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13:03CONSOLIDATED HEARINGS BOARDIN 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-OP-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 61-85 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.

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DATE: February 3, 1988

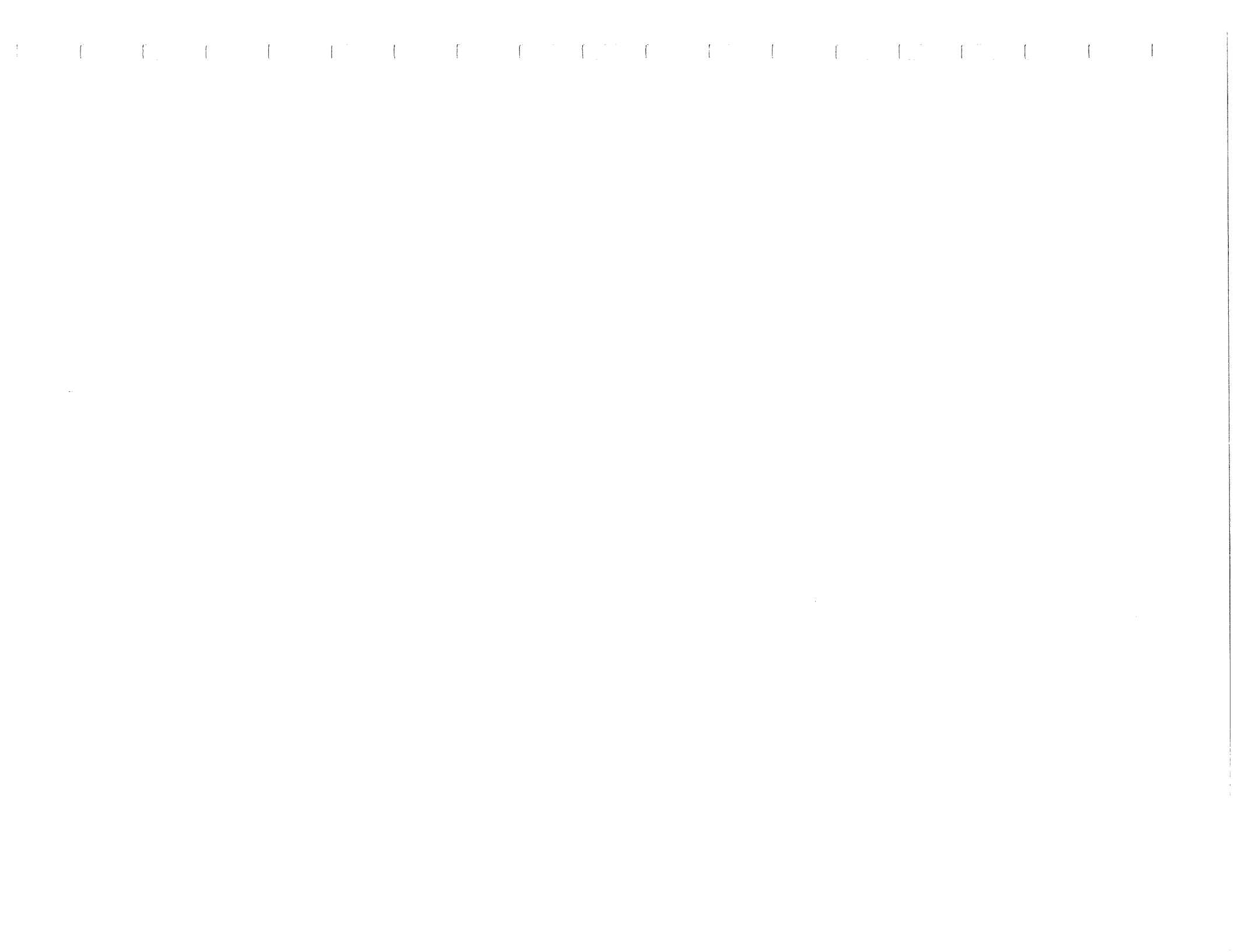
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I N D E X

WITNESSES:

ROWE, Dr. Donald Kerry, resumed:

CHARLESWORTH, Dr. David Leonard, resumed:

Cross-examination by Mr. Tidball, cont'd 20154
Cross-examination by Ms. Cronk 20231

E X H I B I T S

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THE CONSOLIDATED HEARINGS BOARD

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

- and -

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9 Water Resources Act, R.S.O. 1980, c.361, as amended;

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

- and -

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

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18 Honourable Bernard Grandmaitre, Minister of Municipal
19 Affairs, on a request by the Regional Municipality of
20 Halton to amend the Official Plan for the Town of
21 Milton to redesignate a parcel of land comprising Part
22 Lots 3 and 4, Concession 2 N.S. in the Town of Milton
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25 of a landfill site, Minister's File No. 24-OP-0208-A01;

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BEFORE: H. H. Lancaster, Q.C. - Chairman

Dr. D.J. Kingham - Member



Hearing conducted at The Oakville
Granary Commercial Centre, 105 Robinson
Street, Oakville, Ontario, on
Wednesday, February 3, 1988

VOLUME 85

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 and 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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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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Per: P.D. McQueen



Oakville, Ontario.
February 3, 1988.

--- Upon commencing at 9:35 a.m.

MR. LANCASTER: Good morning, please be seated.

Mr. Tidball, before you get into your examination, I don't know if I mentioned before, the Ontario Municipal Board is having a seminar on the 17th of February, that is a week Wednesday. I was not planning to attend, but I think I will now. There will be a couple of Ministers there. It looks like a very good seminar for the Board, so we will not be sitting the 17th or 18th of February unfortunately. That is the Wednesday and Thursday of the week next.

MR. TIDBALL: Thank you, Mr. Chairman.

DR. DONALD KERRY ROWE, resumed:
DR. DAVID LEONARD CHARLESWORTH, resumed:

CROSS-EXAMINATION BY MR. TIDBALL, (cont'd):

Q. Dr. Charlesworth, there were, I count, two matters left over from yesterday and I wonder if you had time to do them? The first one was, I think you said that you would check with your office as to the depth of the Chlon well?

DR. CHARLESWORTH: A. That is correct.
We checked that well and recorded a depth of 13.28



1 metres, which is the depth that we had shown on our
2 section. Apparently the R in the Trow record means
3 that the 60 feet quoted there was a report from the
4 resident. We subsequently updated.

5 Q. You actually measured it with a
6 tape?

7 A. We actually measured it.

8 Q. Where does that have its screen?
9 Maybe you need Section RB-RB?

10 A. That is the one we put with a
11 question mark, but it places it in what we have shown
12 as the lower granular unit, possibly what Trow showed
13 as the upper granular unit.

14 Q. Thank you.

15 The other matter is, two sketches that
16 are up there now under that particular cross-section.
17 Dr. Kingham asked yesterday if you could use some time
18 and put it into some sort of scale. I see that you
19 have.

20 A. I have another point on the wells.
21 The engineers that took those measurements commented,
22 observed that they were of sound construction. The had
23 a concrete cap.

24 Q. Is that all three wells or just
25 the Chlon well?



1 A. That was all three wells he
2 commented on. Two were behind houses and one just in
3 front of the house.

4 Q. So the ones that are behind the
5 houses would be what, 30 metres?

6 A. They would be...

7 Q. Could you then move on to the
8 overhead that you have just put up, which I take it to
9 be a regional cross-section of some sort?

10 A. Yes. All I have tried to do on
11 here is to clarify my doodlings from yesterday, Mr.
12 Chairman. This is a sort of regional cross-section
13 from the top of the escarpment down to the lake. What
14 I have marked on there are the blue arrows which I see
15 as the likely, both the regional flow pattern and also
16 as I indicated yesterday, I think there is a good
17 likelihood that the actual flow, the actual flow from
18 beneath the site follows a similar pattern. The water
19 that recharges from the higher ground will go deeper
20 but it will all move in that kind of pattern. I have
21 superimposed on it in red the simplified approach that
22 I suggested for the modelling and the red line that is
23 dotted in is sort of the zone of lower, less salinity
24 that we defined. The red arrow, I have called assumed
25 flow path for modelling, recognising that in fact the



1 real flow pattern may have more of a downward component
2 than this simplified pattern that we have adopted for
3 modelling.

4 MR. LANCASTER: Doctor, that is more or
5 less a composite of your other two. I think we will
6 just mark it as the next exhibit, M-469.

7 --- EXHIBIT NO. M-469: Composite prepared by
8 Dr. Charlesworth.

9 MR. HODGSON: I wonder if the Board
10 could ask the witness to provide us each with a colour
11 photocopy of that?

12 MR. LANCASTER: Would that be possible?

13 DR. CHARLESWORTH: Yes. I assume there
14 are facilities around here.

15 MR. LANCASTER: I think you will
16 probably have to add in the colour.

17 DR. CHARLESWORTH: Maybe it is easier
18 for me to add in the colour.

19 MR. TIDBALL: Q. Dr. Charlesworth, you
20 may have done that already, but could you just read
21 what it says between the two arrows?

22 DR. CHARLESWORTH: A. I said probable
23 flow pattern in shale beside the blue arrow and assumed
24 flow path for modelling beside the red arrow.

25 Q. Just a couple of things about this
exhibit, now Exhibit M-469. I assume there is a fair



1 degree of vertical exaggeration there?

2 A. About ten times. It is not
3 really drawn to scale, but it is about ten times
4 exaggeration.

5 DR. KINGHAM: Excuse me, that is about
6 ten times in what region? I am looking, for example at
7 403, to Lake Ontario and there seems to be no vertical
8 gradient there whatsoever, although I see there is
9 quite a vertical gradient in the escarpment to 403.

10 DR. CHARLESWORTH: The real vertical
11 gradient has been exaggerated about ten times relative
12 to the horizontal. So, on a real scale that would be
13 compressed in this direction or lengthened in this
14 direction.

15 DR. KINGHAM: I understand what you are
16 saying. I am asking you simply whether or not you
17 applied that vertical exaggeration right across?

18 DR. CHARLESWORTH: Yes.

19 DR. KINGHAM: That would be comparable to
20 this then, which is from H-40. I am just trying to
21 understand. It looks me to as though it is very flat
22 from Highway 403 to Lake Ontario.

23 DR. CHARLESWORTH: The gradient at depth
24 is certainly flat between 403 and the lake. I think
25 that in essence we have a more horizontal flow pattern.



1 DR. KINGHAM: I am sorry, I am not being
2 clear. The ground level?

3 DR. CHARLESWORTH: The ground level?

4 DR. KINGHAM: Is 403 about the same
5 elevation as Lake Ontario?

6 DR. CHARLESWORTH: It is somewhat
7 higher, so maybe I have not got enough vertical
8 exaggeration.

9 DR. KINGHAM: I just wanted to
10 understand.

11 MR. TIDBALL: Q. A couple more things,
12 Dr. Charlesworth. Can I assume that if you extended
13 this picture off to the left as far as you wanted to,
14 carrying the fact that the Queenston shale underlies a
15 good portion of Southern Ontario, you would have the
16 same sort of picture?

17 DR. CHARLESWORTH: A. Yes, I think that
18 is a reasonable assumption. I haven't considered it,
19 really considered how far back the flow system goes.

20 Q. Does this account, I take it you
21 haven't made any attempt in this picture to sort of
22 account for where the majority of the flow might be,
23 just in terms, let me put it this way, it seems
24 reasonable to say that most of the flow in the
25 Queenston shale would occur closer to the surface and



1 as you get further down you have got less and less flux
2 going through it; is that fair?

3 A. I think that is a reasonable
4 assumption. I think that most of the flow is in the
5 very shallow zone and reappears, most of the
6 infiltration will actually reappear in a relatively
7 short distance.

8 Q. Would you say the volume of flow
9 decreases with depth?

10 A. I think it is likely.

11 Q. Would that simply be because of
12 anisotropy?

13 A. I think it is as you get deeper,
14 any fractures in the shale become tighter, less
15 capacity to move within the shale.

16 Q. Just so we are clear, Exhibit M-
17 469 doesn't attempt to depict anything about the volume
18 of flow?

19 A. No, it does not, it is schematic.

20 Q. Thank you, Dr. Charlesworth. Dr.
21 Rowe, please.

22 Dr. Rowe, I just want you to go back
23 briefly to something we were discussing yesterday and I
24 wanted some clarification. Could you put up overhead
25 No. 22, it is actually the third page of your summary



1 of parameters.

2 DR. ROWE: It is overhead 22 from
3 Exhibit M-444, is that correct?

4 Q. It's this overhead. I apologise
5 for not asking yesterday. It is this overhead that
6 essentially sums up how you accounted for the process
7 of what I termed yesterday filling the box beneath the
8 landfill?

9 A. That is correct, yes.

10 Q. The top portion refers to how you
11 adjusted the concentrations to account for this element
12 of long-term storage within the matrix?

13 A. That is true.

14 Q. I am just looking down at the
15 bottom then in your note. This has to do with the one
16 to ten years we spoke of yesterday. As I understand
17 it, you did the one to ten-year calculation but in
18 doing scenario A, you assumed it was zero?

19 A. That is correct.

20 Q. I just wanted to go to that very
21 briefly. You have got there, as I understand it, your
22 one year then comes from a fracture spacing of 5
23 centimetres?

24 A. About 5 centimetres.

25 Q. That is vertical fracture spacing?



1 A. It doesn't have to be. If I
2 could go back to the doodle I was using yesterday, Mr.
3 Tidball, which was on overhead 18. What is of concern
4 is the distance that contaminant has to travel to get
5 into the rock, Mr. Chairman. What we are visualizing
6 is a situation where the contaminants are moving down
7 through a series of vertical fractures and also we have
8 a series of horizontal fractures. Once it comes down,
9 obviously it starts to move along the horizontal
10 fractures, if there is a lateral component of flow.
11 The way I have drawn it there, it looks like
12 approximately square boxes, but you could well have a
13 situation such as this where we have different fracture
14 spacings in the vertical and horizontal direction so
15 that we might have one fracture spacing with respect to
16 how it is getting down and another fracture spacing in
17 the horizontal direction. What is critical is how far
18 this contaminant has to travel to get in and saturate
19 the matrix of that chunk or block of shale. These
20 distances should be interpreted as the minimum
21 distance. Whether it is the vertical distance or
22 horizontal distance, doesn't make any difference. If
23 it is in fact coming in from two directions as opposed
24 to one, it will saturate a little faster.

25 Q. That is, as I recall, what you



1 said yesterday. I simply wanted to put to you the
2 simple proposition, it is a question I guess. If your
3 vertical spacing in the scenario was much greater than
4 either of those, even in your 5 or 30 centimetres and
5 let us say you still have horizontal spacing in the
6 order of 5 to 30 centimetres, but the vertical spacing
7 might be say in the order of metres, would it have any
8 impact on the ten-year figure; is the answer no?

