a drawing which shows one
11 of the wells they developed and Hvorslev tests done
12 over several occasions, and you can see the increase
13 in permeability and it is about three orders of
14 magnitude to higher permeabilities.

15 My feeling on this is that a couple
16 of things can happen; first of all it is highly
17 fractured shale unit, and what we have instrumented
18 is not instrumented in the way we have defined it
19 here, fracture by fracture, and one zone within that
20 unit may be instrumented and that is a starting
21 point. I won't pick a specific point, but one of
22 these units or one or two of these fractured
23 units may be instrumented and we may not be seeing
24 the full effect.

25 Now I will give you an example of that.



1 Pumping well 6 on Hvorslev tested at 10^{-6} ; on the
2 pumping test, it tested at 10^{-2} , OW-3. So,
3 Hvorslev was 10^{-6} centimetres per second or 10^{-7}
4 and the pumping test was 10^{-2} and so the existence
5 of this zone, given that we have first of all
6 instrumented only one or so of the fractures within
7 the unit, does not say that unit is not there. We have
8 seen it in other areas and we know what's on the
9 other side of this general cross-section, No. 1.

10 No. 2, you have to explain the
11 hydraulic gradients on the site and the way the
12 hydraulic gradients or the downward hydraulic
13 gradients can best be explained is with the permeable
14 unit which is definitely identified to the east of
15 this section. As I say, individually you cannot
16 see that unit within there but, on the other hand,
17 what we have done is isolated some relatively small
18 zones and we are measuring individual or a couple
19 of fractures but it is our opinion that the 10^{-2}
20 zone does exist, it generates the gradients within
21 the area and we have seen other places such as the
22 HC 3 well where our initial permeabilities are
23 very low but under pumping tests they come out
24 quite high, and we think it is under-development
25 of the wells and given the Hvorslev tests are under-



1 taken at the wells shortly after the wells are
2 drilled and Gartner, Lee has seen similar effects on
3 their site as well.

4 Q. I take the import of all of
5 that to mean that at least as far as the highly
6 fractured unit go, you don't have that much
7 confidence in the Hvorslev test because it may only
8 be measuring a couple of fractures?

9 A. We have seen it in two cases
10 and we also saw it on Site D, where you will get
11 into a permeable unit which tests out at 10^{-2} and
12 Hvorslev gives us 10^{-6} and when you carry it out
13 on relatively new wells, you are probably measuring
14 some borehole damage as well. }

15 So, with Hvorslev, we do not place
16 ~~as much emphasis on Hvorslev as we do on the~~
17 ~~pumping tests.~~

18 Q. As I understand it, you pump
19 tested this zone and also pump tested in a couple
20 of smaller areas the weathered zone?

21 A. Yes.

22 Q. And you got much less
23 dramatic results?

24 A. We test pumped around the
25 No. 4 well and we did not find a lot of lateral



1 continuity. We found some, and that is why the pinch-
2 out edge is somewhere in this area and if you look
3 at No. 3, which is located to the east, we had a
4 permeability of around 10^{-2} I believe, and I
5 will have to check the exact numbers, but there was
6 relatively high permeability to the east of this
7 and we certainly have the pumping test on the other
8 side of the section which indicates large lateral
9 continuity to the zone and we see that show up in a
10 lot of wells.

11 Gartner, Lee mentions they have
12 varying results on theirs and several of their
13 wells have high permeability in about that same
14 region, but my evidence was yesterday in-chief that
15 I didn't expect this zone, given that it's a
16 fractured medium, that it would be exactly the same
17 in any event. However, even on this section we
18 have the strong downward gradients on this part of
19 the site and, in that type of a situation, it is
20 explained best where you have a permeable unit
21 underdraining the upper materials and creating the
22 hydraulic drive with it exiting somewhere and
23 creating the hydraulic drive which takes the water
24 down.

25 Q. Could I back you up to something



1 you just said? I was under the impression that you
2 only conducted one pump test on the highly
3 fractured unit?

4 A. No, there were three pumping
5 tests conducted on that. I am sorry, Mr. Beechinor
6 is correcting me. Pardon me, I hope I haven't made
7 a mistake.

8 Q. Could I refer you to page 53
9 and that might help.

10 A. I may be wrong. If I might
11 just check with my colleague.

12 Could you refer me again?

13 Q. Page 53 of H-40 at the bottom
14 of the page, there is a heading that says Other
15 Fracture Zones and it says "Two other pumping
16 tests were conducted....".

17 Could we agree that two other pumping
18 tests are both referring to pumping tests in the
19 weathered shale?

20 A. According to this, yes.

21 I apologise, I was provided with a piece of
22 information a few days ago by one of my staff which
23 I will have to check out, some numbers he gave me.

24 Q. I think all of this was by
25 nature of a tangent anyway, but you just mentioned....



1 A. I raised the question and I
2 apologise. I was given some information the other
3 day on a map and I will have to check on what it
4 means and report back to you, because I believe I
5 have been referring to something that isn't correct.

6 Q. Mr. McQuaid points out it
7 still may not be clear. Can we agree you only did
8 one pumping test on the highly fractured unit?

9 A. Yes.

10 Q. I want to ask you specifically
11 about that pumping test, and maybe this goes back
12 to the same wrong piece of information you were just
13 discussing, but I thought in your evidence in-chief
14 you referred to the packer tests at HC 3 and HC 4
15 and referred to some problems in doing them where you
16 couldn't get results at all and for that reason you
17 did a pump test. As I understand it, HC 3 and HC 4
18 are relatively central to the site, are they not?

19 A. Yes, they are.

20 Q. The pumping test you did on
21 the highly fractured unit was down in the very far
22 corner of the site near the corner of King Road
23 and the North Service Road?

24 A. That is right.

25 Q. Why was it done that way and



1 I'm sure there's a good reason, but we are curious.

2 A. I had mentioned this in-chief,
3 that there were three reasons why we conducted the
4 pumping test and one was to look at the continuity
5 of these type of zones and the second was to see
6 what their significance was and we were particularly
7 interested in wells 3 and 4. However, the third
8 purpose as we mentioned was to look at the potential
9 for installing contingencies at the site, having
10 identified that there were permeable zones within
11 the unit. We decided to put in a test pumping well
12 near the southern boundary to look into the purge
13 well concept.

14 Q. All right. Now, from my
15 information, that well was drilled to a depth of
16 something like 30 metres?

17 A. Yes.

18 Q. And was screened over the
19 entire thickness of the highly fractured zone?

20 A. Yes. It wasn't screened, I
21 believe it was an open hole.

22 Q. An open hole?

23 A. An open hole.

24 Q. That open hole was about 11
25 metres long?



1 MR. BEECHINOR: A. I would have
2 to check that.

3 Q. Can we agree it's about that
4 order of magnitude?

5 A. It sounds about right.

6 Q. Can I take you to Appendix 10
7 in Exhibit H-40-A and I am looking at the first
8 page and I think we are back to a Jacob
9 approximation, are we not?

10 A. Yes, that is correct.

11 Q. Can you assist me, and I think
12 the same thing occurs all the way through, but the
13 Jacob approximation has a formula that goes with
14 it and it's expressed there and what does "T"
15 stand for, to start with?

16 MR. SOBINSKI: A. Transmissivity.

17 Q. "S"?

18 A. Slope of the curve.

19 Q. "Q" is flux?

20 A. Yes.

21 Q. And "r"; what does "r"
22 stand for?

23 A. Radius, distance -- in a case
24 like this, the distance from the pumping well.

25 Q. What does "b" stand for?



1 A. "b" is the assumed thickness
2 of the fracture unit.

3 Q. I want to draw your attention
4 to "b". In these calculations, and I think this
5 occurs throughout this appendix, but "b" is assigned
6 a value of .3048 metres?

7 A. Yes.

8 Q. Isn't the fracture zone
9 thickness something like 11 metres?

10 A. Well, this is a problem you
11 have when you deal with rock, what to assign a
12 thickness, Mr. Chairman, and in sand and gravel it
13 is relatively easy and we alluded to this the other
14 day in direct evidence, in sand and gravel it's
15 easy and we know how much we screen and it is fairly
16 uniform and you use that as a thickness, but in rock
17 you have a different problem because there are
18 portions which will be competent and, in fact, the
19 volume of the fractures is relatively small and
20 they could be anything from hairline cracks to
21 something that's a little weathered and muddy and has
22 some thickness to it. So, much of the rock, even
23 within these units, the solid competent rock
24 even where there are fractures there is solid
25 competent rock between fractures and in order to



1 calculate -- the way these equations work, we come
2 up with a transmissivity , we don't come up with
3 hydraulic conductivity, but transmissivity is
4 hydraulic conductivity times thickness. The problem
5 with rock is assigning a thickness to the unit you
6 are actually seeing that may be transmitting
7 water. So, what we decided when we undertook this
8 work was to try and standardize this to some degree
9 for comparative purposes the fracture units
10 being something of the order of some fractures within
11 a foot or so, and we then took a foot as a sort
12 of standard method of coming up with a K value, or
13 hydraulic conductivity value, and it was necessary
14 because the units in shale are fairly heterogeneous
15 and coming up with absolute thickness is difficult.
16 For example, a piece of solid rock or solid shale
17 would have a hydraulic conductivity of 10^{-10}
18 and won't contribute any water to the borehole at
19 all, or essentially none. We have had to standardize
20 in order to use the pumping test information and
21 we standardized on the basis of about a foot over
22 the sections of giving us the permeable zone.

23 Q. The question that comes out of
24 that, Mr. Sobanski, is that you have got an open
25 hole essentially for 11 metres or so?



1 A. Yes.

2 Q. Don't you have water coming in
3 over that entire thickness?

4 A. No.

5 Q. Why not?

6 A. As I say, the solid shale
7 itself will give you very little water.

8 Q. Maybe I am misunderstanding
9 you.

10 A. We have tried to do -- what we
11 have tried to do is an attempt to recognise the fact
12 that there is a lot of solid rock in the hole and
13 the problem with doing a rock test is going from
14 transmissivity, which is what the formulae calculate,
15 to hydraulic conductivity which we are all talking
16 about and which is used more in the porous medium
17 models. We have a problem of getting in a rock
18 unit to see how transmissivity converts to hydraulic
19 conductivity and I can draw a picture of our problem.

20 This is the type of situation we are
21 dealing with. Transmissivity is equal to Kh and so
22 it's hydraulic conductivity times thickness and
23 what we measure when we do a pumping test is T ,
24 transmissivity.

25 Q. That is actually derived from



1 physical data as opposed to a calculation?

2 A. It comes out of the equation and
3 T is transmissivity and it comes right out of
4 the Jacob equation. If I have a sand and gravel unit,
5 I don't have a problem and I know that these
6 equations are equivalent to porous medium equations
7 and we use them all the time in rock pumping tests
8 and they work for us, and Darcy's Law is involved
9 in all of this and it works for us, but when we
10 want to come up with K, and we could have reported
11 this as transmissivity, I suppose, but that makes it
12 more difficult for people to understand because we
13 are talking about hydraulic conductivity. The
14 transmissivity is equal to hydraulic conductivity
15 times thickness and, when we do a test, we come up
16 with this value and not hydraulic conductivity.

17 MR. McQUAID: "This value?"

18 MR. SOBANSKI: We come up with
19 transmissivity not hydraulic conductivity and so
20 we must work backwards. In the case of a sand and
21 gravel, the whole medium is essentially full of
22 pores which are contributing water to this system
23 and I don't have a problem at all in defining what
24 my height or thickness of unit is, and when I get
25 a transmissivity here, I simply divide it by the



1 thickness of my aquifer zone and I come to hydraulic
2 conductivity very easily. When I come to rock though,
3 I am faced with a current problem and when we try
4 Hvorslev, it's the same problem. We standardized
5 everything we have tried to do here, we have tried
6 to standardize roughly, and perhaps it has thrown
7 in, nor errors, but we have tried to be consistent,
8 but where we do Hvorslev, we have done the same thing.
9 We are now trying to deal with a situation where we
10 have some pores coming in, fractures in this case
11 that are giving us water, but in between those
12 fractures, and these fractures are very fine and
13 narrow and in between there we have pieces and
14 portions of solid rock that are contributing
15 essentially nothing and they have permeabilities
16 or hydraulic conductivities in the order of 10^{-10} .
17 What we have attempted to do is to find a common
18 base whereby in rock we can compare these trans-
19 missivities and what we did in looking at these units,
20 is to say look, the zones vary from little fine
21 crack areas, which are sort of muddy and what
22 sort of a value might we apply here that is
23 reasonable to bring it back to this equipment to
24 porous medium thing and it was judgment that we
25 settled on about a foot or about .3 of a metre.



1 Otherwise we have no way of truly defining K,
2 hydraulic conductivity, because it just isn't correct
3 to take a rock case -- you could, for example, have
4 had 50 feet of screen and had one fracture, one
5 fracture contributing all of your water, so how
6 do you get the hydraulic conductivity of one fracture?
7 The thing is you would have to get in there and
8 physically measure its aperture in order to be
9 able to come up with the thickness.

10 MR. TIDBALL: Q. I think I understand what you
11 are saying, but let me try and put it in what I
12 think may be the simplest terms. What you are saying
13 here is that in that particular well you have 11
14 metres uncased?

15 MR. SOBANSKI: A. Yes.

16 Q. For the purposes of trying
17 to do this calculation, you assume one foot of it
18 approximately is fractures?

19 A. Is contributing water.

20 Q. It's as though you stacked
21 all the fractures on top of one another and made
22 one big fracture and, if you did that, you would
23 have a foot and it's an assumption?

24 A. Even then with some rock in
25 it, but making it equivalent to porous media and



1 that is precisely it, it is an assumption. We had
2 no other way of getting the value for hydraulic
3 conductivity out of this, unless an assumption is
4 made, some sort of an assumption on thickness.

5 Q. That's helpful, thank you.

6 Am I correct that the whole key
7 to the existence of the highly fractured unit is
8 the pump test? Is that what really sort of puts it
9 away for you in terms of defining it as a very
10 distinct hydrostratigraphic unit with a
11 large ability to carry water?

12 A. No, I don't think it's just
13 that.

14 Q. What is it? In your opinion
15 what it is that confirms for you that there is a
16 highly fractured unit?

17 A. The downward gradients are
18 as significant to me in defining there is a unit
19 below the ground surface here that is taking an
20 ample quantity of water. It's the gradients we
21 believe that certainly led us to suspect there was
22 a more highly fractured unit, something that
23 would transmit more water, and the pumping test
24 confirmed it, but from the gradient information,
25 when we saw the original gradient information prior



1 to the pumping test, we felt there was a permeable
2 unit at depth to create those hydraulic gradient
3 conditions.