9 A. The answer is no, it wouldn't have
10 a significant impact, because once it gets down and in
11 these fractures, when I said it doesn't have an impact,
12 it doesn't have an impact on this calculation.
13 Obviously if you had no vertical fractures at all, let
14 us take the extreme and take the fracture spacing to
15 infinity, which means no vertical fractures, then you
16 have impact material and that will certainly retard the
17 movement of contaminants down to the system. That is
18 essentially what Trow were modelling in their model,
19 scenario C.

20 Q. The movement is basically
21 diffusion through that tight matrix?

22 A. It would be effective diffusively.

23 Q. Can I then take you back to where
24 we left off yesterday?

25 A. If you just give me a moment to



1 put these back in the right spot.

2 Q. While you are there, I think I
3 need the next overhead, 23A.

4 A. 23A.

5 Q. Yes. Dr. Rowe, we left off
6 yesterday talking about the calibration of your model
7 to the results of monitoring from the Burlington
8 landfill site, essentially the Gartner, Lee plume
9 delineation study. I wanted to sort of come back to
10 that for a moment before I put some situations to you.
11 I would like your opinion on them as to their effect on
12 the calibration. Just so we are all sort of clear as
13 to where we are, this particular figure is actually
14 Figure 4 of your report and it is the figure that shows
15 all of the cases for Burlington with respect to
16 benzene.

17 A. That is correct.

18 Q. As I understood it, cases 1, 2 and
19 3 consider a Darcy velocity of 0.7, that is the number
20 that you back out of Trow's infiltration calculation?

21 A. Yes. Perhaps if I could just make
22 it crystal clear what that means, at least attempt to
23 do so. If what we are talking about here is if one
24 has the rock and if we are looking at a zone 25 metres
25 thick, Mr. Chairman, and we are looking at a Darcy



1 velocity in that zone of 0.7 metres per annum, then
2 here is our landfill sketch. If there is flow coming
3 in from that landfill into the rock and for the
4 purposes of this diagram, I have excluded the very
5 shallow system which reappears on the site, Mr.
6 Chairman. What I am talking about is the contribution
7 of the flow coming into the rock, the recharge which is
8 turning around and moving through that 25 metre
9 thickness. So, the 14 millimetres is the component of
10 the recharge that is moving through that 25 metre thick
11 zone. If there were another 25-metre thick zone with
12 similar fracturing, then we would be looking at 28
13 millimetres coming in, is that clear?

14 Q. I am not sure that it is, Dr.
15 Rowe. It took me a long time to try to come around to
16 this, but as I understand the way the units that the
17 Darcy velocity is expressed in, you can visualize that
18 0.07 (sic) metres per annum as the amount of flow that
19 is flowing through a box, if you will, that is one
20 metre by one metre.

21 A. That is correct.

22 Q. You have twenty-five of those
23 stacked up in the horizontal direction. To get it back
24 to 0.14 you have to calculate it back to the length of
25 the landfill?



1 A. That is correct.

2 Q. In a vertical direction for Site F
3 there would be 1250 of those?

4 A. Correct.

5 Q. That is how you get from 0.07
6 (sic) down to 14 millimetres?

7 A. That 14 millimetres, as I said, is
8 if it flowing through 25 metres of rock. If it were
9 flowing through 50, that is 28 millimetres.

10 Q. Similarly if you were using a
11 Darcy velocity of 0.05, you do the same thing to come
12 up with one millimetre.

13 A. That is correct, yes.

14 Q. In fact in this calculation you
15 have simply ignored any potential for underflow, that
16 is the flow coming from behind the site, accounting for
17 any of the horizontal or the lateral Darcy velocity?

18 A. That is correct, because what I
19 was concerned with here is the conservative situation
20 of the mass being carried down from the landfill and
21 transmitted downgradient to the site, Mr. Chairman.
22 If there were flow coming in from north of the site,
23 then that would dilute the concentrations. Of course
24 the mass of contaminant that is moving down is related
25 to how much is being brought in by the flow from the



1 landfill itself.

2 Q. While we're on that, Dr. Rowe, I
3 just want to pursue that a little bit further. If you
4 could go in, let us say 0.05, you went in and there was
5 a way to measure the fact it was 0.05.

6 MR. HODGSON: I am sorry to interrupt my
7 friend, but the microphone is whistling and making a
8 funny noise.

9 DR. KINGHAM: It's just turned up very
10 high today. The only way would be to turn it down and
11 have Mr. Tidball speak louder.

12 MR. TIDBALL: Q. If the Darcy velocity
13 in this lateral thickness of 25 metres, this zone of 25
14 metres is in fact the real number it's 0.05?

15 DR. ROWE: A. That is correct.

16 Q. If that is going to be the number
17 and if you make an assumption that there was some
18 component of that attributable to an area behind the
19 landfill and it doesn't matter at this point whether it
20 is 10 metres or 1000 metres. If there was some flow
21 there, it simply means that the 1 millimetre that you
22 have got coming in, it actually has to be less than 1
23 millimetre; is that correct?

24 A. That is correct, and that would,
25 if I was to try and consider that then I would have a



1 lower impact.

2 Q. Similarly, if the real number was
3 0.7, the real number was 0.7 for whatever reason, just
4 a higher number, the real number was 0.7 Darcy velocity
5 moving laterally, some of that was attributable to
6 underflow, then the amount of infiltration coming in
7 the top would be somewhat less than 14 millimetres?

8 A. That is correct.

9 Q. Now, can we go back to overhead
10 No. 23. The line, I think you have drawn it in green,
11 I am not sure, it is the line that is 25 metres from
12 the landfill.

13 A. This line that I am pointing to,
14 yes.

15 Q. That is the location of both GL-24
16 and GL-12, is that correct?

17 A. That's the approximate location of
18 those two holes.

19 Q. As I understand what you did,
20 primarily with this graph, but also with the one for
21 chloride was to look at it and say all right run
22 combinations of parameters including different Darcy
23 velocities and there's three of them, see which one of
24 them best fits, no impact at 25 metres. Is that the
25 point of the calibration exercise?



1 A. That is, yes.

2 Q. So in fact what you are doing is
3 you are attempting to calibrate to zero at GL-24 of
4 close to it?

5 A. Or close to it, yes.

6 Q. There is no certainty in this.
7 There is a margin of error here?

8 A. I am not sure whether you are
9 asking me if there is a margin of error in the
10 calculations or a margin of error of uncertainty?

11 Q. There is a margin of uncertainty
12 in these curves?

13 A. These curves are trying to take
14 uncertainty in the parameters, yes.

15 Q. So the exercise you went through
16 in trying to calibrate your model to determine, first
17 of all to determine the critical input parameters is
18 Darcy velocity and then to try to determine what the
19 appropriate Darcy velocity was, just to see where you
20 got at or near zero at 25 metres?

21 A. That was an attempt, yes.

22 Q. That is what you did?

23 A. That's what I did.

24 Q. That is why you assume that cases
25 1 and cases 2 and 3 don't make any sense, because



1 otherwise you would see very high levels of benzene at
2 GL-24?

3 A. That is correct.

4 Q. When you get down closer, all the
5 other curves, and perhaps it is the scale of this
6 particular graph, all the other curves look relatively
7 close. You discarded 4, 5 and 6, cases 4, 5 and 6,
8 that is with a fracture spacing of 5 centimetres and a
9 Darcy velocity of 0.7, because you are still getting
10 impacts in the order of 60 micrograms per litre of
11 benzene?

12 A. That's correct.

13 Q. So it was to calibrate at or near
14 zero where we see ---

15 A. That is so.

16 Q. I just want to ask you a few more
17 things about that calibration so that we can put this
18 in perspective and explore a little bit.

19 To go back to something we were talking
20 about yesterday, Dr. Rowe, I wanted to ask you what the
21 impact, what would be the impact on the estimation of
22 what an appropriate Darcy velocity is if GL-24 was
23 instrumented in such a way that it wasn't detecting
24 contaminants that were merely passing by. You covered
25 this yesterday, the scenario where piezometers could be



1 set in zones of low hydraulic conductivity and the bulk
2 of the flow is passing by in fracture zones. What would
3 that do to your estimation of the appropriate Darcy
4 velocity?

5 A. You are suggesting that all three
6 piezometers are in the material and by fortune there
7 are a lot of fractures amidst it.

8 Q. I think there are any number of
9 scenarios we could go through and I was trying to
10 generalize it. Perhaps I could generalize it further
11 and say what if the contaminants at GL-24 were not
12 detected. There could be many, many reasons for that,
13 but let us assume if that was the case, if contaminants
14 were at GL-24, we don't know the levels, they're just
15 there, but we're not seeing them. What would that do to
16 your estimation of the appropriate Darcy velocity to
17 use?

18 Q. Clearly if they are there and if
19 we don't see them, then the comparison is not
20 appropriate. However, there are a lot of ifs there.
21 There is not just borehole 24, there is also borehole
22 12. Admittedly we're looking at benzene here, but when
23 I come to an opinion, I don't look at just one set of
24 results, I look at a number of results, a number of
25 contaminants, and when one looks at the picture from a



1 number of results, then I would think it is unlikely
2 that you have a large plume at GL-24 and not detect it
3 elsewhere. It is quite possible that there are very
4 small concentrations at GL-24 that have not been
5 detected, but I find it unlikely that there are massive
6 concentrations at GL-24 that have not been detected in
7 some other way, would not have been detected in some
8 other way.

9 Q. I certainly understand your
10 position on that, Dr. Rowe, and I thought you were
11 clear on it yesterday.

12 I am simply asking you, with that
13 qualification, simply concentrating on GL-24 as the
14 reference point, 12 as well if you like, 12 and 24,
15 concentrating on that and the point that you are
16 calibrating to. If in fact the real result is not
17 zero then, it is something higher and it doesn't matter
18 for the purposes of this question whether it is very
19 high or very low, there is something there. What
20 impact would it have on what you think is the
21 appropriate Darcy velocity?

22 A. You said it doesn't matter what
23 the number is and, Mr. Chairman, I think it does. If
24 there is something there and it is in very small
25 concentrations, that has no impact on my conclusion.



1 If there is something there and it is at high
2 concentrations, then if I was drawing my conclusion
3 from that borehole alone, it would have an impact, but
4 if there was something there at high concentrations,
5 then I would expect to see it evidenced in other ways.

6 Q. All right, I understand that
7 qualification.

8 MR. ESTRIN: I don't think he finished.

9 DR. ROWE: Well, I was also going to add
10 that I indicated in my evidence I think and also in my
11 report that based on the information available to me
12 including the data from Dr. Charlesworth regarding the
13 hydraulic conductivity and the gradients as well as my
14 own interpretation of a suite of figures that are in
15 this report, that 0.05 seemed the most reasonable. I
16 am not excluding the possibility that could be less.
17 I also indicated in my report that I would be prepared,
18 and I did consider the possibility that it was as high
19 as two and a half times that, namely 0.125 metres per
20 annum.

21 As you can see in this figure, but
22 perhaps can see a little bit better if I, I think we
23 can see it in this figure, case 26 and 27. If we look
24 at 27 it is there. Case 26 is showing impact in the
25 case of benzene, I am eyeing it on the scale, but say



1 about 18 micrograms per litre. So that in terms of my
2 projections of what is likely to happen at Site F, I
3 considered not only 0.05 but two and a half times that.
4 Part of the reason was that I was thinking of the
5 possibility of small amounts, small amounts being at 24
6 and not detected.

7 Q. If we could look at, I just want
8 to examine that a little bit further. If, for
9 example, I am trying to read off your curve here. If,
10 for example, we found a concentration of 20 micrograms
11 per litre of benzene in GL-24, that might lead you then
12 to conclude that case 26 would be the appropriate case,
13 all other things being equal. Just isolating that one
14 case. That looks about the right curve?

15 A. Yes, within those terms of
16 reference.

17 Q. That would then lead you to say
18 the Darcy velocity is 0.125?

19 A. I wouldn't conclude that, I would
20 say it is more likely to be that.

21 Q. It is more likely to be 0.125.
22 Similarly if it was something higher than that, there
23 is no magic to this, Dr. Rowe, I am not suggesting it
24 is anything higher or lower, I am saying perhaps if it
25 was 40, that might lead you to the conclusion the Darcy



1 velocity was a little bit higher than that?

2 A. That might be true. I also would
3 add I wouldn't be looking at just benzene, I would be
4 looking at a suite of parameters and interpreting them
5 within the range of parameters I have looked at. That
6 is specifically why I looked at the case of a non-
7 reactive contaminant as well as benzene. There is a
8 suite of contaminants within that range.

9 Q. Dr. Rowe, just before we finish
10 that, I just have one other question. You refer to
11 some of the other boreholes that Gartner, Lee have
12 installed and we've already talked about 12 and you've
13 got boreholes 13, 16 and several others marked on here.
14 Just a quick question, because it may come from some
15 other data. I am looking at the plume delineation
16 study and I don't see any results for organics in GL-
17 12?

18 A. I am not suggesting there are
19 organics in GL-12 nor at 13.

20 Q. I don't see the results of any
21 analysis for organics?

22 A. That's right.

23 Q. It wasn't done?

24 A. No.

25 Q. Could I then turn your attention



1 to another possibility. In constructing your model and
2 using your various input parameters, perhaps you can
3 put that overhead up, actually, the input parameters,
4 particularly overhead 20, keeping that one handy.

5 A. Could I just have a point of
6 clarification? You asked me about borehole 20 and you
7 meant volatile organics?

8 Q. Yes.

9 A. My answer assumed you meant
10 volatile organics.

11 Q. I wanted to draw your attention to
12 two of the input parameters you used, particularly
13 matrix porosity and diffusion co-efficient. They are
14 down at the bottom.

15 I am sorry, it is overhead 20. Trow
16 used 0.1. I am sorry, I forget your evidence on this.
17 Did you in fact do some independent testing of your own
18 and that is where the 0.1 to 0.11 came from?

19 A. That is correct, we had a sample
20 core taken. We performed tests on that to determine
21 the porosity and we got the porosity in the range
22 indicated. For the purposes of calculation, I was
23 conservative and used the value of 0.08.

24 Q. So matrix porosity, using a
25 conservative value, you dropped it down a factor of



1 about 20 per cent?

2 A. Twenty per cent, yes.

3 Q. Similarly with the diffusion co-
4 efficient, this is the diffusion co-efficient you
5 actually used?

6 A. Right.

7 Q. You actually measured with the
8 field test and there is an exhibit that details how you
9 measured that in the laboratory?

10 A. That is correct. Can I just
11 clarify. There are a number of diffusion co-efficients
12 shown. The value I actually used was 6×10^{-7} .