4 Q. All right. Now, given what
5 you have come up with and the strong
6 lateral flow in that highly fractured unit, what
7 should the gradients be below the fractured unit?

8 A. The model indicates that the
9 gradients should be into the fractured unit.

10 Q. So from the moderately fractured
11 unit beneath the highly fractured unit, there should
12 be upward gradients towards the highly fractured
13 unit?

14 A. Well, unless there was
15 another permeable zone a little deeper, yes.

16 Q. You measured, as I guess you
17 do with any landfill site, you measured hydraulic
18 head in all of your wells?)

19 A. We did.

20 Q. And you measured continuously
21 and that accounts for the hydrographs in Appendix
22 A or are they hydrographs?

23 A. They are not continuous and
24 were taken from time to time, I believe a couple of
25 times a month.



1 Q. The actual hydraulic head
2 measurements are found in Appendix 5?

3 A. This is -- these are a set of
4 hydraulic head measurements taken in April of 1986
5 which were used for -- or were used for the
6 interpretation.

7 Q. Just so I understand it, you
8 take these hydraulic head measurements and you
9 calculate the gradients you see in the field?

10 A. Yes, based on knowing the
11 difference between the levels of the piezometers.

12 Q. That is the same for any
13 landfill site and that is how you get the head
14 or the gradients, I am sorry?

15 A. Yes.

16 Q. You also take that information
17 and plot potentiometric contours on, and in this
18 case drawings 13, 14, 15 and 16, which show
19 potentiometric contours, both in the overburden
20 and in the bedrock. Is that right?

21 A. Yes, that's correct.

22 Q. Could I take you then to
23 drawing 13, and I should have mentioned it to you
24 so you would have it available but it would be on a
25 board somewhere, the potentiometric contour map



1 for the shallow bedrock.

2 Now, I wanted you to make it clear
3 exactly what this drawing tells us, Mr. Sobanski.
4 As I understood it, this is the direction of
5 groundwater movement in the shallow shale, the
6 uppermost shale?

7 A. Yes, that is correct and
8 Mr. Beechinor will correct me if I am wrong, but
9 it is from the contact of the overburden/bedrock
10 or, in the case of shale outcrop areas, it's the
11 shallow standpipe within the shale unit itself.

12 Q. In some cases it is virtually
13 at the surface because the shale outcrops at the
14 surface?

15 A. In the centre of the site, if
16 you like to say that, yes.

17 Q. But you have told us, I
18 believe, that in this case and this particular area,
19 the vertical gradients dominate and most of the
20 flow is downwards; is that right? I am trying
21 to get at how we interpret this map and as a layman
22 I look at it and say it looks like in the shallow
23 bedrock all the stuff is heading south to the lake,
24 but that is not what is happening?

25 A. You can't interpret vertical



1 gradients from this map. You have to go back to
2 the type of model being prepared and in fact there
3 is a lot of lateral flow through the upper units,
4 the upper weathered shale, and there would be a
5 lot of lateral flow picked up by the tiles and
6 then we deal with the flow that would go down through
7 the very tight layer, going down to the deeper unit,
8 but this is essentially showing what the contours
9 are like just on top of the rock.

10 Q. In fact it simply mimics the
11 topography, does it not?

12 A. Yes, but we would expect it
13 to with steep grades down to the lake, we would
14 expect the deep zone....

15 Q. All I was trying to ask you,
16 and I don't think it's a complicated question, but
17 this doesn't portray some lateral flow at the bedrock
18 contact zone from the site to the lake, or does it?
19 Do you see how to get that out of there?

20 A. You couldn't get it from this.
21 The general flow along that zone, there is a component
22 of flow along that shallow zone to the lake, however.

23 Q. Is there throughout the
24 Queenston shale a bedrock contact zone? Is there
25 always an area at the top of the rock that is



1 fractured? I suppose that applies to Site D, since
2 there is in fact Queenston shale at that site too?

3 A. My colleague is advising me
4 on what we found in some of the cores and he
5 advises me there were some areas where we did
6 find some completely competent rock beneath the
7 overburden that was not weathered.

8 Q. So the answer is no?

9 A. The answer has to be qualified,
10 but at least I know there is often a weathered
11 zone on top of the Queenston shale, but apparently
12 we have some cores here that weren't weathered.

13 Q. I was just asking you about the
14 hydraulic head information, Appendix 5. Have you
15 examined that and, if you have on its own, and again
16 the same question I asked you about the hydraulic
17 conductivity, but on its own does the distribution
18 of the head throughout the shale at Site F show
19 the existence of a highly fractured zone and, in
20 particular, I am interested in a comment you made
21 a few minutes ago, that you would expect to see
22 upward gradients from below that zone into it.
23 Perhaps I could refer you to one or two in particular.

24 Now, if we look at HC 8, if I could
25 refer to that one, and piezometer 1, and I think



1 we can agree, and if you put up the coloured cross-
2 section it might be clearer, but piezometer 1 is
3 well below where you show the highly fractured unit?

4 A. Yes. Piezometer 1 is below
5 where we are showing that.

6 Q. Piezometer 2 is at or near
7 the line that divides the two, is it not?

8 A. Yes, it is slightly above.

9 Q. And similarly piezometer 3 is
10 directly in it, is it not?

11 A. Yes.

12 Q. Could we go back to Appendix 5,
13 which is the water elevation data for April 15, 1986
14 and it's a little more than half-way through Exhibit
15 H-40-A?

16 A. Could I have the reference
17 again?

18 Q. Appendix 5 in your appendices,
19 the straight head levels from April of 1986?

20 A. Yes, I have got it.

21 Q. You go to HC 8, which is the
22 first borehole on the second page?

23 A. Yes.

24 Q. Can you confirm for me that
25 at least on that date the gradients are down



1 throughout and in fact all the way from 1 in
2 piezometer 1 down to piezometer 4?

3 A. No, they are up from three to
4 four. The gradient from 3 to 4, it's up.

5 The elevation in 3 is higher.

6 Q. It's slightly higher?

7 A. Yes, and the gradient there
8 is slightly up on that date and then yes, the
9 gradient then is downward.

10 Q. It's downward from 1 to 2?

11 A. Yes.

12 Q. 3 to 4 -- can we deal with
13 1, 2 and 3, because I was confused, as I always
14 think of 1 as being the top one but it's the bottom
15 one?

16 A. Keep in mind when we drill
17 them, we call that 1, because it's the pilot hole.

18 Q. If we want to understand,
19 going from the top to the bottom, we go from
20 piezometer 4 down to piezometer 3 and there is
21 a slight upward gradient?

22 A. Yes.

23 Q. And then from piezometer 3
24 down to piezometer 2, which, in the case of HC 8,
25 both are arguably within the wedge or the highly



1 fractured unit?

2 A. Yes.

3 Q. And piezometer 2 may be very
4 near the boundary?

5 A. Yes, in this interpretation,
6 that is correct.

7 Q. In any event, from 3 to 2
8 the gradients are downward, are they not?

9 A. They are.

10 Q. From 2 to 1, the gradients
11 are downward?

12 A. Yes, they are.

13 Q. Could we do the same thing
14 with HC 5, which on that cross-section is the next
15 borehole?

16 A. If I may just point to it on
17 the cross-section.

18 Q. In that case, can you
19 confirm that piezometer 1 again shows a relatively
20 good distance below what you show as the lower
21 boundary?

22 A. Yes.

23 Q. And then piezometer 2 seems
24 to be pretty much dead centre in the highly
25 fractured unit?



1 A. Yes.

2 Q. And piezometer 3 and
3 piezometer 4 are up above the highly fractured unit?

4 A. Yes.

5 Q. Can you confirm for me that
6 again, and going from the surface down, we are
7 showing downward gradients?

8 A. Yes, that is correct.

9 MR. TIDBALL: Mr. Chairman, if you
10 would like to take an afternoon break, I think this
11 would be a convenient spot.

12 THE CHAIRMAN: Fine.

13 MR. TIDBALL: Mr. McQuaid has referred
14 to this process as mounding.

15 THE CHAIRMAN: We will take it
16 with us.

17
18 --- Recess

19
20 THE CHAIRMAN: Please be seated.

21 Mr. Tidball, are you going to get
22 to the core of the matter?

23 MR. TIDBALL: Will this be explained
24 or is it there for some future purpose? I don't
25 know if Mr. Lederer wants to do something with them?



1 MR.LEDERER: What precisely are my
2 choices?

3 Well, since the issue has arisen as
4 to what you see when you sample, it seemed
5 advisable to introduce these and it seemed this was
6 as good a time as any, if Mr.Tidball doesn't mind
7 the interjection, as I can stand and have my second
8 opening--since I had two opening statements, perhaps
9 I could have a second crack, but perhaps Mr.
10 Sobanski and Mr. Beechinor could explain what these
11 are and what they represent, because they do
12 represent samples of the units under discussion at
13 this point in Mr. Tidball's cross-examination.

14 MR. TIDBALL: That would be very
15 useful.

16 Q. Can one of you gentlemen
17 help us? First of all, what borehole are they from?

18 MR. SOBANSKI: A. If anyone would
19 like more, I would be happy to provide it.

20 Q. We should get a complete
21 core and lay it out.

22 MR.BEECHINOR: A. And this is
23 HC 4 on the left axis.

24 Q. What section of the core is
25 this?



1 A. From HC 4 we have a rock core
2 sample from four feet below the ground surface
3 which is representative of that first shale unit
4 which is a moderately fractured and weathered shale
5 unit.

6 MR. SOBANSKI: A. This is from a
7 depth of 4 feet in HC 4 and so we will look at
8 what the weathered shale looks like. You can see
9 it isn't powder, Mr.Chairman, it's a fractured unit
10 that breaks into plates, and within that as you
11 get deeper, and we are talking four feet, so it
12 is in the upper reaches, and inside that you run
13 into zones which are tight, which is what you look
14 at as well, but that is basically the type of
15 material we are dealing with. It's not a mush, but
16 you can drill some of this material with an auger
17 because there are enough broken plates that the
18 auger can actually go through this.

19 MR. TIDBALL: Q. Did you say this
20 was the top 4 feet?

21 MR. SOBINSKI: A. This was from a
22 depth of four feet.

23 Q. Down to?

24 A. This zone would go -- you will
25 have to pardon me, but is that metres? This would



1 go in various shades and this would go down to a
2 depth of 10 metres. I am sorry, not 10 metres.
3 That would be about 5 metres.

4 Q. If we look at Figure 2
5 and HC 4 being the borehole on the left, this is
6 a representative portion of that top cross-hatched
7 area?

8 A. Yes, and we say weathered and
9 there are zones that are sort of mottled and we
10 have a little iron stain from time to time such as
11 we do on top of the green shale and this is sort
12 of representative of that zone.

13 Mrs. Tanner, here are some vugs,
14 some holes in the rock where it has weathered out
15 some gypsum.

16 The next is the massive unit
17 which occurs at a depth of 61 feet in this case
18 below ground level or 18.6 metres. I see some
19 has broken off, but here we can see the gypsum
20 infilling in some old fractures in this massive
21 unit and indeed if we clean that off we can see
22 it's sort of a cross between red and green and we
23 can see the interbedding in the shale unit.

24 MR. BEECHINOR: A. That characterize
25 the weakly fractured shale here.



1 DR. KINGHAM: This is from HC 4
2 at a depth of

3 MR.SOBANSKI: 18.6 metres
4 below surface or 61 feet.

5 DR. KINGHAM: For further clarification,
6 according to your core log, that would be three-
7 quarters of the fracture frequency, which means we
8 should see fractures every five to thirty centimetres?

9 MR. SOBANSKI: I think what they
10 would be describing in a case like that would be
11 breaks along a bedding plane such as this where the
12 core is broken, but we feel it is fairly massive.
13 We can see within this unit wavy bands and
14 structures across and we may get breaks when we
15 actually drill it.

16 DR. KINGHAM: The point I am seeking
17 for clarification, so everybody knows, has to do
18 with the page that follows Appendix 2, the title
19 page, which shows the fracture frequency and it says
20 there should be three to twenty fractures per metre
21 or on average 5 to 30 centimetres between fractures.

22 MR. SOBANSKI: According to their
23 logs, that would be it, so I would say you are
24 probably on the low end of that scale and there
25 aren't very many.



1 MR. BEECHINOR: I am just checking
2 the log here.

3 MR.SOBANSKI: The fracture frequency
4 I believe in this case would be one to 3 metres if
5 I am right and there are two open spaces at 18.6
6 metres.

7 MR. TIDBALL: Q. Does that core
8 start at 18.6 or is it written on it somehow?

9 MR. SOBANSKI: A. This is on top
10 of massive shale and I am not sure which is top
11 and bottom. However, if anyone has any interest....

12 MR. BEECHINOR: A. Does that
13 answer your question?

14 DR.KINGHAM: I guess so. In fact,
15 it is 1 to 3 per metre?

16 MR. BEECHINOR: That's right, so
17 that means the distribution of fractures is very
18 low or relatively low in that core sample and in
19 fact it can get much less than that and I have
20 seen distances of rock core that have essentially
21 no fractures for distances of 2 to 3 metres or
22 4 metres. I think we are just about here, just
23 at the contact.

24 MR. TIDBALL: Q. Just so I understand
25 that, in looking at the core log, as Dr.Kingham



1 points out, you are showing one-half of that in
2 bar graph darkened and you are saying that indicates
3 there is 1 to 3 fractures per metre and that is
4 what you are looking at?

5 MR. BEECHINOR: A. That's right.

6 MR. SOBANSKI: A. The next section
7 is identified as the bottom of the highly fractured
8 shale unit from 95 feet below ground level or a
9 depth of about 29 metres. Really what we are showing
10 here is the contrast. We can see originally in the
11 weathered shale we have a lot of fracture frequencies
12 and we come to a unit that's very tight and now we
13 are back into a unit that has some muddy sections
14 within in, it has fractures or potential fractures,
15 both horizontally and transverse. You can see the
16 problem I had when I use the equations to try and
17 calculate what the hydraulic conductivity is. We
18 are trying to find out roughly how these transmit and
19 how much the solid rock transmits, but this is the
20 type of formation we get and some of it is even
21 more brachiated than that. Part of this
22 brachiation, and I apologise for the mess, but
23 part of the brachiation may be from the drill and
24 a piece of core may slip and then get smashed to
25 pieces into something like we see in this bag,



1 but when we talk about this highly fractured unit,
2 you can see the type of material you are talking
3 about with lots of solid core, but something has
4 fractured it at various angles and you can see
5 the transverse angles of the fractures in this case.