13 Q. Which varies from the actual
14 results of your analysis of the actual shale itself by
15 a factor of 4, a factor of 2.5?

16 A. A factor of 2.5.

17 Q. So you have been conservative on
18 that factor as well, which you have seen in the
19 laboratory and reducing it by two and a half times.
20 All right. If you go back then, I am sorry, we are
21 flipping around, to overhead 23 and I wanted to ask you
22 a similar question to the one I asked a minute ago.

23 What would be the impact on your
24 estimation of an appropriate Darcy velocity if you
25 adopted the measured parameters for matrix porosity and



1 diffusion co-efficient?

2 A. In fact I think I looked at this
3 when I did the study, just for my own interest. My
4 recollection is that it makes a little bit of
5 difference, but it wouldn't change the general
6 conclusion.

7 Q. I assume that it would mean more
8 of the contaminant mass could be moved into the matrix
9 because there is more pore space and it could move in
10 quicker because the diffusion co-efficient is higher?

11 A. That is correct. It would tend
12 to be beneficial, to attenuate the contaminants more
13 than I have looked at in this case here.

14 Q. Am I right that although it may be
15 difficult to show on these curves, the effect on
16 perhaps all of these curves would be to move them
17 slightly to the right?

18 A. That is correct.

19 Q. You say that it is not
20 significant?

21 A. And the other aspect of it too,
22 Mr. Tidball, is that if the parameters are as I say
23 they are from the tests, then when one goes to project
24 what is happening at Site F, the beneficial effects
25 will be greater there than they are for Burlington



1 landfill because we are looking at much larger travel
2 distances, much larger times and therefore much larger
3 volumes of water. So if in fact things are as good as
4 I suggest they are, then that is very beneficial.

5 Q. I understand that, I think. If I
6 could just take you back one step. We agreed it would
7 move all your curves slightly to the left. Would it be
8 even noticeable on this graph?

9 A. I would have to check that. The
10 scale of this graph is such that it might not be
11 noticeable.

12 Q. Let us assume it would be
13 something you could see. Would the impact of that
14 simply be that in order to calibrate again to that zero
15 at GL-24, zero at 25 metres, you would have to use a
16 marginally higher Darcy velocity?

17 A. Yes, that would be the impact, but
18 in answering your question, I think we should not just
19 look at overhead 23. I think we should also look at
20 overhead 24, which is the corresponding curve for a
21 conservative species.

22 You can see that there a small change is
23 not going to affect my interpretation very
24 significantly. I am not saying that the Darcy
25 velocity is 0.05, I am saying it is the most likely



1 value. It could be as high as 0.125.

2 Q. I understood that, Dr. Rowe. I
3 am just exploring the limits of what you have done.

4 A. Within that range, what you are
5 talking about, I don't think it will change much.

6 Q. If you could again go back to
7 overhead 23, I want you to keep that up there as the
8 main reference, but feel free to go to 24 if you need
9 to. We talked yesterday on the topic of anisotropy.
10 Again I wanted to ask you, what would be the impact on
11 your estimations of the appropriate Darcy velocity if
12 the shale is anisotropic, and I think you have to base
13 it on the assumption your model can account for that.

14 As I understand your model, it can
15 account for anisotropy.

16 A. The model I have used does not
17 account for anisotropy.

18 Q. If it could, if this is an
19 abstraction that you really can't answer, I understand
20 that and just tell me that. If it could somehow
21 account for that, what would it do to your estimation
22 of what the appropriate Darcy velocity should be?

23 A. Well, I think one can't just look
24 at anisotropy in isolation. What is important here is
25 the flow, not whether it is anisotropic. One has to



1 couple with anistropy with the gradients. You are
2 quite correct that one would expect the vertical
3 hydraulic conductivity on this site to be less than the
4 horizontal hydraulic conductivity, but the flip side of
5 that coin is that the hydraulic gradients are greater
6 vertically than horizontally. When you put the two
7 together, then in terms of Darcy velocity and --

8 Q. Which is Darcy velocity, is just
9 one times the other?

10 A. That is correct. Then the impact
11 may not be and I suggest will not be of significance.
12 One would think, just looking at the hydraulic
13 conductivity alone.

14 Q. What kind of an impact, do you say
15 it would have any impact on your calculations of the
16 Darcy velocity?

17 A. Certainly. In this scenario A, I
18 am looking at the material getting down there very
19 quickly. I am essentially approaching it from the
20 standpoint that suppose things are very bad with
21 respect to vertical fracture spacing beneath the site,
22 if that were the case, then the water could easily get
23 down through those vertical fractures and I am worried
24 about moving horizontally. That is one of three
25 scenarios that I have considered.



1 The second scenario is an intermediate
2 scenario which says okay, it is not that permeable in
3 the vertical direction. It does take time to come down
4 and I looked at that in my scenario B, Mr. Chairman.
5 The third scenario is the scenario suggested by Trow
6 that there is a weakly fractured massive shale unit
7 where there is going to be a lot of resistance to the
8 downward movement of contaminants and I also considered
9 that.

10 So, in concluding, Mr. Chairman, I have
11 tried to cover the extreme ranges that you are
12 discussing.

13 Q. I appreciate that, Dr. Rowe. Can I
14 ask you about one final factor that goes into the
15 calibration and ask your opinion on how it would, how
16 changing it would affect the results of the
17 calibration? I am referring specifically to the total
18 mass that you have used available for transport from
19 the Burlington site. As I understand it, you used
20 2200 tonnes of chloride and an equivalent tonnage for
21 benzene that I don't have at my fingertips?

22 A. That is correct.

23 Q. You have assumed that all of that
24 mass is available for transport. You have assumed
25 none of it is being collected or going anywhere else?



1 A. Yes, that is correct.

2 Q. Can you tell us how you calculated
3 the 2200 tonnes?

4 A. It was an estimate. Obviously
5 one has to look at the size of the landfill, that was
6 one factor was went in. I looked at the other numbers
7 I had been using with respect to Site D, primarily Site
8 D, namely being 4400 tonnes and the 7800 tonnes.
9 Making allowance for the fact that I don't think the
10 real situation is in the order of 7800 tonnes and
11 making allowance for the area, I estimated a value of
12 2200 tonnes.

13 Now in the time scale that we were
14 looking at the problem, it wouldn't make a great deal
15 of difference whether it was 2000 or 2600. On a
16 larger time scale it would make a difference, but not
17 on a small time scale, it wouldn't.

18 Q. Do I take your last answer to mean
19 that the 2200 more or less corresponds to the 4400 at
20 Site D?

21 A. Crudely, but not exactly.

22 Q. That is simply some sort of a
23 crude measurement of comparable area and thickness of
24 fill, that sort of thing?

25 A. Very crude. I was just trying to



1 get a handle on what the number might be. Obviously I
2 have much less certainty on what is happening at the
3 Burlington landfill than what has been projected at the
4 others.

5 Q. You have told us that you assumed,
6 that 2200 tonnes, the comparable tonnage of benzene, if
7 I can go back to the terms of your model and the
8 expression I used, moved down into the box, and then
9 your model ran to show how it moved from that point on?

10 A. That is correct.

11 Q. I take that to mean then that you
12 haven't accounted for any leachate collection from that
13 area of the landfill site?

14 A. No, I haven't, because that area
15 of the landfill site does not, as I understand it, have
16 a leachate underdrain system.

17 Q. Do you assign any importance to
18 the fact that it has had a toedrain collector system
19 around the perimeter of that site since, I am not sure
20 the year, I believe it's in evidence, perhaps 1981 or
21 1982?

22 A. Certainly the toedrain system
23 would collect some of the leachate, I would expect that
24 to be the case.

25 In fact, that is probably a major



1 factor, a major area where the leachate has really been
2 collected. What I was concerned with here was looking
3 at the component of it going down. The effect of what
4 you are suggesting, Mr. Tidball, would be, is to reduce
5 the mass of contaminant.

6 Q. Yes.

7 A. I don't know how much has been
8 collected.

9 Q. There are a couple more questions,
10 then I want to explore about what the effect of it
11 would be. I take it you have also made, not made any
12 allowance for leachate loss from break-outs that
13 apparently occur frequently at times in the past or
14 from perhaps travelling at that very top few metres,
15 the shallow zone that Dr. Charlesworth refers to and it
16 discharges to creeks. That doesn't account for any
17 loss there?

18 A. No, it does not.

19 Q. It doesn't account for any loss
20 with regard to flow towards Falcon Creek and any break-
21 outs on that side?

22 A. It doesn't, but I would again make
23 the point we are looking at a very small time scale,
24 fifteen years here. Over that time scale, I don't
25 think it would have a profound effect on the results,



1 over a longer time scale it would.

2 Q. How big a difference would there
3 have to be in the mass before it would make any
4 significant difference on the curves you show on
5 overhead 23?

6 A. When you start talking an order of
7 magnitude, it would start having a significant effect.

8 Q. Say by reducing it to say just
9 cutting it in half, just to be arbitrary. If you
10 reduced it down to 1100 tonnes of chloride and a
11 corresponding halving of the benzene figure, do you say
12 it would have no impact or just a marginal impact?

13 A. I wouldn't say it would have no
14 impact, I would say it wouldn't change my conclusions.

15 Q. I understand it won't change your
16 conclusions. What effect would it have on the curves
17 we see on overhead 23?

18 A. The primary thing you would notice
19 is that the concentration at the source would drop.
20 Perhaps if we could go to overhead 24, this, if we
21 in fact focus our attention on case 11 on figure 24,
22 you can see that in this case, this case is the only
23 one where it is really observable. The concentration
24 is starting to drop within the source and in fact
25 the concentration in the source is less than what it is



1 further downgradient. That is because we start off
2 with a plug of contaminant at a given concentration and
3 as it moves along it is being attenuated as it moves
4 through, but as the mass is being removed from the
5 landfill, the concentration is dropping, so in this
6 case here, because of the high velocity, a lot of the
7 mass is being moved out. We are starting to see a
8 drop.

9 What would happen if we used a smaller
10 mass, we would see this part of the curve dropping
11 down. We would see more humpiness.

12 Q. More humpiness?

13 A. If I could call that humpiness.

14 We find that there is going to be a peak moving a
15 distance away from the landfill. It would tend, it
16 would give you some attenuation, it would affect the
17 entire curve, but the greatest effect would be near the
18 source.

19 Q. And you are using, you are
20 focusing on, I guess, cases 10 and 11. Those are
21 cases where the Darcy velocity is 0.7?

22 A. Those are the cases that would be
23 most affected by the mass of contaminant from the
24 landfill.

25 Q. I take it what you are telling me



1 is that the effect of any shift there isn't going to be
2 significant, but you are still going to see a
3 significant impact at GL-24?

4 A. That is correct. You would still
5 see a very significant impact. These curves would
6 change, but you would still see a very significant
7 impact that led to my conclusion.

8 Q. When you get down into these
9 curves, they are more subtle, I guess, for want of a
10 better word, and you are going to have a slight
11 shifting again to the left, I assume, less mass and
12 less impact?

13 A. That is correct if one were to
14 consider that the curves might look closer to the
15 0.125, but I don't, in my opinion, Mr. Chairman, it
16 wouldn't significantly change my conclusion.

17 Q. Dr. Rowe, you have spoken, I am
18 trying to think of the word, it was either a level of
19 confidence or a level of comfort that the existence of
20 the Burlington site gives you in your modelling
21 exercise, the fact that there is monitoring data there
22 to show you that at GL-24 there is no, or very marginal
23 impact. It gives you that sort of confidence in this
24 modelling exercise. I want to make sure I have it
25 right?



1 A. Yes, I think certainly, Mr.
2 Chairman, the fact that we have a landfill there which
3 wasn't adequately engineered in the first place, to
4 today's standards, and it appears by all evidence that
5 is available and all testing we have here to date, to
6 be performing satisfactorily, it gives me a great deal
7 of comfort.

8 Q. Would it give you a greater level
9 of comfort, Dr. Rowe, if in fact the results of the
10 monitoring program, the results of the plume
11 delineation study actually showed a pattern of leachate
12 contamination over distance? By that I mean, I am not
13 at all meaning to imply that you find leachate down
14 south of 403 or anything like that. I am simply saying
15 that if you had say, a monitor 5 metres from the toe
16 and 10 metres from the toe, and you saw declining
17 concentrations, would that give you a greater level of
18 comfort?

19 A. From the perspective of a
20 researcher I certainly would be interested in more
21 data, but when one looks at the reality of the
22 situation, I think the evidence is sufficient, based on
23 all the information I have had available to me to give
24 me confidence about that.

25 Q. I would like you to answer the



1 question. If you had that kind of data, isn't it true
2 it would give you a greater level of comfort because
3 you are more sure of what you are calibrating?

4 A. Sure, I would like more data
5 if were available, but I think there is adequate data
6 available.

7 Q. Is it the problem that, if there
8 is one here, that you are calibrating to a zero and you
9 don't really know that the zero is zero, I am sorry,
10 you don't really know that it means that it is one
11 centimetre from GL-24 or 20 metres from GL-24, you
12 don't know. All you know is it is less than that?

13 A. That is correct, and when one
14 looks at what the implications would be, that if it is
15 less than that, if it hasn't reached GL-24 in 15 years,
16 Mr. Chairman, I believe there is no potential impact
17 downgradient of Highway 403.

18 Q. I understand that.

19 A. Irrespective if it is one
20 centimetre from GL-24 or 24 metres.

21 Q. All I am suggesting, Dr. Rowe, is
22 that you have calibrated very carefully to a specific
23 point 25 metres, and I realize you have allowed a
24 margin for error, but you have calibrated to a very
25 specific point. The result at that point happens to be



1 zero, depending on whose evidence you take, as you
2 accept as being the real result. If we assume it is
3 zero, all you really know then, if the result of all
4 that then is to say the Darcy velocity is 0.05, all you
5 really know for certainty is that it is less than that?

6 A. Oh yes, and I am happy to say it
7 is less than that.

8 Q. Now, Dr. Rowe, I asked Dr.
9 Charlesworth yesterday and I believe we touched on it
10 ourselves, about the actual physical nature of the
11 shale in the vicinity of Site F in the Burlington
12 landfill site and the fact that there are local hetero-
13 geneities. Dr. Charlesworth doesn't particularly
14 prefer the interpretation in H-220, which is the pink
15 and yellow-coloured hydrostratigraphic interpretation
16 done by Mr. Beechinor. I think there was some
17 agreement that there are local heterogeneities, local
18 zones of fracturing that could exert some influence on
19 the movement of ground water and on the movement of
20 contaminants. Can we agree that the influence of
21 those kinds of heterogeneities, that physical nature of
22 the rock, on the distribution of the contaminants, that
23 is you are tending to see if you have an area of
24 preferred flow, you might see contaminants higher in
25 one place than you would in another? Can we agree that



1 the result of all of that would be that you would
2 calibrate to something, you could calibrate to
3 something higher or lower than 0.05?