6 Mr. Beechinor can correct me if I
7 am wrong, but my recollection is that these holes
8 were all drilled with air to prevent as much water
9 contamination as we could. These are air-cored,
10 so the zones we see that may be muddy probably had
11 not been introduced with the drilling fluids which
12 we used, which was air.

13 MR. BEECHINOR: A. That's right.

14 MR. SOBANSKI: A. What we are looking
15 at is relatively small pieces and I am not sure how
16 selective our person was in picking these, but when
17 you lay these cores out you can see the various
18 features show up. So, I guess one can see better
19 from this what is difficult to describe in words
20 when we talk about these units. They become more
21 apparent when they are laid out side-by-side.

22 Now, I have one more section here.

23 MR. BEECHINOR: A. Perhaps I can
24 direct the Board to the borehole log for HC 4-85
25 and the summary section, and it starts at sheet 1 of 6,



1 HC 4-85. We have just demonstrated that there is
2 what I call a zone of discontinuity at a depth of
3 29 metres below ground surface and the way you
4 can identify that in the borehole log or the core
5 log is by looking say mid-way down the page where
6 you see a category called fracture zones and
7 then the depths and the widths we found them. We
8 see fracture zones at depths recorded here between
9 29.8 and 29.81 metres and then at 30 metres,
10 and we also see fracture zones between 28.5 and
11 29.8 metres.

12 When I say you can't totally rely
13 on that bar graph of fracture frequency, this is
14 what I mean. You have to go right to the summary
15 of information contained there and plot that
16 information out to actually see the distribution
17 of these discontinuities or the frequency of these
18 discontinuities with depth.

19 The bar frequency of fractures is
20 fairly broad, broad-scale in nature, and it really
21 is calculating the number of fractures over, say,
22 a five-foot length of core and so it doesn't get
23 down to the detail necessary and the bar graph
24 doesn't get down to the detail necessary sometimes
25 to reflect precisely the brachiated nature of say



1 small units, a foot or less or something like that,
2 and we are just able to describe it in words.

3 DR. KINGHAM: Your drawing
4 that attention to it makes us ask why a fracture
5 zone might start at 10.5 and stop at 10.6 and
6 start at 10.7 and stop at 10.72 and how did you
7 decide to start and stop within a tenth....

8 MR. BEECHINOR: Where are you
9 reading?

10 DR. KINGHAM: The part you were
11 just reading.

12 MR. BEECHINOR: We would see a
13 good deal of fracturing between 10 to 10.1 metres
14 and then there would be a small break, a piece
15 of competent rock and then the fracturing would
16 start up at 10.5 and extend to 10.6 metres and
17 then there must have been a break of one point of
18 a metre and we start up at 10.7 to 10.72. There
19 is a lot of detail going into this, I agree.

20 DR. KINGHAM: Okay.

21 MR. TIDBALL: While we are on that,
22 there is a question I had about that as well.
23 In the paragraph on fracture zones which Dr. Kingham
24 just read, I read this or from all this information
25 I understand you are calling the highly fractured



1 unit everything that happens below approximately,
2 and just let me find it, let's say 24 metres, and
3 if that's the case, if we look at this paragraph that
4 says fracture zones, about a half the fractured
5 zones are above the highly fractured unit and
6 half of those fractures are below the highly
7 fractured unit and I don't know what to read into
8 that.

9 MR. BEECHINOR: Remember fracture
10 zones appear in the moderately fractured weathered shale and
11 some of those reported fractures can be attributed
12 to this unit.

3A

13 MR. TIDBALL: Q. As can some of the
14 fractures in the weakly fractured massive shale?

15 A. Sorry?

16 Q. Some of the fracture zones
17 you are also showing in that zone as well, do you
18 not?

19 A. I'm saying there can be some
20 fractures in the weakly fractured shale units and
21 as an example, we pointed out the frequency of
22 fracturing would be an example -- the frequency of
23 fracturing in the weakly fractured shale unit,
24 it could be between 1 and 3 metres.

25 We are not saying there are no



1 fractures in the weakly fractured shale units, we
2 are saying there is a less concentrated number of
3 fractures as opposed to saying the highly fractured
4 shale unit and the moderately fractured shale.

5 Q. I suspect in the weeks to
6 come I think you will be asked a few more questions
7 on this subject and if we could I would like to move
8 to a different topic entirely, Mr. Sobanski, and
9 that is the computer modelling.

10 Your description of the computer
11 modelling process starts at page 57 of Exhibit H-40,
12 and I don't know if you need to refer to the text,
13 but for anyone who wants to follow. I wonder if
14 you could confirm with me the steps you go through
15 in doing this computer modelling so we all under-
16 stand it?

17 As I understood it, you start with
18 that finite element grid, which is Figure 5 on
19 page 60?

20 A. Yes, that's correct.

21 Q. That's the starting point,
22 or sort of everything for the model gets plotted
23 on there?

24 A. You start up this way then
25 generate the grid.



1 Q. That grid is for a cross-
2 sectional slice through the site?

3 A. Yes.

4 Q. For your purposes, you are
5 assuming it is essentially the same across the site
6 and that cross-section could apply along cross-
7 section B-B or A-A or is it a specific cross-
8 section?

9 A. In this case here it's a specific
10 cross-section running from HC 1 to HC 16.

11 Q. But you are assuming lateral
12 continuity in the third dimension, if you will, and
13 you are assuming....

14 A. I see, yes, you do.

15 This is a two dimensional model
16 and we are not looking at the other dimension.

17 Q. As I understood your
18 explanation, the top line on that grid is the water
19 table?

20 A. Yes.

21 Q. In some cases the top line
22 is in the bedrock and in some cases it's in the till?

23 A. Yes, it could be.

24 Q. In any event, in many cases
25 there is actually material in the physical sense



1 on top of that top line, if we are looking at it
2 stratigraphically?

3 A. Dry material, you mean, yes;
4 unsaturated, yes, correct.

5 Q. The boundaries on the lefthand
6 side, the bottom on the righthand side, it ends up
7 like being a solid flow line, does it not?

8 A. That's right, it's a no-flux
9 boundary.

10 Q. As I understood it, what you
11 do when you run this model is that you input a
12 hydraulic conductivity value or K value for each
13 of these nodes; is that right?

14 A. Yes.

15 Q. There is eight hundred and
16 some odd, I believe, or something like that?

17 A. Yes. 912 nodes and 1702
18 elements.

19 Q. Do you input anything else
20 other than the boundaries we have talked about
21 and the K value for the nodes?

22 A. We put in the boundaries and
23 we put in the K values, I believe, and then attempt
24 to simulate the heads.

25 Q. That is what the computer



1 does for you, simulate the heads?

2 A. Yes.

3 Q. What I am wondering about
4 is the source of the K value for all of these nodes.
5 There are 912 of them, and can you confirm for me
6 that for the highly fractured unit, which we end
7 up seeing on the model once it is run in Figure 6,
8 you inputted a value of 10^{-2} ?