4 A. I am not quite sure whether that
5 is more than one question.

6 Q. Let me put an example to you and
7 it might assist. Let us assume that in the plume
8 delineation study, Gartner, Lee hypothetically had a
9 well 10 metres from the toe of the landfill, so closer
10 to the landfill than GL-24. One of those piezometers
11 showed a reading of 10 micrograms per litre of benzene.

12 Now, given the fact that we know there
13 is local heterogeneities, we know there are fracture
14 zones, we know the areas of preferred movement of
15 contaminants. For the purposes of your modelling
16 exercise, if you used that 10 micrograms per litre as
17 your reference point, use that as a point to calibrate
18 to, you don't know for sure what the average would be
19 over the 25 metre zone because your model requires
20 uniform flow over the 25 metres. I think that is the
21 point?

22 A. No, I don't think that is quite
23 the case, Mr. Chairman. The model requires uniform flow
24 over whatever thickness one is addressing. For the
25 purposes of illustration, I used 25 metres in the



1 report. It is equally true whether that zone is one
2 metre thick, 5 metres thick or 50 metres thick. I am
3 assuming uniform flow through a zone of thickness T.

4 Q. How does it account then for a
5 zone of higher fracturing, a zone within whatever
6 thickness you used, whether it is 25, 50 or 10 or a
7 zone of half a metre, a metre or some other number you
8 can think of where the bulk of the contaminants are
9 being channelled?

10 MR. ESTRIN: Can we get the question
11 clear. Are you asking the witness to assume that in
12 that kind of zone you have just described that the bulk
13 of the contaminants are flowing? As long as that is
14 the assumption, that he is asking....

15 MR. TIDBALL: As long as, I thought I
16 had....

17 MR. ESTRIN: I don't think it had been
18 established.

19 MR. TIDBALL: I think that's right, Mr.
20 Chairman.

21 Q. The whole thing is predicated on
22 the fact these zones could be there and could be
23 exerting that kind of influence on the system.

24 MR. ESTRIN: I just rise to make the
25 distinction between what that kind of a zone is that is



1 assumed to be there, as between the flow of water and
2 the flow of contaminants. That hasn't been clear.

3 MR. TIDBALL: Q. Dr. Rowe, I asked Dr.
4 Charlesworth about this yesterday. I had been
5 assuming that if there is a zone -- and I am again not
6 talking about the zone that Trow postulated to be there
7 -- simply any zone of significantly less lateral
8 extent, it doesn't really matter. A zone that was
9 fairly highly fractured and would carry, had an impact
10 on the system of carrying a good proportion of the
11 ground water, would also carry a good proportion of the
12 contaminants, would it not?

13 DR. ROWE: A. There are two parts, at
14 least two parts to that question. If you are asking me
15 if you have a continuous zone of major extent in the
16 frame of reference one is dealing with, if your
17 question is hypothetically we have a continuous zone
18 and hypothetically it is of major extent within one's
19 frame of reference, then if there is again a
20 hypothetically large flow, would that carry
21 contaminants with it? The answer is yes, there are so
22 many hypotheticals in that question, Mr. Tidball. I
23 wonder, and certainly this is my understanding from
24 Dr. Charlesworth, that while there is local variation,
25 there is some question about whether these things are



1 connected. In Trow's interpretation, as I understood
2 it, they looked at what I would call a fairly worst
3 case visualization of the highly fractured zone in that
4 they pictured this large zone extending a great
5 distance. Certainly my understanding of what Dr.
6 Charlesworth has said, and from our discussions, is
7 that you could have highly fractured zones but not
8 continuous or connected; certainly on a larger scale.
9 That would mean you wouldn't get those large flows, you
10 may not get those large flows you are discussing.

11 Q. Perhaps we can talk about
12 something real, some real field evidence, Dr. Rowe.
13 Trow has put a fair degree of weight on the results of
14 one particular pumping test at Site F. I think it is
15 your position from what you just said, and certainly
16 the Board has heard lots of evidence that that in fact
17 may have been over-interpreted. I think that is what
18 you just said, and I think the reality is, is it not,
19 that Trow managed to exert some influence several
20 hundred metres away using that pump test. If we can
21 assume then, it may not be too wild an assumption, if
22 we can assume it is some kind of an area there, some
23 kind of an area of fracturing, it may not extent beyond
24 that 200 metres, but it is there and you've got
25 something of that kind of magnitude and with that kind



1 of conductivity, I acknowledge that Dr. Charlesworth
2 has problems as to how to calculate that, he thinks it
3 should be an order of magnitude higher or lower. I am
4 sorry, that kind of zone, that's what I'm talking
5 about. If you had that kind of a zone, I assume it
6 would act as some kind of preferential conduit for
7 contaminants, would it not? It may not go where Trow
8 says it would go, but it may, in a local area, tend to
9 channel contaminants, would it not?

10 A. The answer to that depends, I
11 think, on exactly where this zone you postulate is.
12 Also on the material around it. If one has, for
13 example, in Trow's idealization, Mr. Chairman, they
14 have a zone of weakly fractured shale overlying this
15 zone we have just been discussing, this highly
16 fractured unit. In that case there the transport is
17 certainly related to the highly fractured unit, but it
18 is controlled by the mass of shale separating the waste
19 from that unit. I don't think one can focus attention
20 simply on the fractured unit, you have to look at the
21 less fractured units around it and what the
22 implications of that would be, Mr. Chairman.

23 Q. Can I come back then, Dr. Rowe to
24 the original question and ask you to make the
25 assumption; that's the only way we can do this. If we



1 go back to this hypothetical borehole 10 metres from
2 the toe of the Burlington landfill, and in one of the
3 piezometers we find, we measure 10 micrograms per litre
4 of benzene?

5 A. All right.

6 Q. Isn't it in fact true that if you
7 then, if you then try to use that 10 micrograms per
8 litre to calibrate your model, so the 10 micrograms
9 became your reference point at 10 metres, that if in
10 fact there is some kind of preferential movement of
11 contaminants going on there, that wouldn't necessarily
12 be accurate in the 25 metre zone, 10 metre or 50 metre?

13 A. No, that is correct, it would be
14 accurate in that particular zone.

15 Q. In fact the Darcy velocity, the
16 bulk Darcy velocity in this 25-metre zone or whatever
17 thickness you like, would in fact be something
18 different? We don't know exactly what it would be. It
19 is just that in that particular place?

20 A. As you posed the problem to me,
21 Mr. Tidball, the bulk Darcy velocity in the 25-metre
22 zone would be less. We'd be looking at the worst case.

23 Q. Dr. Rowe, I have one more question
24 on your model, the model itself and the calibration of
25 that model. I will preface this by saying that I will



1 accept, for the purposes of this question, I certainly
2 accept the value of the modelling exercise on trying to
3 quantify matrix diffusion. I accept that, so over the
4 long-term, for the purposes of this question, that is
5 assumed, that what you have done is a very good attempt
6 to quantify matrix diffusion. I would like you to
7 comment if you will on the appropriateness of
8 calibrating the model itself, calibrating it using this
9 microscale picture, using the picture Dr. Charlesworth
10 was talking about, the bulk conductivity of 4.5×10^{-6} .
11 In light of what we have been talking about, local
12 heterogeneities, if you accept for the moment that
13 there are local heterogeneities, would you comment on
14 the appropriateness of using a sort of macro picture to
15 calculate to a very specific spot at a very short
16 distance from the landfill, a very short period of
17 time?

18 A. Again one has to ask oneself how
19 extensive are these local heterogeneities. Obviously
20 if we are going to be relying on simply one data point,
21 one piezometer. Then that is not as good as relying
22 on several piezometers. There are, I think, three in
23 borehole 24. If one is looking in borehole 12, there
24 are more of them. Admittedly they are not recording
25 volatile organics, but if there was this massive plume



1 emanating from the landfill, you would think it would
2 be picking up something significant.

3 Further downgrade we have other
4 boreholes. I cannot, I am not wishing to suggest that
5 it wouldn't be better to have more data. Sure, it
6 would be nice to have more data, but I don't see any
7 evidence from the information available of a problem,
8 and I think, Mr. Chairman, that when one is, if there
9 were no landfills there, I could have gone through and
10 used Dr. Charlesworth's hydraulic conductivity and
11 gradient and made some predictions of what is going to
12 happen at Site F. Then I could have been conservative
13 and said well he is out by a factor, and what is going
14 to happen. Indeed that is what I did. Since we had
15 the Burlington landfill there, I felt it appropriate to
16 at least try and look at how the Burlington landfill's
17 performance fitted in with what the calculations would
18 project for the Burlington, for the Site F landfill.
19 So, I am attempting to make use of the information that
20 is available to me.

21 Q. I want to make sure I understood
22 what you just said, Dr. Rowe. Am I right, do I take it
23 from what you said in fact you did look at it in
24 isolation, you did look at it apart from the Burlington
25 landfill, making some assumption that the landfills



1 weren't there or that there were not monitoring data.

2 A. The results that I present with
3 respect to Site F stand alone. I could have produced
4 those results irrespective of whether there is a
5 landfill at Burlington or whether there is a Burlington
6 landfill. What I have done in addition to that is I
7 have tried to use exactly the same concepts to see what
8 one would expect at Burlington, because I was trying
9 to understand why it was behaving as it was behaving.

10 Q. I assume Dr. Rowe that if you had
11 done, if you had done that for Site F in isolation, I
12 am trying to understand where we get to, do we then, if
13 we look at in isolation, do we end up with the kind of
14 picture you paint at Site F where you draw an envelope
15 around the possible results and the envelope goes from
16 0.05 to 0.7?

17 A. Based on the data that I have been
18 given, the probable Darcy velocity is 0.05. That is the
19 number that approximates the hydraulic conductivities
20 and the hydraulic gradients that Dr. Charlesworth has
21 indicated to me.

22 Now, I have gone and looked at a number
23 two and a half times that, 0.125, to assess the effect
24 of the gradients perhaps being higher or the hydraulic
25 conductivity being higher; either one. So I have tried



1 to get some idea, not only for what is the expected
2 case, based on Dr. Charlesworth's data but what I have
3 called my worst case, using more conservative
4 parameters. That would stand on its own, with or
5 without the Burlington landfill.

6 Nevertheless, the Burlington landfill is
7 there and therefore I thought I should analyze it and
8 fit it in, the two interrelate, but the work that I did
9 for Site F could stand on its own.

10 Q. On a very local scale, Dr. Rowe,
11 just go back a bit. You just told us that aside from
12 the Burlington landfill, the kind of Darcy velocity you
13 have used, the 0.05 corresponds with Dr. Charlesworth's
14 bulk conductivity of 4.5×10^{-6} by the kind of gradient
15 we are seeing at the site?

16 A. That's right.

17 Q. If you look at it very locally,
18 this is the nub, certainly our concern. If you look at
19 it in a very local picture, in fact your hydraulic
20 conductivity is all over the map and Dr. Charlesworth
21 has canvassed in his report, the range one might
22 expect. If you recall Dr. Charlesworth told me it is
23 something like 10^{-2} or 3, up to 10^{-7} or 8. There is an
24 enormous number of conductivities. If you use that
25 you would get the same lateral gradient, in fact you



1 could have this enormous range of Darcy velocities,
2 couldn't you?

3 A. That is true, but you have to look
4 at the level of conductivity.

5 Q. That's right, and that is
6 something we just don't know?

7 A. That is something Dr. Charlesworth
8 should speak to rather than me.

9 Q. Dr. Charlesworth?

10 DR. CHARLESWORTH: A. The question was?

11 Q. Dr. Charlesworth, I've just been
12 talking to Dr. Rowe about -- what Dr. Rowe is telling
13 me, Dr. Charlesworth, is that aside from the Burlington
14 landfill and his ability to calibrate to it, using the
15 kind of lateral gradients you find at Site F and using
16 the bulk hydraulic conductivity value you gave him, he
17 ends up with a Darcy velocity of approximately 0.05.

18 I put to him that in the shale at Site
19 F, or at Burlington, or at Bayview for that matter,
20 there are hydraulic conductivity values that are all
21 over the map. In fact if you multiply that by the
22 same gradient, you get a range of Darcy velocities that
23 are all over the map. Dr. Rowe then has questioned the
24 level of inter-connectiveness of the more transmissive
25 zones. I simply put to him that that was an unknown



1 and he has deferred to you on that.

2 I am simply asking you, do you agree
3 with that, is it an unknown or do you agree with me it
4 is an unknown?

5 A. It is an unknown in a sense, but I
6 think it is reasonable to look at the situation there
7 and conclude that a reasonable approximation for his
8 modelling is to take this bulk value, recognising that
9 there will be local variations.

10 Q. And we talked about that
11 yesterday, Dr. Charlesworth, and we agreed, did we not,
12 that that is appropriate, you can appropriately call
13 that a sort of macroscale interpretation. If we stand
14 back, way back and say how does the flow, how does
15 groundwater movement in the shale in the vicinity of
16 Site F down to the lake, we can come up with that
17 interpretation and it makes perfect sense?

18 A. That is correct.

19 Q. The question is, on the very local
20 scale?

21 A. Yes. Certainly on the local scale
22 it is conceivable that you would have, you certainly do
23 have variations on the local scale. The reason that I
24 have, that gives me confidence here in taking this kind
25 of general picture in terms of assessing what might



1 happen at Site F is the performance of the existing
2 landfills. If a significant quantity was going down
3 one particular conduit, and we don't see evidence for
4 one large conduit, then you would have, you would be
5 seeing problems somewhere. If you are not seeing
6 problems somewhere, then on the whole scale of things,
7 what I am trying to say, there is not a problem and it
8 does not give me concern. Let us assume that is not
9 happening and the stuff is moving in the shallow zone,
10 let us model what would happen there.

11 Q. I understand that, Dr.
12 Charlesworth. What you have done, perhaps because it
13 is the only realistic thing you think can be done, you
14 have simply averaged things out and come up with the
15 sort of blended picture?

16 A. Yes that is right. I see
17 Dr. Rowe's model, Dr. Rowe talked about the comfort
18 level of the Bayview landfill. I see Dr. Rowe's model
19 as being a comfort factor in looking at what has really
20 been happening at Burlington and Bayview. Maybe we
21 don't know exactly what is happening, but he has
22 suggested that if we have the worst case of stuff
23 moving in the shallow zone and he has suggested, his
24 model has indicated a mechanism that might explain why
25 we are not seeing a problem there. His model is part



1 of my comfort level.

2 Q. Let us explore that a little
3 further, Dr. Charlesworth. I will ask you the same
4 question I asked Dr. Rowe, accepting as I think you do,
5 that Dr. Rowe's modelling exercise is a very valid
6 attempt to quantify matrix diffusion over the long
7 term. Do you think it is valid or intuitively correct
8 and that is an expression we have used several times.
9 Is it intuitively correct to you to calibrate, knowing
10 you have got heterogeneities in the shale and I am not
11 suggesting again there is any massive fracture zone.
12 Knowing you have got heterogeneities in the shale,
13 knowing that every place you put down a piezometer you
14 are finding a somewhat different hydraulic conductivity
15 knowing all of that, does it make sense to you to
16 calibrate his model very specifically to a point in
17 time that is very short and the location on the
18 landfill in terms of travel distance that is very
19 short? Does that seem intuitively right?

20 A. My interpretation probably centres
21 around the word calibration, Mr. Chairman. I don't
22 really see that. Dr. Rowe uses that word. I don't see
23 it as that. Dr. Rowe can model what may happen at Site
24 F and he can compare that with what has apparently
25 happened at Bayview, what may have happened at Bayview.



1 That is a comparison that gives me some confidence in
2 his model for Site F. Dr. Rowe may correct me, but I
3 do not see his calibration at Site F as an integral
4 part, sorry, his calibration at Burlington as an
5 integral part of his model that he is doing or an
6 essential part of the model he is doing at Site F.
7 You can run your model and you can say we have some
8 data here, certainly there are questions about the
9 data, but you run it and you compare it with that data
10 and it fits the data that is available. I think we
11 will find on every aspect of work that has been done in
12 this whole general area, there will be questions. There
13 is no completely definitive answer to what has happened
14 at Bayview, Burlington or Site F, so there will be
15 questions. If you have got a piece of data that fits,
16 and I go back to Dr. Rowe's term here, that is a
17 comfort level or a comfort factor here. I don't see
18 it as a necessary integral calculation.

19 Q. Dr. Charlesworth, if you don't see
20 it as a calibration, or simply, what did you call it, a
21 sort of checking after the fact, is that fair?

22 A. I think we said checking in
23 parallel with the fact.

24 Q. I take it then you accept, do you
25 accept prima facie the use of a Darcy velocity of 0.05



1 metres per annum? If that is in fact what happened is
2 it feasible to restrict the input Darcy velocity to
3 0.05 in the examination of Site F and 0.125 then?

4 A. He used a value that was derived
5 from, that is derived from numbers that we give to him,
6 so I think that was reasonable and he had a safety
7 factor in there.

8 MR. TIDBALL: I shall be another half-
9 hour. Shall I continue or would this be an appropriate
10 place for the morning break?

11 MR. LANCASTER: Perhaps we should take a
12 break now.

13 --- Recess
14

15 MR. LANCASTER: Please be seated.

16 MR. TIDBALL: Q. Dr. Rowe, I would like
17 to turn our attention to scenario B, if we could for a
18 few moments. I had asked you to get out Exhibit M-
19 456; that is the overhead that explains it.

20 DR. ROWE: A. Is that the figure you
21 are referring to? M-456 is it?

22 Q. Now, as I understand scenario B,
23 Dr. Rowe, I just want to make sure that we all have
24 this correct. As I understand scenario B, Dr. Rowe,
25 what you have done here is essentially tried to account



1 for some vertical travel distance before there is
2 horizontal movement through the shale?

3 A. That is correct.

4 Q. This isn't scenario C, this is
5 something quite different. Perhaps you could explain
6 the difference between this and scenario C?

7 A. Scenario C, Mr. Chairman, is
8 adopting Trow's hydrostratigraphy and flow model
9 essentially. Modelling migration down through the
10 weakly fractured massive shale unit and then along what
11 they have identified as, postulated as a highly
12 fractured zone. That is scenario C. That is not what
13 we are talking about here. What we are talking about
14 in this case is scenario B, is the movement of
15 contaminant down through the rock. In this case I
16 selected a 15 metre thickness and the main reason I did
17 that was to correspond to the thickness of Trow's
18 weakly fractured unit for purposes of illustration and
19 then moving laterally from there.

20 So, if we were interested in a point 25
21 metres downgradient, then one could picture a particle
22 of contaminant moving down 15 metres and then along 40
23 metres, so it has moved a total distance of, sorry,
24 moved down 15 and along 25, so it has moved a total
25 distance of 40 metres. All I have done is I have taken



1 exactly the same results, it seems we are humming here
2 again.

3 I have taken exactly the same results
4 that I showed before, Mr. Chairman, and I have changed
5 the location of where the 25 metres from the landfill
6 is, so that actually it is 40 metres from the origin,
7 taking account of down and across. This is simply to
8 give some idea, both for myself and anybody else
9 reading the evidence, as to what the effect of taking
10 that travel distance might be.

11 Q. Now, so that I understand it, you
12 didn't run a separate model for this, the exercise was
13 simply to move the line that says 25 metres, to move it
14 over so that on the graph it is actually at 40 metres?

15 A. That is correct.

16 Q. That is all that's involved here?

17 A. That is correct.

18 Q. That makes the assumption then
19 that the distance, the travel distance down through the
20 25 metre window at the front of the landfill before
21 flow turns in a lateral direction, that just assumes
22 that the same parameter is applied in that you have
23 tipped it up?

24 A. That is correct, yes.

25 Q. Now, in this scenario, Dr. Rowe,



1 we are just wondering if there is an inconsistency.
2 Perhaps you can help us. If you look at, we talked
3 this morning about the relationship between the
4 vertical Darcy velocity and the lateral Darcy velocity
5 and how to get between them, because you account for
6 the length of the landfill. We get up here that in
7 fact if you look at this, if you try to look at this as
8 sort of a logical case, and we realize it is simply a
9 case you have used to illustrate a point. In fact,
10 the vertical Darcy velocity here should be 0.001 or 1
11 millimetre?

12 A. That, the results would not be
13 terribly significantly affected by that fact. What I
14 am essentially assuming here is that the Darcy velocity
15 is 0.05 metres per annum, that is the essential
16 assumption.

17 Q. This is the method you have chosen
18 to try and include the fact that there is some, there
19 is some time spent, can we again use the expression in
20 filling the box beneath the landfill, and that is how
21 you try to account for that uncertainty in terms of
22 calibrating your model to that 25 metre point?

23 A. In a sense, that is true.

24 Q. I am wondering, Dr. Rowe, would it
25 be equally or more valid to have simply run your model,



1 instead of for year 15, but for year 5 or some other
2 year in between to try to account for the ten-year
3 process you say it could conceivably be to reach
4 equilibrium within the 25-metre zone. Could you have
5 done that, would the result have been valid?

6 A. I think there are two issues here,
7 Mr. Tidball. In fact, I did run the model for the ten-
8 year period and the results are given in Appendix B of
9 the report.

10 Looking at that, my conclusions were
11 unchanged, but the other issue was whether they are
12 talking about ten years for saturation. Now, in fact
13 ten years corresponds to a particular fracture spacing.
14 If saturation has not occurred, Mr. Chairman, if
15 saturation had not occurred, then the concentrations
16 would be even higher than what we are looking at.
17 Really the whole, perhaps the most important thing in
18 the context of what we are talking about here is the
19 righthand side of the diagram, which expresses it in
20 non-dimensional terms. Anybody, and you've got
21 consultants, can interpret the results for any initial
22 concentration.

23 Q. Finally, Dr. Rowe, could I turn
24 you to your scenario C, which is your modelling of
25 Trow's "better-fit" parameters. Could I ask you to put



1 up overhead 4, please.

2 A. I am putting up at the moment the
3 overhead for Figure 4, Exhibit 444.

4 Q. As I understood your evidence, the
5 model you are using here is the two dimensional model
6 you used on Site D?

7 A. That's right.

8 Q. It really has no relation at all
9 to the parallel plate model you used?

10 A. That's right. It's looking at a
11 different idealization of this system and therefore I
12 am using a different model. One selects the model
13 appropriate to the idealization.

14 Q. I assume through this flow system,
15 again one of the advantages is there is continuity of
16 concentration, continuity of flux, the same advantages
17 you have listed with respect to Site D?

18 A. That is correct.

19 Q. And consequently conservation of
20 mass?

21 A. That is correct.

22 Q. I wonder if you could assist us,
23 we get here a downward Darcy velocity through the
24 weakly fractured shale of 0.0023?

25 A. Yes.



1 Q. And a lateral Darcy velocity
2 through the highly fractured shale of 0.4?

3 A. Right.

4 Q. We understand that you have sort
5 of accounted for a one to one dilution in terms of, so
6 you have accounted for an under-flow, if you will,
7 through that highly fractured shale. That is simply
8 taking it off the better-fit Flonet result?

9 A. That's right.

10 Q. So of the Darcy velocity of 0.4
11 metres per annum in the highly fractured shale, 0.2 of
12 that should be due to the landfill?

13 A. Approximately, yes.

14 Q. So if we calculate it out, the 0.4
15 times -- 0.2 then times the 5 metre thickness should be
16 roughly equal to the 0.0023×300 ?

17 A. Sorry, could you say that again.

18 Q. The 0.2 metres per annum which is
19 half of the flux through the highly fractured unit,
20 that times the thickness of the highly fractured unit
21 should approximately equal the Darcy velocity through
22 the weakly fractured unit that is 0.0023 times the 300
23 metres where recharge can occur?

24 A. The recharge that is coming in
25 here from this portion of the landfill is 0.0023 , which



1 is a number that Mr. Sobanski quoted in his evidence.
2 300 metres is approximately scaled off Exhibit H-221
3 and the product of those two numbers is approximately
4 the contribution coming down in to this zone here.
5 That is, except for my scaling off Trow's diagram, that
6 is not my interpretation, that is their evidence.

7 Q. And then so if you can just accept
8 this for the moment, that the product of 0.2×5 is
9 obviously one, but the product of 300×0.0023 is
10 something like 0.69. Do you ascribe any significance
11 to that?

12 A. Well, that is just indicating
13 perhaps -- can I just go back a step. Are you asking
14 whether 0.69 is different to the approximately one?

15 Q. It's obviously different. I am
16 asking you whether, I know you are using Trow's data
17 and I know you scaled it off. Is that what accounts
18 for the difference? If continuity of flux applies,
19 they should be the same, but you are using somebody
20 else's data, is it as simple as that?

21 A. Yes, it is. I would like to
22 explain that if I could, please.

23 This, Mr. Chairman, is overhead 3, which
24 is essentially a photocopy of Exhibit H-221. What we
25 have here is a zone where Trow have flow coming down



1 from the landfill and moving along the highly fractured
2 unit. There is a contribution from off site. If one
3 scales off this distance here, it is approximately 300
4 metres, but it is very difficult to scale accurately.
5 For one thing, this scale is distorted, due to
6 photocopy. It is approximately 300 metres. This
7 distance up here, I can see it is of similar magnitude.
8 So, one can argue that if about two cubic metres per
9 year per annum is coming out here, as Mr. Sobanski
10 suggested in his evidence, and approximately one, and I
11 emphasize the word approximately, one metre per annum
12 is coming down here and one metre per annum is coming
13 down here. Mr. Sobanski also in his evidence, when
14 somebody asked him and I can't recall who now,
15 indicated that the actual down recharge at the zone was
16 about 2.3 millimetres per annum. If you multiply that
17 number by 300, you get the number you came up with,
18 which is 0.69. That means in fact that if you use
19 those numbers, accepting the fact this is a rough
20 scale, where I presume Mr. Sobanski's number came from
21 his computer output, if you use that rough approach,
22 then there is more dilution than I suggested.

23 Q. I just wanted to make sure that we
24 understood it.

25 A. Those are not my numbers.



1 Q. We talked several times about the
2 impact of GL-24 and somewhere in Exhibit M-444 it
3 states, where if you impose this model on the
4 Burlington landfill site, you wouldn't expect an impact
5 at GL-24?

6 A. That is correct.

7 Q. Were you able to calculate when
8 you would expect an impact, I don't care about the
9 exact year. Are we talking in the range of next year
10 or in the next century?

11 A. Well, it is somewhere in between.
12 It is closer to the next century. I can't remember
13 the precise number. I will see if I have got the
14 number.

15 Q. I don't think it matters, I was
16 simply wondering about the scale of the thing, what are
17 we talking about?

18 A. When you were asking me to, I
19 assumed you were asking me about a point in the highly
20 fractured zone?

21 Q. Yes.

22 A. It takes a long time before it
23 gets there.

24 Q. We are assuming it would be the
25 highly fractured zone you'd be measuring in because



1 other than that it and the peak is moving vertically
2 beneath the landfill site?

3 A. That's right.

4 Q. Am I right you only ran this model
5 for chlorides?

6 A. You are correct, that is what I
7 did.

8 Q. And the result for, what would be
9 the result for benzene?

10 A. The result for benzene would be
11 substantially more attenuation, a much lower
12 concentration.

13 Q. Is that because of attenuation
14 through the massive shale?

15 A. Mr. Chairman, the reason benzene
16 would be attenuated, it would be partitioning onto the
17 organic matter in the shale. I think Mr. Beechinor
18 spoke to the concept of partitioning in his evidence,
19 as I recall, either he or Mr. Sobanski.

20 Q. I wanted to try and put this is
21 some kind of perspective with respect to what the Board
22 has before them from Mr. Beechinor. It occurred to
23 me, Dr. Rowe, that what Mr. Feenstra has done in his,
24 what Trow has done is it has run the flow nets model,
25 which is essentially a hydraulic model, it tells you



1 about the hydraulics of the system and doesn't tell
2 them anything about contaminant movement; right?

3 A. That is correct.

4 Q. Mr. Feenstra comes along and he
5 does a contaminant transport model, I forget the model
6 he used now, but it doesn't matter, it was the Ogata-
7 Banks model, which is something quite different, but he
8 is using the same kind, he is using the flow picture
9 that Trow painted for him; right?

10 A. Yes indeed, I think that is a
11 rational approach.

12 Q. Just in sequence then, what Trow
13 has done is, they have come along and run this
14 hydraulic model again and come up with the better-fit
15 model, what they call the better-fit model, which you
16 agree is a better fit to the known data?

17 A. Right.

18 Q. What you are really doing here is
19 filling in the last piece; is it appropriate to put it
20 that way? You have simply now run a contaminant
21 transport model onto the hydraulics of that?

22 A. Yes, indeed I think that is
23 exactly what I was trying to do, because the better-fit
24 model during the testing of Trow, and obviously they
25 didn't have time to go and re-run a contaminant



1 migration model and I thought that piece of the picture
2 needed to be completed, so I did that.