9 A. 10^{-3} .

10 Q. 10^{-3} ?

11 A. Yes.

12 Q. For each of the nodes in there?

13 A. Yes.

14 Q. Across the middle through
15 HC 4, HC 5, HC 8 and HC 14?

16 A. Yes.

17 Q. Based on the pumping test?

18 A. This was based on the pumping
19 test, yes.

20 Q. For the rest of the nodes, you
21 inputted K values that you had inferred for each of
22 the zones based on

23 A. Our best estimates.

24 Q. Your opinion that the shale
25 was divided into discrete zones and you assigned a



1 K for each of those zones?

2 A. Yes.

3 Q. So, the first two layers
4 perhaps on the very far lefthand side would
5 actually be till, would it not?

6 A. On the far lefthand side of
7 the upper unit is till.

8 Q. Then you go down through
9 weathered and then through the massive or weakly
10 fractured and then below that actually you are
11 into the moderately fractured?

12 A. Yes.

13 Q. For all of those zones, did
14 you sort of divide up -- does this grid get
15 divided up and then you assign values on a bulk
16 basis? Do you understand what I mean?

17 A. Yes.

18 Q. What did you use as a source
19 of your data for all of the points to the left of
20 HC 1 or have you inferred a carrying through of
21 those zones?

22 A. What I am looking at is a
23 page of one of the interrogatories, page 60.

24 Q. Which interrogatory response?

25 A. I am just trying to see if I



1 can find out where this is.

2 Q. Is this something called
3 the calibrated hydrostratigraphy?

4 A. Yes.

5 Q. On page 60 -- there is a page
6 number, but I think it just happens to be off
7 some other page, but it's found somewhere in the
8 interrogatory responses to Weir & Foulds' questions?

9 A. Yes, we have taken it out of
10 here so we don't have it in our book.

11 Q. We're at a bit of a loss if
12 we are going to refer to it. We all have two
13 sets of interrogatory responses Mr. Sobanski
14 prepared; one to a set of questions from Mr. McQuaid
15 and one to a set of questions from Ms. Vigod and I
16 don't believe they've been filed and they don't
17 have exhibit numbers and I don't even know if the
18 Board has them, and I was going to get into the
19 other one actually in a few minutes and Mr. Lederer
20 being absent, I don't know...

21 MR. HODGSON: I have no objection
22 if my friend would like to put them into evidence.

23 MR. TIDBALL: I have no extra copies
24 and that's the problem. Could we deal with it and
25 try and get some copies and file them?



1 THE CHAIRMAN: If you wish.

2 MR. TIDBALL: Q. You are just using
3 it as a source of your information, are you not?

4 MR. LEDERER: I am glad I came along.
5 They certainly should go in evidence and all parties
6 have them and Mrs. Tanner will recall, if no one
7 else does, but at the time of the preliminary meeting
8 there was a discussion about the interrogatories and we
9 were under some duty to deliver them to everybody,
10 which we have done, but no one indicated to us until
11 this moment they were going to use them in evidence,
12 so we will have to find copies and bring them.

13 THE CHAIRMAN: Thank you.

14 MR. TIDBALL: Q. There seems to be
15 two page 60s, and we are not sure which one we are
16 talking about. Go to the very last page and you will
17 see almost exactly the same thing. Maybe it doesn't
18 matter.

19 MR. SOBANSKI: A. They are both
20 essentially the same, I am advised, and the back one
21 shows the location of the piezometer well screen, but
22 it is essentially the same drawing.

23 Q. Is this essentially what you
24 inputted to the computer?

25 A. Yes, that's correct.



1 Q. The till unit, which is up on
2 the top left and which occurs again in the middle
3 of the site and which is dotted, you assigned a
4 value of 1×10^{-7} to each node where we see that
5 dotting?

6 A. Yes.

7 Q. Similarly for the fractured
8 weathered shale unit, which is shown or which
9 actually is blank, I suppose, you give a value of
10 10^{-5} ?

11 A. Yes.

12 Q. And similarly downward?

13 A. Yes.

14 Q. Now, can you tell me or can
15 you confirm for me where you got or what the source
16 of the hydraulic conductivities used here was.
17 I think you told me that the source of the
18 conductivity for the highly fractured shale unit
19 which is 10^{-3} is actually a little bit above the
20 pumping test, is it not?

21 A. Lower, it's a lower value.

22 Q. In the pumping test you got
23 10^{-2} and you are using 10^{-3} ?

24 A. We used a lower hydraulic
25 conductivity much for the same reason that we talked



1 about here on the pumping tests, to take into account
2 that the model has a fairly thick grid and we are
3 looking at a regional flow system and so consequently
4 to compensate for the thickness of these elements,
5 which are relatively thick, we lowered the
6 permeability of that unit by one order of magnitude
7 in order to compensate for that.

8 Q. What is the source of the
9 hydraulic conductivity values for the rest of the
10 units?

11 A. 10^{-7} was from recovery tests
12 done on site as well as information from Gartner,
13 Lee on the adjacent property. I believe all these
14 values were given in the text.

15 Q. In the description of each
16 unit?

17 A. In the description of each
18 unit, yes, and other than that change on the highly
19 fractured shale unit which we modified because the
20 grid is fairly coarse, we can't get something in
21 that's about a foot thick, we modified that by a
22 full order of magnitude to account for any change
23 of thickness.

24 Q. But other than the highly
25 fractured shale unit, which value you obtained by



1 bumping up the pump test results, the rest are all
2 from H vorslev tests?

3 A. Yes, they are.

4 Q. I think you told me earlier
5 that when you had a Hvorslev -- when you had a
6 value of 10^{-6} you calculated according to
7 Hvorslev in the highly fractured shale unit, you
8 didn't put much reliability on that vis-à-vis the
9 pumping test, and I am wondering what kind of
10 reliability we can put on those values for the
11 rest of the shale units?

12 A. Well, certainly we have to say
13 for that weakly fractured massive shale unit we -- I am sorry,
14 when I said they all came from tests because that
15 one didn't, but when we look at the weakly fractured massive
16 shale unit, 1×10^{-7} , we said we had to assume that
17 value to give us the reasonable fit with the model.
18 We found thin zones within that unit that had K
19 values of 10^{-5} and the work that Dr. Cherry had
20 done out on the site had found values as low as
21 10^{-10} , so we had to strike some kind of balance.
22 This was the first one we used in the model and we
23 tried others, both higher and lower, to see what the
24 effect of changing the permeability of the massive shale
25 unit was, but in terms of what credence you can put



1 on these, I guess the credence you can put on
2 hydrogeological data in general. If you want to say
3 it is absolutely no good at all, we don't think it's that
4 bad, but we know that we do get problems from
5 time to time and spurious data.

6 Hydraulic conductivity happens to be the
7 most difficult parameter we measure in our field. It
8 is easy to measure a water level, but determining a
9 hydraulic conductivity exactly is not so easy.

10 Q. So you take this or you took
11 this kind of a map -- not map but grid, and you
12 inputted K values and this "Flonet" computer
13 program runs and am I right that what it gives you,
14 it gives you a head value for each of the nodes?

15 A. Yes, it does.

16 Q. And then whether within the
17 program or subsequently that gets contoured and what
18 we end up with is what you have at Figure 6, the
19 computer simulation?

20 A. Yes, which shows flow lines
21 as well as the head distribution.

22 Q. We can see the head
23 distribution, because for a large part they are
24 vertical lines and in the middle of the site they
25 bend around, but they are simply lines almost like



1 a potentiometric....

2 A. They are potentiometric lines.

3 Q. Potentiometric lines, and the
4 stream tubes, or are they called stream lines?

5 A. You might as well call them
6 flow lines.

7 Q. The flow lines would normally
8 flow perpendicular to those, but because of the vertical
9 exaggeration, they don't?