3 Q. Thank you, Dr. Rowe.

4 Now, having before you, if we can put
5 aside scenario B for the moment, having a choice, and
6 as a professional who does these things all the time,
7 which of the two pictures, if you will, which of the
8 two models, scenario A or scenario C do you prefer?

9 I know you have told us scenario A is
10 more conservative. Which of them do you think is more
11 reasonable, what can the Board take from all of this?

12 A. I think I would like to answer
13 from the perspective of potential impact. From the
14 perspective of potential impact what I would prefer is
15 Trow's to be correct because there is going to be
16 lesser impact, but from an engineering perspective,
17 whichever of the two is correct, the impact on ground
18 water quality south of 403 would be minimal.

19 Q. So is your answer to what you
20 would prefer is it doesn't really matter, because the
21 result is the same?

22 A. That is correct. If you ask me
23 which I prefer---

24 Q. I don't mean prefer from the point
25 of view of what results you get that you like better, I



1 mean from the point of view of looking at all of it and
2 looking at the reasonableness of the picture, the
3 reasonableness of the interpretation, trying, in terms
4 of trying to model what is going on at Site F, which of
5 them seems more reasonable to you?

6 A. You are perhaps asking me a
7 question that is going a little too far into
8 hydrogeology for me to answer. From a geotechnical
9 perspective, I think both Trow and Dr. Charlesworth
10 made a serious attempt to understand what the system
11 is. I have taken their independent interpretations of
12 the system and I have looked at what the potential
13 impact is and my conclusion is that in either case, the
14 impact is minimal.

15 Q. Thank you for that answer, Dr.
16 Rowe. I wonder if I could ask Dr. Charlesworth the
17 same question. Dr. Charlesworth, as a hydrogeologist
18 looking at the whole picture the two models paint,
19 which do you think is more reasonable?

20 DR. CHARLESWORTH: A. I have a problem
21 with some aspects of Trow's model, as I indicated. I
22 have problems with the details which may or may not be
23 correct in terms of the classification of the system.
24 I don't see the evidence for the discharge zone which
25 is part of the model. If we took a scenario of their



1 kind of flow system without a discharge in that zone, I
2 don't see any reason why he should not, you could not
3 model the similar layers they have, but not
4 discharging, but continuing down as my sketch I drew
5 this morning.

6 I would say that, I have difficulty in
7 saying which is best. I think ours is reasonable
8 because it is in a way conservative. It suggests that
9 the flow, we are looking at a sort of worst-case where
10 the flow is in the shallow zone where I think there is
11 a component downwards. It may well be that the reality
12 is somewhere between the two.

13 Q. Thank you, Dr. Charlesworth. I
14 just have one question for Dr. Rowe and then I think
15 the remainder would be for you, Dr. Charlesworth, and
16 you may want to comment on this question as well.

17 Dr. Rowe, given your modelling exercise,
18 and I am coming rapidly to a conclusion here. Given
19 your modelling exercise and your predictions of impact
20 for Site F, I am wondering what suggestions you
21 would have for the design of this landfill,
22 specifically the leachate collection system, given that
23 and I know we talked very generically yesterday about
24 things that should happen with a leachate collection
25 system. Do you have any suggestions that ought to be



1 incorporated into the final design of Site F?

2 DR. ROWE: A. The design as I
3 understand it, is illustrated on Exhibit H-42-B5(r). I
4 think yesterday or the day before, I suggested they
5 should make sure they can clean all the collection
6 tiles. As it is shown on that drawing, it is not
7 evident to me that they can. Obviously, also there is
8 not a great deal of detail here but they are going to
9 have to pay particular attention to the collection down
10 to the south of the site. Everybody seems to agree
11 that there is going to be a significant flow down in
12 that direction. It is not a major difficulty to
13 engineer that, but obviously it has to be done here.

14 Q. Just while we are on that point,
15 can we agree, Dr. Rowe, that one of the problems with
16 locating a site on the side of a hill like this is
17 having to pay particular attention to the front end of
18 the site, and without attention there is the
19 possibility of leachate break-outs and consequent
20 surface water contamination?

21 A. Could you begin again?

22 Q. I am just questioning because
23 basically the site is on the side of a hill, a long
24 sloping hill. You note some concerns about the front
25 of the leachate collection system and I am simply



1 asking, is the problem there that one could get
2 leachate break-outs towards the toe of the landfill
3 with consequent surface water contamination?

4 A. There is the potential for break-
5 outs and certainly one needs to consider that in the
6 design. It was my understanding that Trow were going
7 to address that. It is not a difficult thing to
8 address.

9 Q. Anything else with respect to a
10 leachate collection system?

11 A. The general comments I made about
12 cleaning leachate collection systems, the desirability
13 of it, maintenance, apply equally well at both sites.

14 Q. Now, Dr. Rowe, on the question of
15 design there was something that occurred to me in
16 looking at this and looking at the results of the model
17 and looking at the weight you put on the fact we are
18 seeing no impacts from the front half of the Burlington
19 site, even though there is no leachate collection
20 system. I am wondering, Dr. Rowe, if a natural
21 implication of your modelling exercise is that you
22 don't need underdrains here at all?

23 A. That may well be true, although I
24 am not suggesting one should design it.

25 Q. So, how do we get from the first



1 half of that answer to the second half? If it may well
2 be true, why would you bother to do it with all the
3 additional problems of having to clean it?

4 A. Well, one's intention would be to
5 try to reduce the number of break-outs referred to
6 earlier, and by collecting the leachate through a
7 leachate collection system, it is my view that you
8 would be reducing the potential for the break-outs.

9 Also, one would like to reduce the
10 likelihood of mounding within the waste, just as you
11 would like to at Site D. It is not as critical at
12 this site because you have got quite a steep gradient
13 on this site. Even steeper when you look at the
14 contours of the landfill, they are even steeper than
15 the slope of the tiles. So there is quite a steep
16 gradient which is going to mitigate the effects of
17 mounding, but nevertheless, I think one should try and
18 engineer the system. I don't think that engineering
19 is essential, but I should qualify that. I don't
20 think the underdrain system is essential to the
21 performance of this, but I think it is highly desirable
22 and I would not recommend that it be built without it.

23 Q. Because it is not as critical at
24 this site, you haven't bothered to go through a
25 calculation of how long the underdrains would have to



1 operate, or do we use the same figures? For Site D, I
2 can't remember the overhead, but the overhead that told
3 us that under various cases you need the underdrains to
4 last anywhere from 55 to 80 plus years.

5 A. The answer to that question really
6 goes back to the first question you asked me, as to
7 whether you need them at all. The answer is, based on
8 the information available, the system would perform
9 reasonably well without them, but I am not recommending
10 that they do that.

11 Q. Thank you, Dr. Rowe.

12 Dr. Charlesworth, just two or three more
13 questions.

14 Again, given the results of the impact
15 assessment done by Dr. Rowe, I am wondering what
16 suggestions you would have with respect to the
17 monitoring, the monitoring system for this landfill
18 site?

19 DR. CHARLESWORTH: A. I would suggest
20 certainly a series of monitoring holes south of the
21 landfill, north of the 403 that would run across the
22 line of the flow path as we see it.

23 Q. In terms of, again I take it you
24 were here for Mr. Sobanski's description of that and
25 you reviewed Mr. Feenstra's suggestions with regard to



1 monitoring?

2 A. Yes, I did.

3 Q. Do you have anything, both of
4 them, just to remind everyone, both of them suggested a
5 system of monitors in the area between 403 and the
6 site. Do you make any specific suggestions or
7 additions?

8 A. I am in general agreement. I
9 would take care to monitor, to design the hole so that
10 you monitored all the zones in the profile, so that you
11 avoided questions of whether you are actually
12 intercepting.

13 DR. KINGHAM: To what depths would you
14 put those monitoring wells ?

15 DR. CHARLESWORTH: That's an interesting
16 question. I would go to, I feel that you certainly
17 have to go as deep as, as deep as their existing holes.
18 I would be inclined to go deeper, just to answer the
19 questions. There is a point at which flow, you can be
20 certain that flow is going to move laterally. I would
21 go, in terms of actual numbers, I haven't considered
22 the actual number, but I would certainly go deeper than
23 the current holes, just to set everybody's mind at
24 rest.

25 MR. TIDBALL: Q. Just to make sure I



1 have those points, Dr. Charlesworth. You are simply
2 suggesting two things with regard to the monitoring
3 program: one, that the holes that are drilled go
4 deeper than the existing holes and two, that they
5 concentrate, I think as Mr. Feenstra went through, they
6 concentrate on the fractured zones.

7 DR. CHARLESWORTH: A. I think you
8 should monitor the whole profile, but pay attention to
9 the fractured zones. My reason for going deeper is
10 that if you detect, I don't believe it is significant,
11 but it will set people's minds at rest if we do find
12 something.

13 MR. TIDBALL: Q. Dr. Rowe, I notice you
14 are standing, do you have something to add to that?

15 DR. ROWE: A. I just want to supplement
16 that in his evidence the other day, Dr. Charlesworth, I
17 think, pointed out that it was the intention to
18 establish the top of the site before the bottom of the
19 site. I think his implication was that one should
20 monitor that as well.

21 Q. Do you agree with that, Dr.
22 Charlesworth?

23 DR. CHARLESWORTH: A. I think it would
24 be prudent to establish some monitoring at the first
25 cell.



1 Q. Dr. Charlesworth, briefly one
2 other area. The question of contingencies. Trow has
3 deal with the question of a contingency plan, their
4 contingency plans are predicated on the fact that there
5 is a zone of highly fractured shale beneath the site,
6 and that they can simply put purge wells in there and
7 pump that. I am wondering what contingency plans you
8 would envision for the site, given the kind of model,
9 given the kind of hydrostratigraphy that you
10 postulated?

11 A. It is my opinion that contingency
12 plans will not be required here because of the poor
13 nature of the ground water and the fact that it moves,
14 will likely move to depth and not appear at the
15 surface. I would concur with the system of Trow,
16 however one interprets the data for the pump test, they
17 did show you can induce a cone of influence around the
18 well that they pumped. The most effective test was to
19 one side of the site. I would suggest that
20 contingency wells could be considered in the unlikely
21 event, in my opinion, that they were required.

22 Q. I take it you would envision the
23 use of those kinds of wells in whatever fracture zones
24 you could find?

25 A. Yes, I would envisage them, I



1 wouldn't envisage ever having to use them, Mr.
2 Chairman, but if you had to use them, then you would
3 be, you would want to demonstrate that they could
4 create a cone of influence within various....

5 Q. You would agree with me,
6 Dr.Charlesworth, that it is prudent in this landfill
7 site, as it is in any landfill site, to plan for the
8 event that you have been wrong, that the predictions
9 have been wrong and in fact something else is
10 happening?

11 A. I think it is prudent, but it is
12 less critical in this.

13 Q. Finally, the last question Dr.
14 Charlesworth, you gave some evidence, and I don't
15 recall the reference in your witness statement to it,
16 but your position, as I understand it was, that with
17 respect to the Reasonable Use Concept, which is Exhibit
18 E-214, I believe, it was your position that the
19 reasonable use of the ground water in the shale south
20 of Site F was for leachate attenuation or for
21 contaminant disposal, I forget the term you used?

22 A. You have rephrased it, but in
23 essence the only reasonable use that I can envisage for
24 the ground water in the shale here.

25 Q. Could you go to paragraph 68 of



1 Exhibit 444? I read paragraph A to say that the most
2 reasonable use of the groundwater regime downgradient
3 at Site F and its environs is for waste disposal; the
4 poor quality ground water of this area is a good
5 resource for the disposal of waste. You then go on to
6 compare it to Site D, and I am not concerned with that
7 right now. Can I assume, Dr. Charlesworth, that when
8 you made that statement you were talking only about the
9 ground water in the shale?

10 A. That is correct.

11 Q. Would you agree, as I think Mr.
12 Feenstra did -- I don't want to put that on him. Would
13 you agree with me that there is a reasonable use for
14 the ground water in what has been called the rind in
15 the lacustrine deposits south of 403 and there may be a
16 reasonable use in terms of domestic use, although that
17 is somewhat limited?

18 A. I think that may be a reasonable
19 use. Given the nature of that environment, the
20 urbanization that has taken place there, I think it is
21 susceptible to pollution from other sources than the
22 landfill.

23 Q. I don't disagree, no disagreement
24 there, Dr. Charlesworth, I simply want to make sure I
25 understand what you are saying there. Your statement



1 here does not refer to the so-called rind, it is
2 referring to the shale?

3 A. It is referring to the shale, that
4 is correct.

5 Q. We can agree, can we not, that
6 there is some potential for use in that rind of ground
7 water in the Aldershot community and we can have long
8 discussions about how much of that can be used?

9 A. There is some limited potential.

10 MR. TIDBALL: Thank you, Dr.
11 Charlesworth. Thank you, Dr. Rowe, those are my
12 questions.

13 MR. LANCASTER: Thank you, Mr. Tidball.
14 Ms. Cronk, are you prepared?

15 MS. CRONK: Thank you, Mr. Chairman.

16 CROSS-EXAMINATION BY MS. CRONK:

17 MS. CRONK: If I have to hold this for
18 the next three hours, I am going to have to ask for an
19 adjournment.

20 Q. Dr. Charlesworth, if I could
21 perhaps direct my initial questions to you. They
22 will, Mr. Chairman, Dr. Kingham, initially concern Site
23 F and the evidence of these witnesses with respect to
24 Site F.

25 Dr. Charlesworth, I would like to review



1 with your very briefly so that I have a clear
2 understanding, and hopefully, in order that the Board
3 might have a clear understanding of the preparatory
4 work that you did with respect to Site F in order to
5 formulate the opinions that you have expressed to the
6 Board.

7 I ask you to turn to page 1-1 of your
8 Site F report.

9 That, for the record, is Exhibit M-437.
10 At page 1-1, Dr. Charlesworth, you indicate that you
11 were retained by the Town of Milton to review the work
12 carried out by Trow on behalf of the Region and that
13 you reviewed various reports that had been prepared by
14 Trow?

15 DR. CHARLESWORTH: A. That is correct.

16 Q. Sir, I am conscious of this to my
17 left. If there is any difficulty hearing, please let
18 me know and I will just carry on and ignore it.

19 So that the first category of report, if
20 I can put it that way, were those prepared by Trow and
21 at various stages of the Region's environmental
22 assessment study?

23 A. That is correct.

24 Q. We know from your detailed
25 evidence that you reviewed the two technical reports



1 that Trow had prepared, one each with respect to each
2 of the sites, together with the appendices to those
3 technical reports?

4 A. Yes, I did.

5 Q. Did you, Dr. Charlesworth, since
6 it's not clear to me from your report, review the
7 earlier reports, both in draft and final form that had
8 been prepared by Trow? I have in mind, for example,
9 the final technical report on hydrogeology and
10 hydrology issues. Did you review that?

11 A. Yes. I am not sure about the
12 draft and final, but certainly in final form.

13 Q. What about the comparative
14 analysis report that was prepared by Walker, Wright,
15 Young & Associates? That includes an appendix, my
16 recollection is Appendix A, which essentially is the
17 comparative analysis prepared by Trow, the final
18 document on the two sites from a hydrogeological point
19 of view, did you review that?

20 A. Yes, I reviewed that.

21 Q. Then you also indicate at page 1-1
22 that you reviewed a number, your phrasing was,
23 "numerous documents prepared by other consultants and
24 research workers." At page 8-1, if I could ask you to
25 go there, there is a list of some fourteen references



1 to various reports and documents, the first of which
2 pertains to reports authored by Trow, but the remaining
3 twelve do not. Do they represent the reports and
4 documents by other consultants that you have reviewed?

5 A. No, those are the ones that I have
6 referenced in my report.

7 There are a number of other documents,
8 almost too numerous to mention, probably twice as many
9 as that list which include, along with letters, short
10 reports; a variety of reports.

11 Q. During the course of Mr.
12 Sobanski's evidence, Dr. Charlesworth, there was an
13 exhibit marked, an Exhibit N-187, Mr. Chairman, which
14 was in summary form a list of certain reports and
15 documents that had been prepared over the years by
16 various consultants with respect to the Burlington
17 landfill site, the Bayview site and as well Site F.
18 I will give you a copy of that, Dr. Charlesworth,
19 Exhibit N-187.

20 Dr. Charlesworth, the very first, the
21 first section of the exhibit pertains to reports
22 dealing with the Burlington landfill site and the first
23 item is, item No. 1 is a report dated September 26th,
24 1979 by Gartner, Lee Associates Limited concerning the
25 proposed Burlington landfill site expansion. As I read



1 your list of references in your report, that is one of
2 the reports that you reviewed and is listed as item 5,
3 is that correct?

4 A. Yes, that is correct.

5 Q. Then item 3 on Exhibit 187 refers
6 to a number of the monitoring reports prepared by the
7 Gartner, Lee firm with respect to the Burlington
8 landfill over the period 1981 to 1987. I see a number
9 of those referred to on your list of references. I
10 draw your attention to item No. 6 on your list, that is
11 one of those monitoring reports, is it not?

12 A. That is correct.

13 Q. Item 7 does not appear to be, I
14 will come back to that, but Item 8 on your list appears
15 to be the 1984 monitoring report prepared by Gartner,
16 Lee?

17 A. That is correct.

18 Q. Item 9 is the 1985 monitoring
19 report?

20 A. Yes, that is correct.

21 Q. Did you review any other of the
22 Gartner, Lee monitoring reports that you now recall,
23 apart from those three that you have specifically
24 referenced?

25 A. Yes. My recollection is that I



1 reviewed each of the annual reports that they have
2 published. Two or three more than I have actually
3 referenced.

4 Q. If I could take your attention to
5 item 7, that is the Gartner, Lee Associates report
6 prepared in 1984 concerning the Burlington landfill
7 site continued use and that was prepared for M.M.
8 Dillon Limited and that was referred to on Exhibit 187
9 as item No. 4?

10 A. That is correct.

11 Q. Then item No. 6 on Exhibit N-187
12 is the plume delineation report. We know that you
13 reviewed that?

14 A. That is correct.

15 Q. The other two items in Section A
16 of Exhibit 187 relate to oral evidence that was heard
17 at public hearings in June, 1980, that is item No. 2
18 and to evidence heard in June, 1984 again at public
19 hearings and various reports that witnesses at those
20 hearings prepared. May I ask you first, did you
21 review any of the transcripts of the evidence from
22 either of the hearings referred to in those two items?

23 A. Yes, I reviewed extracts from the
24 transcripts and some of the summary reports. I forget
25 at this moment the exact details of which ones, but



1 certainly part of that.

2 Q. Then, dealing with the reports set
3 out on Exhibit N-187 with respect to the Bayview Park
4 landfill site, the first and second items on Exhibit
5 187 refer to reports prepared by Morrison Beatty
6 Limited, the phase 1 or what they call the phase 1 and
7 phase 2 studies and item No. 4 on page 2 refers to
8 their phase 3 study. I note that your list of
9 references refers at pages, at items 2 and 3 to the
10 phase 2 and phase 3 Morrison Beatty studies. Did you
11 review those?

12 A. I reviewed all three of the
13 reports. The phase 1 was superseded by the phase 2.

14 Q. Then item No. 3 on page 2 of
15 Exhibit 187 is a report by Dr. Cherry, and as I
16 understand it, by Mr. Lush, authored in October 1980
17 concerning the hydrological suitability of the National
18 Sewer Pipe Limited site and obviously part of Site F as
19 now proposed by the Region and that is referred to as
20 item 13 in your list of references; is that correct?

21 A. That is correct.

22 Q. Item 4 we have dealt with. Item
23 5 is a report on Exhibit N-187, prepared by Gartner,
24 Lee Associates, entitled Bayview Park Landfill Site
25 Leachate Discharge Investigation, Phase 1. On my



1 review of your list of references, that was not
2 mentioned. First am I right, and secondly, if I am, did
3 you in fact review that report?

4 A. Yes, you are correct, it is not on
5 my list and yes, I did review that report.

6 Q. Item No. 6 on Exhibit 187 is a
7 report authored in September, 1982 by Acres Consulting
8 Services Limited entitled Solid Waste Management
9 Strategy Study, Final Report. That as well, as I read
10 it, is not references in your list of references. Did
11 you review that report?

12 A. Yes, I did.

13 Q. That, as I understand it, was a
14 report commissioned by the City of Burlington at the
15 time?

16 A. Yes, it was.

17 Q. Item No. 7 on Exhibit 187 refers
18 to a report prepared in September, 1984 by Conestoga-
19 Rovers and Associates Limited, and a firm called Eco-
20 plans Limited, relating to the landfill capacity and
21 feasibility of the NSP Property. Again, I don't see
22 that referenced in your list of references, and I was
23 curious as to whether you have read that document?

24 A. I have read that document.

25 Q. Item No. 8 on Exhibit 187 is Ms.



1 Hewetson's master's thesis to which both you and Dr.
2 Rowe have made reference. I take it you have read
3 that?

4 A. I have, yes.

5 Q. I think in fact that is item No. 4
6 on your list of references?

7 A. Yes.

8 Q. Then item 9 on Exhibit 187 refers
9 to monitoring reports by Conestoga-Rovers & Associates
10 Limited with respect to Bayview Park. They date from
11 1986. Item No. 12 on your list of references is a
12 reference to their updated 1986 monitoring report. I
13 take it you read that?

14 A. Yes, I did.

15 Q. Have you read any other documents
16 authored or issuing from that firm with respect to the
17 monitoring program that they are conducting at Bayview?

18 A. My recollection is yes there are
19 additional documents other than the ones that are
20 listed there. I have some difficulty remembering the
21 exact references for them at this point.

22 Q. Perhaps I will come back to that.
23 Item No. 10 finally on Exhibit 187 is a reference to
24 various reports prepared by Trow concerning Site F?

25 A. Yes.



1 Q. Do I have it then correctly, Dr.
2 Charlesworth, that you have reviewed, as part of your
3 preparatory work, to form your opinions on Site F, all
4 of the reports referred to on Exhibit N-187 and
5 portions of the transcripts of evidence given at the
6 public hearings referred to in items 2 and 5 under
7 Section A?

8 A. That would be correct.

9 Q. Did you, or perhaps I should
10 simply ask you this, did you prepare or do you have
11 available to you a list of the documents that you in
12 fact did review, and if not, could you obtain one for
13 me?

14 A. I could obtain one for you, yes.

15 Q. Then I notice, as well, that in
16 your list of references, item No. 14 is a report, a
17 report by Keros Cartwright prepared in 1982 entitled
18 Evaluation of the National Sewer Pipe Limited
19 Burlington Landfill. I take it you also reviewed that
20 report and I believe there is a quote from that report
21 in your report on Site F?

22 A. Yes, I reviewed that report.

23 Q. Mr. Cartwright, as I understand
24 it, is a hydrogeologist from the State of Illinois, who
25 was retained to review NSP's proposal for a private



1 landfill site; is that your interpretation?

2 A. That is my interpretation. I
3 believe at the time he was the head of the State
4 hydrogeology or ground water division for the State of
5 Illinois.

6 Q. I have drawn your attention, Dr.
7 Charlesworth, to the three Morrison Beatty reports, two
8 of which you referenced in your list of references,
9 they date from 1979 to 1981. Did you, as part of your
10 review of Site F, also review a document prepared by
11 Morrison & Beatty Limited in 1985 concerning certain of
12 the reports that had been prepared during the Region's
13 environmental assessment study?

14 A. Yes, I did, I had forgotten about
15 it, but I did.

16 Q. Now, apart from the reports listed
17 in your list of references, those additional ones that
18 you have mentioned, you are going to provide me a list
19 that will set out, to the extent that you are now able
20 to reconstruct it, all the reports and documents you
21 reviewed relative to Site F?

22 A. Yes, I will do that.

23 Q. You told the Board that you were
24 present for part of the evidence of Mr. Sobanski, is
25 that correct?



1 A. That is correct.

2 Q. I understood you to say in your
3 discussion with Mr. Tidball, that you were not present
4 for Mr. Feenstra's evidence, but you had reviewed the
5 transcripts of his evidence before this Board?

6 A. That is correct.

7 Q. Did you as well review the
8 transcripts of the evidence of Mr. Sobanski for the
9 portions of time that you were not present?

10 A. Yes, I did.

11 Q. Did you as well review the
12 evidence of Mr. Hiraishi or not?

13 A. Only selected portions of it.

14 Q. Did you review the witness
15 statements prepared by those witnesses?

16 A. Yes, I did.

17 Q. You also refer at page 1-1 of your
18 report, Dr. Charlesworth, to certain original or field
19 work that had been undertaken by your firm with respect
20 to Site F? I am referring to the second paragraph on
21 page 1-1. As I understand it, you monitored water
22 levels in a number of wells at Site F. I understood
23 you to tell Mr. Estrin that was from August to October
24 of 1987; is that correct?

25 A. That is correct.



1 Q. Was that the installation of mini-
2 piezometers that you were referring to?

3 A. No, we monitored the levels in the
4 existing boreholes at the site; predominantly Trow and
5 also Waterloo boreholes.

6 Q. What then was involved in the
7 installation of mini piezometers?

8 A. We installed those, those were, as
9 I explained in my evidence-in-chief, these were
10 shallow, hand-driven piezometers that we installed in
11 April of last year in order to try and get some handle
12 on the likelihood of the existence of discharge zones.

13 Q. That were installed April of 1987?

14 A. Yes, that is correct.

15 Q. There is a series of hydrographs
16 that you had reference to in your evidence in Appendix
17 A of your report. Were they prepared as a result of
18 the monitoring of the water levels in the boreholes
19 that you undertook?

20 A. The hydrographs, yes, in Appendix
21 A of the report.

22 Q. How many series of piezometers did
23 you install?

24 A. I am sorry, the hydrographs in
25 Appendix A are the existing holes that we monitored.



1 We do not have hydrographs for our mini piezometers. We
2 took spot measurements on, right after installation and
3 on three other occasions for the mini piezometers.

4 There were five locations for mini piezometers.

5 Q. I am sorry, five you said?

6 A. Five locations.

7 Q. Would you just refresh my memory
8 as to where those were, Dr. Charlesworth, briefly?

9 A. I am looking at Exhibit M-437-D1.
10 Our first mini piezometer was piezometer A, situated
11 maybe one-quarter of the way up the centre of the
12 proposed landfill site. Piezometer B is just north of
13 the north service road in the extreme south of Bayview
14 Park. Piezometer D is in, at the edge of the wetland
15 area, south of 403, sorry, C is and also piezometer D
16 is in that same general area, and piezometer E is in
17 the stream bed of the stream that drains through that
18 wetland area.

19 Q. I am sorry, that wetland area?

20 A. The wetland area south of the 403,
21 which has been the subject of discussion with regard to
22 its functioning as a discharge zone or not.

23 Q. Is that the drilling program that
24 you referred to in your evidence in-chief with Mr.
25 Estrin, a limited drilling program, I thought you



1 mentioned something about that?

2 A. No, no. If I referred, the only
3 context in which we referred to drilling was a shale
4 sample was collected for Dr. Rowe using a drilling rig
5 for him to do his laboratory tests on.

6 That was not really part of our
7 investigation.

8 Q. When was that shale sample
9 obtained?

10 A. I think March or --

11 Q. Do you have a record you could
12 check?

13 A. I think Dr. Rowe is going to check
14 the date. It was the early part of the year.

15 Q. Of which year? Last year?

16 A. Of 1987.

17 Q. Perhaps over the luncheon break?

18 A. I don't remember the exact date,
19 but I think probably March or April.

20 Q. Rather than have you guess....

21 DR. ROWE: A. We commenced the tests on
22 May 26th, so the samples would be taken a few days
23 before that.

24 Q. May 26th, '87 and from what
25 location on the site was that sample taken?



1 DR. CHARLESWORTH: A. The location I am
2 now pointing to, which could be described as being a
3 short distance, maybe one-third of the way up the site
4 west of our mini piezometer installation A.

5 Q. I am sorry, north of your
6 piezometer A?

7 A. No, west.

8 Q. Is that marked on Exhibit M-437-
9 D1?

10 A. No, it is not. Would you like me
11 to mark it?

12 Q. Yes.

13 MR. ESTRIN: How have you marked it?

14 DR. CHARLESWORTH: With a red dot. I
15 will add it to the legend.

16 MS CRONK: Q. Perhaps you could
17 indicate drilling location?

18 DR. KINGHAM: Drilling location for
19 shale sample.

20 MS. CRONK: Q. How deep did you drill
21 in taking that sample, did you take a full core?

22 A. I was there just for the locating
23 of the rig I should add. I was not on site for the
24 actual collection of that sample. The core was
25 actually from 9 to 11 metres.



1 DR. ROWE: A. Specifically it was 9.3 to
2 approximately 11.9.

3 Q. That was the core sample that was
4 then provided to Dr. Rowe for testing in his
5 laboratory?

6 DR. CHARLESWORTH: A. That is right.
7 Dr. Rowe had a research assistant, a graduate student
8 on site for the actual collection of the sample.

9 Q. Apart from the monitoring of the
10 water levels you have outlined, the installation of
11 mini piezometers at these five locations you have
12 described, and I am assuming that those locations A
13 through E are set out on Exhibit M-437-D1?