10 A. In fact that is correct.

11 Q. And those represents a certain
12 unit of flow?

13 A. That's right.

14 Q. Now, at page 61 of your
15 report, the last sentence before the section that
16 starts discussion and the sentence reads:

17 "The resulting computer simulation
18 represents a reasonable approximation
19 of the field data with respect to
20 geology, hydraulic conductivity,
21 water table, and groundwater gradients
22 (horizontal and vertical)."

23 That is that sentence and the
24 resulting computer simulation being what we see in
25 Figure 6?



1 A. Yes.

2 Q. I just want to deal with that
3 sentence for a moment. First of all, you say it
4 represents a reasonable approximation with respect
5 to geology and geology is one of the givens, isn't
6 it, and isn't that one of things you put into it
7 essentially?

8 A. Yes, that's right.

9 Q. Similarly, hydraulic
10 conductivity is in fact a main input?

11 A. Both the geology -- the
12 geology is breaking down those various hydro-
13 stratigraphic units and the two combined, the
14 hydraulic conductivity and the geology, give you
15 the measure of the hydrostratigraphy.

16 Q. All I am trying to do is
17 understand exactly what this means?

18 A. I understand.

19 Q. And the water table is again
20 given because that is the top boundary of your model?

21 A. That's correct.

22 Q. I want to deal specifically
23 with the groundwater gradients. I am wondering,
24 and the gradients are simply derived from hydraulic
25 head, are they not?



1
2 A. Yes. Really what we are
3 looking at are heads.

4 Q. And I am wondering what you
5 consider to be a reasonable approximation from the
6 model to the field data of the gradients?

7 A. I can only give you what
8 my modeller tells me on what may be a reasonable
9 approximation. We are looking at a regional
10 flow system and when you look at that piece of
11 land there, if my numbers are correct, and I may
12 stand corrected, you are looking at a surface
13 area of about one and a half square kilometers and
14 represented on that system are several points of
15 hydraulic measurement and so we are looking at a
16 regional flow system here in trying to simulate
17 with a computer model an approximation of what
18 we have seen in our wells and what seems to be
19 reasonable, given our knowledge of the system.

20 If we look at that section, the
21 section is over 200 metres thick at its thickest, I
22 believe, so consequently what we are dealing with
23 is a totally saturated system throughout this whole
24 thing and so what the computer will look at and
25 tries to simulate in a system that is saturated
to that degree are various heads. The type of



1 agreement and disagreement we get in some cases is
2 good and in other cases perhaps we don't have a
3 real measure of what is a perfect fit -- we know
4 what a perfect fit is, but what's a good fit, and
5 a reasonable fit here our modeller feels would be
6 a couple of metres, which is really in terms of
7 the thickness of the section about 1 per cent
8 and looking at it that way, but the type of
9 simulations we have got here in terms of the heads
10 that are duplicated, run from very close to a
11 couple of metres, but again you are looking at
12 a regional system and so that type of a simulation
13 seems to me to be fairly reasonable.

14 Q. Let me try and boil that down
15 into perhaps something simpler.

16 Are you telling me that what your
17 modeller is saying is that he considers it to be a
18 reasonably good fit if you are within a couple of
19 metres of the actual head you are measuring in the
20 field with the computer data?

21 A. Yes, and still generating the
22 type of gradients you are seeing and he feels that
23 that is reasonable in looking at a regional system.

24 Q. Mr. Sobanski, in some answers
25 to interrogatories from Ms. Vigod, you supplied some



1 information on the modelling and you supplied
2 actually quite a few of the calibrations you did,
3 didn't you? This is in Appendix -- Addendum 3 to
4 this booked called Sensitivity Analysis, Site F
5 Groundwater Model.

6 MR. LEDERER: We will have the same
7 problem because nobody informed me they wanted to
8 put this into evidence.

9 MR. TIDBALL: This is only one page
10 and I have copies. I want to refer you to the page
11 that looks like this without the yellow and it has
12 the various wells with the different head levels on
13 them. I had some copies made, just so we could get
14 around this problem.

15 THE CHAIRMAN: Mr. Lederer, I think
16 we should file these interrogatories, at least the
17 one.

18 MR. LEDERER: The difficulty is that
19 what Mr. Tidball is referring to is the second book.

20 THE CHAIRMAN: Perhaps you could mark
21 the page.

22 MR. LEDERER: It seems silly to mark
23 the page if the whole book is going to be filed. If
24 you could give me a moment, I may have a copy.

25 THE CHAIRMAN: I would say H-84 and



1 H-85.

2 MR. TIDBALL: Which one is which?

3 THE CHAIRMAN: The interrogatories
4 of Mr McQuaid are H-84 and H-85 is the interrogatories
5 of Ms. Vigod.

6
7 --- EXHIBIT No. H-84: Interrogatories of Mr.
McQuaid.

8 --- EXHIBIT No. H-85: Interrogatories of Ms. Vigod.

9
10 MR. TIDBALL: I am sorry, Mr. Chairman,
11 I apologise for the confusion.

12 Q. Mr. Sobanski, can you confirm
13 that what this data shows is for a series of wells
14 and what the actual field data was measured in
15 April of 1986, the second column?

16 MR. SOBANSKI: A. That is correct.

17 Q. The third column shows the
18 water level elevations for the actual calibration
19 you used, which is in Figure 6?

20 A. Yes.

21 Q. The best fit, so to speak,
22 and the other two columns refer to other
23 calibrations?

24 A. Yes, that is correct.

25 Q. I think you just told me
that your modeller considers within a couple of



1 metres a reasonably good fit?

2 A. It says here he would consider
3 three, according to this drawing which is his.

4 Q. That is why he has put a star
5 beside the ones, and it may be cut off at the bottom
6 but it indicates a difference from the corresponding
7 field value of 3 metres or more?

8 A. Yes.

9 Q. The ones with a star are
10 HC 4, piezometer 1, which is a difference of something
11 over 5 metres?

12 A. Yes, that's correct.

13 Q. In HC 5, piezometers 2 and 3,
14 both have stars and they are 4.73 metres and 5.79
15 metres out respectively?

16 A. Yes, in that order.

17 Q. In HC 8, again piezometer
18 2 is out just over three metres?

19 A. Yes.

20 Q. As is piezometer 3?

21 A. Yes.

22 Q. Could we go to that cross-
23 section we coloured, please. Can you confirm that
24 HC 4 piezometer 1 is somewhere near the bottom
25 boundary of the highly fractured unit and I don't



1 want to hold you to the exact boundaries if you want
2 to come back and say it's somewhere different?

3 A. If we are talking about HC 4,
4 No.1, that's correct.

5 Q. And similarly HC 5, piezometer
6 2, piezometer 3 -- piezometer 3 -- piezometer 2
7 is directly within the highly fractured unit?

8 A. That's correct.

9 Q. And piezometer 3 is just
10 above, is it not, somewhat above?

11 A. Yes.

12 Q. Go to HC 8. Can you confirm
13 for me that both piezometers 2 and 3 are within the
14 highly fractured unit?

15 A. Yes, they are.

16 Q. Mr. Sobanski, let me put
17 this to you as directly as I can. The modeller's
18 opinion is that it's a reasonably good fit if it's
19 within three metres, and the five examples on here
20 where it is outside of three metres all occur in
21 or relatively close to the highly fractured unit
22 and I am wondering if you could give us some
23 explanation as to why that is occurring?

24 A. I am not sure specifically.
25 First of all, we have a lot that do match reasonably



1 well, but in the overall context I could
2 only say we are looking at a regional system here
3 and it is affected by the surrounding points. We
4 have other wells that fit extremely well and in
5 this case we have several that don't fit and the
6 one we are talking about, and we are talking
7 relative fit, and some of the others are two metres
8 or so off and these are off three, which are starred,
9 but none of them other than the fixed water table
10 are exactly right on because there wouldn't be
11 enough data to calibrate a regional system and that
12 is the problem with fracture flow. The fixed
13 water table is always on because that is a fixed
14 point and in the others you could take it and say
15 within this unit you have variations of three metres,
16 but I also have variations of two at the next
17 piezometer which is not in the unit, and so overall
18 he has found a problem -- not a problem but a
19 problem with calibrating a regional system based on
20 this data. It won't fit exactly and it can't and
21 there isn't a huge quantity of data available.
22 However, my modeller advises me for this type of a
23 system that this is a good fit, and he does the
24 modelling and he says that these are not bad fits.



1 few of your exhibits actually, and if we look at
2 that cross-section, you are showing us a discharge
3 zone upwards through what you have referred to as
4 the discharge zone till?

5 A. Yes.

6 Q. Would I be correct that we
7 should be seeing upward gradients in that area;
8 is that what this model tells us?

9 A. Yes, the model would indicate
10 that we would have some upward gradients in that area.

11 Q. Do you have any information
12 that verifies the existence of upward gradients in
13 that area?

14 A. We have marshy areas down in
15 that area, bullrush swamps, which we feel are part
16 of the indication that it is a discharge area.

17 Q. Other than that, do you have
18 any head data, hydraulic head data from down there?

19 A. Not hydraulic head data, but
20 we did a bit of work with one of the earlier drawings
21 in the report, drawing No. 4, and I am not sure
22 if we have it mounted on a board or not.

23 Q. The drawing entitled Natural
24 Surface Water Drainage and Location of Surface
25 Water Monitoring Stations?



1 A. I have looked at the site
2 out there and we do not have a well directly in
3 what the computer is indicating would be the
4 discharge zone. For example, it could be more
5 diffuse than the computer model indicates. However,
6 the computer model indicates with a highly fractured
7 unit which incidentally is there because that is
8 where we test pumped, but it would indicate that
9 if this pinches out against the overlying glacial
10 till, there should be a discharge area somewhere
11 down-gradient. We are not moving an awful lot of
12 water. We are talking about six gallons a minute
13 diffused over a fairly broad area.

14 When we start looking at the
15 hydraulic conductivities, we can see roughly what
16 the effect at that time was, and this, using the
17 middle one, was June 17, 1985 and we can see the
18 hydraulic conductivity up fairly near the Bayview
19 Site which at that time was believed to be
20 carrying some contaminants, was around 2100.

21 As you approach the highway, the conductivity fell
22 off slowly and we dealt with a conductivity of
23 around 1500 at the same time. I am picking this
24 time period because there is a third interval
25 where there was not flow in all parts of the streams.



1 Now, as we come across the highway
2 and you could say we picked up some road salt, but
3 we have gone from 1500 up to 2700 as we cross the
4 stream, but from then on we have another little
5 stream coming in from another part of Site F which
6 would also be salt contaminated, running only at
7 1850 and that means we still have the conductivity
8 difference and we have 1850 on this little stream
9 which is located just to the right of the words
10 "Indian Creek watershed" and we are coming under
11 the highway with roughly the same type of a system
12 and we have had an increase up about 700 or nearly
13 800.

14 Now, that pretty well stays the same
15 and doesn't drop off as it goes around the site very
16 much and we have 2600, 2300, 2400, 2600 and so on
17 and it carries on at a fairly high concentration
18 without any apparent dilution from any freshwater
19 all the way down to where it meets the confluence
20 of the main Indian Creek, coming down from the King
21 Road area. There we seem to have a little fresher
22 water and the concentration stays fairly steady all
23 the way down from there on in the 1100 range, which
24 is about half of what we are seeing in this area
25 back around where we are calling the discharge area,



1 and given that the types of concentration we
2 see further down Indian Creek and what we see just
3 before it hits the highway, roughly in the same
4 range and a little different, but 1500 just
5 above the highway and running around 11 to 1200
6 on Indian Creek and in this area we have this
7 high conductivity zone around the 2400 range.

8 Now, this to me is some indirect
9 evidence that indeed we are getting discharge of
10 poor quality water in this area. It may be too
11 that you won't see discharge in any event in that
12 we have talked about the push-pull of the fresh-
13 water layer on top of the salt water and it may well
14 be that the discharge occurs into the sandy unit,
15 the overlying sandy unit and is then moving
16 laterally and discharging into the area of the creek,
17 but there is some indirect evidence from the specific
18 conductance of the waters in this area that they
19 have some anomalously high values, being nearly twice
20 as high as the backgrounds seen in other areas.

21 I have been on the site itself and
22 I have seen spring discharges on the site and there
23 are springs on the site and swampy areas, both south
24 of King Road -- the east and west sides of King
25 Road south of 403 and I didn't view it under ideal



1 conditions unfortunately, but that is the way it
2 had to be. But, there are springs occurring along
3 the bluff -- along the Iroquois shoreline and there
4 are bullrushy areas which we normally associate with
5 wetlands and upwellings of groundwater. I would
6 think for example in our model when we talk about
7 this material and leachate going into zones that may
8 have 10,000 parts per million of chloride, if it
9 were to discharge directly to surface, one would
10 expect to find some salty materials but we don't
11 see that and that is why I am suggesting that the
12 possibility -- and it's a strong possibility to me --
13 that that is moving slowly within that upper sandy
14 unit with the poor quality water coming up and then
15 it's being diluted by rainfall and being carried off
16 to discharge. It seems to me, and perhaps your own
17 hydrogeologist will give you a different
18 interpretation, but in this general area, there is
19 a fairly high specific conductance to the water that
20 exists in the stream and it doesn't diminish as
21 it goes across the site, as it would supposedly do
22 if it were salt, because then it would drop fairly
23 dramatically as more groundwater is picked up, but
24 that doesn't seem to be the case. We hold fairly
25 steady and there's a little bit of a drop, but at



1 this point we are at around 2600 and by the time we
2 get to here we are at 2500 on some of the points.

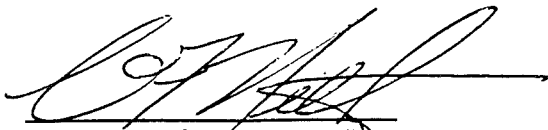
3 In response to your question, we
4 didn't fudge the model to put it between two wells.
5 The wells went in first and then the model came out
6 next.

7 Q. I think I will come back to
8 that, Mr. Sobanski, because I have lots of questions
9 to ask you about that discharge zone in particular.
10 I have something over half an hour left and this
11 would be a convenient time or we can press ahead
12 if you like. I am in the Board's hands.

13 THE CHAIRMAN: I think we will
14 adjourn now. 9:30.

15
16 --- Adjournment (4:47 p.m.)

17 CERTIFIED CORRECT:

18
19 
20 C.F. Nethercut, C.V.R.

21

22

23

* Page 5250 follows

24

25