14 A. That is correct, they are.

15 Q. Thirdly, the drilling exercise to
16 obtain a core sample for Dr. Rowe, did you perform any
17 other on-site drilling or observation tests that you
18 have not yet outlined to the Board at Site F?

19 A. No, other than walking the site
20 and carrying out a general reconnaissance of the area.

21 Q. Dr. Rowe, could I ask you at this
22 point, you have heard the responses Dr. Charlesworth
23 has given me concerning the reports and documents that
24 he reviewed. Is your list different from his or the
25 same?



1 DR. ROWE: A. It is essentially the
2 same. As you were going through it, I don't have a
3 clear recollection of the Gartner, Lee 1982, but apart
4 from that, yes. I may have read it, I just can't
5 recall.

6 Q. Could I ask you to do this, when
7 Dr. Charlesworth makes available the list of various
8 reports and documents he reviewed, could you review
9 that as well and if there are any on the list which you
10 did not review, could you inform me of that and if
11 there are any that you did review that are not on the
12 list could you inform me of that as well?

13 A. Certainly.

14 Q. Now, in terms of actual, apart
15 from the reviews of various documents, apart from the
16 various reports that you reviewed and of course the
17 modelling that you did, can you explain, very briefly,
18 and I am not inviting specifics of the details of the
19 tests Dr. Rowe, what did you do with the core sample
20 that was provided to you by Dr. Charlesworth?

21 A. Yes, Mr. Chairman, what we did
22 with the core sample was we took a portion of that core
23 sample, and as I indicated in my evidence, we
24 determined what the porosity was. We took three
25 portions of it and conducted diffusion tests. We



1 monitored the diffusion of chloride out of the sample
2 into what was initially distilled water and from the
3 result of that test, we deduced the diffusion co-
4 efficient in that shale, in the three samples. I
5 showed results in my evidence, they showed we got very
6 consistent results from the three samples.

7 Q. Apart from those three groupings
8 of tests, did you perform any other tests in a
9 laboratory distinct from your actual monitoring work
10 that was relevant to the conclusions you reached on
11 Site F?

12 A. No the only testing we did in the
13 laboratory was relative to those shale samples.

14 Q. Dr. Charlesworth, you told me a
15 moment ago that you had reviewed a report prepared in
16 1982 by Mr. Cartwright. You have referred to that in
17 your report. I am showing you a report Dr.
18 Charlesworth, entitled Evaluation of the National Sewer
19 Pipe, Burlington Landfill Site on the letterhead of
20 Keros Cartwright, hydrogeologist, dated November, 1982.
21 Is that the report you referred to?

22 DR. CHARLESWORTH: A. Yes it is, Mr.
23 Chairman.

24 MS. CRONK: I would like to have this
25 tendered as the next exhibit.



1 MR. McQUAID: I would like to know
2 whether the author of this is being called? This is an
3 opinion being offered on Site F and we are not able to
4 cross-examine on the document. It is not
5 background.... it is straight opinion, as I understand
6 it, and I am objecting.

7 MS. CRONK: Yes, Mr. Chairman, if I could
8 direct you to page 6-4 of Dr. Charlesworth's Site F
9 report. While indeed that entire section, Mr.
10 Chairman, he refers as part of the summary of the
11 review to various hydrogeological reports that he
12 undertook and he sets out the contents of a number of
13 reports, many of which are before you and he refers
14 obviously to the Trow reports, the Gartner, Lee
15 reports, he refers to work done by Dr. Cherry in 1980
16 and he refers specifically at page 6-4 to this
17 particular report. I take it from what he has just
18 said, prepared by Mr. Cartwright.

19 It is my position, Mr. Chairman, that
20 throughout the entire length of this hearing we have
21 had any number of reports that were read and reviewed
22 by experts who then came to testify before you, marked
23 as exhibits before you, if in fact those reports were
24 used as part of the preparatory work that was done to
25 give evidence. It is not my intention to call Mr.



1 Cartwright, and it is my position I am entitled to mark
2 this report and have it before you, given that Dr.
3 Charlesworth a) read it, b) reviewed it and c) referred
4 to it in his report. What weight you ultimately may
5 choose to attach to it, is a subject for argument at a
6 later date, but in my opinion it is clearly admissible
7 and that is my submission.

8 MR. LANCASTER: I think there is some
9 slight difference, Ms. Cronk, however I do agree with
10 you that it has been referred to before. I think we
11 will hear the opinions of the witnesses here regarding
12 that and give weight to it as we see fit.

13 MS. CRONK: I thank you, Mr. Chairman.
14 I might point out in passing, for example, that the
15 first occasion on which, to my recollection this type
16 of issue arose at this hearing was in the cross-
17 examination by Ms. Vigod of earlier witnesses when she
18 sought to introduce a report entitled Environment
19 Report by Proctor & Redfern Limited with respect to NSP
20 Lands. There was certainly no understanding any
21 representative of that firm would be called by me to
22 give evidence. That report was clearly opinion oriented
23 documentation. I don't ask you to rule on it, but I
24 just for the record point out to you now that that
25 started what I perceived to have been a procedure



1 subsequently adopted. To the extent that any issue
2 may ultimately turn on this report or any other like
3 it, and I thank you for receiving it now. What number
4 should we attach to it?

5 MR. LANCASTER: N-470.

6 --- EXHIBIT NO. N-470: Report of Mr. Cartwright.

7 DR. KINGHAM: I think we appreciate the
8 point you were making. The difficult ground seems to
9 be in all of these, not just this one, in all of them,
10 but where the witness is going to be drawn into
11 somebody else's opinion. I think that is the point,
12 that a number of people have made to us when this has
13 happened before. Obviously these witnesses have used
14 the quotes and you have made reference to them at page
15 6-4 but how far they can get inside the head of
16 somebody else who wrote it is the point we have to
17 watch.

18 MS. CRONK: I recognise that.

19 Q. Dr. Charlesworth, you have
20 referred in your report to portions of this document,
21 prepared by Mr. Cartwright, and I would refer you first
22 to the third paragraph on page 1, in which in the
23 background section of the document, it is indicated:

24 "Based on the hydrogeology of the site,
25 which is summarized below, it is my



1 opinion that the proposed landfill site
2 is suitable for municipal waste."

3 If we go to page 6-4 of your report,
4 that is one of the specific references which you quote
5 from this document; am I correct?

6 DR. CHARLESWORTH: A. That is correct.

7 Q. Then at page 1, following the
8 background section, there is a description of the
9 hydrogeology of the site as perceived by Mr. Cartwright
10 and over at page 2, starting with the first, sorry, the
11 second full paragraph, there is then a description of
12 the ground water flow paths at the site as seen by Mr.
13 Cartwright, starting with the words: "The precise
14 ground water flow paths....". Do you see that?

15 A. I do, yes.

16 Q. What I propose to do, Mr.
17 Chairman, so that it is clear, Dr. Charlesworth, as I
18 understand it, let me back up. Perhaps I should just
19 put this out first. The paragraph reads:

20 "The precise ground water flow paths
21 have not been defined. Each investigator
22 has described the flow paths in slightly
23 different terms. However, there is
24 little significant difference between
25 the descriptions. There are sufficient



1 data to indicate three general flow
2 patterns: 1) Regional groundwater flow
3 system from the highland north of the
4 Niagara Escarpment to Lake Ontario: 2)
5 Intermediate groundwater system in which
6 the direction of flow is similar to that
7 of the regional pattern, but recharge
8 occurs within the shale out-
9 crop region; 3) Local groundwater
10 system consisting of paths a few metres
11 to a few tens of meters in length, the
12 direction of which is governed by local
13 topographic features."

14 If I can stop there for a moment, these
15 are clearly expressions of opinion provided by Mr.
16 Cartwright. I am interested, Dr. Charlesworth, with
17 respect to the extent to which you agree or disagree
18 with the descriptions as set out, based on your
19 knowledge of Site F and the review that you have
20 undertaken. Dealing first with the suggestion that the
21 precise ground water flow paths have not been defined
22 and that each investigator has described the flow paths
23 in slightly different terms, do you agree or disagree
24 with that general statement?

25 A. Yes, and I think that is also



1 applicable today as it was in 1982.

2 Q. Mr. Cartwright then indicates
3 there are sufficient, sorry, he indicates:

4 "However, there is little significant
5 difference between the descriptions."

6 He then goes on to set out his own and
7 that is as indicated, three general flow patterns.

8 First, regional ground water flow system
9 from the high land north of the Niagara Escarpment to
10 Lake Ontario. Dealing with that one first, do you
11 agree or disagree with that categorization as being a
12 component of the flow system as you appreciate it at
13 Site F?

14 A. I would agree with that and that
15 corresponds to the lower arrows on the sketch that I
16 produced this morning.

17 Q. And secondly, he refers to an
18 intermediate ground water system, what he calls an
19 intermediate ground water system in which the
20 directional flow is similar to that of the regional
21 pattern, but recharge occurs within the shale outcrop
22 region and finally to a lower ground water system
23 consisting of paths a few metres to a few tens of
24 metres in length the direction of which is governed by
25 topographic features.



1 Could I stop there and could you put up
2 the diagram that you introduced this morning,
3 Dr.Charlesworth? Mr. Cartwright quite clearly is
4 suggesting in his description that there are, as he
5 perceives it, three elements to the ground water flow
6 pattern at the site. You have discussed your
7 perception with the Board and I wish to know from you,
8 taking into account what he has described, whether you
9 view his description as compatible with your own or
10 different, and if so, in what respect?

11 A. There are differences between the
12 various scenarios described by different workers that
13 have looked at this over the years. I agree with his
14 general description. My terminology has been somewhat
15 different. The modelling sort of superimposed something
16 else on top of it. His regional flow system that he
17 refers to is essentially flow coming down from behind
18 the site up on the escarpment, coming towards the lake.
19 His intermediate flow system would essentially
20 correspond to these arrows, my interpretation anyway.
21 I think there is a gradation between these. There is
22 no clear demarcation. If you have an intermediate
23 flow system which corresponds to my arrows there, I
24 believe, this is where it gets a little, everybody's
25 terminology gets a little different, but he talks about



1 a local flow path a few metres to a few tens of metres
2 in length. I think this is what we are referring to
3 as not really, considering certainly in the modelling
4 Dr. Rowe did, this is a shallow flow that reappears in
5 the creeks. On top of this I have the assumed flow
6 path for modelling purposes. We have this general
7 pattern, but let us look at this "more active" zone
8 that he referred to. That is not the same as his local
9 ground water flow system.

10 Q. When you referred to his
11 description of a regional ground water flow system, you
12 suggested that that was similar to the three blue
13 arrows that you see on Exhibit M-469 at the bottom?

14 A. Yes. That is a fair description.

15 Q. Identify the arrows for me, Dr.
16 Charlesworth. Thank you. You referred to his
17 description of an intermediate ground water system and
18 you then pointed to a series of four blue arrows
19 appearing in the middle of Exhibit M-469?

20 A. Yes. I haven't drawn these
21 arrows with this classification in mind, but I think it
22 fits fairly well to his description. Actually he talks
23 about it recharging within the shale outcrop and
24 following a similar pattern to the lake. So those blue
25 arrows would correspond to his intermediate system in



1 my interpretation.

2 Q. Could I ask you to go back to your
3 Exhibit M-445(r) as it was revised. That is the one,
4 if you recall, sets out an overburden zone and an upper
5 zone.

6 A. It didn't set out an overburden
7 zone.

8 Q. I am sorry, perhaps you could
9 correct me when you have it. That then is Exhibit
10 445(r)?

11 A. That is correct.

12 Q. Is that correct?

13 A. That is correct.

14 Q. It shows, as I look at it, a
15 section which I thought indicated an overburden area?

16 A. Well....

17 Q. O/B.

18 A. The overburden corresponds to the
19 dark shading on this section I put up this morning.

20 Q. You are saying the overburden on
21 Exhibit M-445(r) corresponds to the black shading on
22 Exhibit M-469?

23 A. Yes.

24 Q. Then on Exhibit M-445(r) you have
25 labelled the next zone below surface as the upper zone



1 and how does that correspond to what you have shown on
2 Exhibit M-469?

3 A. That would be what I have
4 indicated in red, an assumed flow path for modelling.

5 Q. If I could ask you to go to page 3
6 of Mr. Cartwright's paper, I am sorry, to be fair
7 perhaps I should have completed paragraph 2 on page 2.
8 I read to you the first two portions. The third reads:

9 "The intermediate groundwater system
10 interactions to some degree with the
11 regional and local groundwater flow
12 systems; the degree of this inter-
13 action is not well defined by the data.
14 The local and intermediate ground water
15 flow needs to be considered in
16 evaluating leachate migration at the
17 proposed site."

18 Dealing first with the suggestion, Dr.
19 Charlesworth, that there is interaction between the two
20 flow systems as Mr. Cartwright has described them and
21 that the degree of interaction is not well defined, is
22 that compatible with your understanding of the flow
23 systems at Site F as you describe them, or are your
24 views different?

25 A. I think that is a fair statement.



1 There are still uncertainties about the details of
2 this.

3 Q. And then the third sentence in
4 that paragraph:

5 "The local and intermediate groundwater
6 flow...."

7 Stopping there, the local and intermediate as you have
8 described the counterparts in your Exhibit M-469, he
9 suggests:

10 "... needs to be considered in
11 evaluating leachate migration at the proposed
12 site."

13 Do you agree with that?

14 A. His local is not shown on here and
15 this is where you get into difficulties of terminology,
16 but I think local flow system is the one that we said,
17 yes, you need to consider it in terms of intercepting
18 it at the toe of the site, but it doesn't move off site
19 and his intermediate, he said needs to be considered
20 and that is what we are looking at when we look at,
21 when we take this assumed flow path. We are essentially
22 covering the upper part of his intermediate system.

23 Q. If you go over to page 3 then, the
24 beginning of the next paragraph, and Mr. Cartwright
25 expresses his view:



1 "The intermediate groundwater flow
2 path,"

3 as he describes it:

4 ".... is the most probable pathway for
5 any leachate that may migrate from the
6 proposed landfill."

7 Do you agree with that or disagree?

8 A. Yes, I would agree with that
9 statement.

10 Q. Are we then, Dr. Charlesworth, to
11 regard your upper zone as, in a sense, fictional if you
12 will, for the purposes of modelling?

13 A. Yes, I think you could. I don't
14 like the word fictional, but it is an assumed zone for
15 the purposes of modelling. It is not a zone where
16 water clearly flows through that zone. As I say, it
17 would more likely correspond to Cartwright's
18 intermediate zone and there would be a component moving
19 downward, but for the purpose of modelling, we assumed
20 that it stays within the upper part of that zone.

21 Q. What I would like to clearly
22 understand, Dr. Charlesworth, from you, based on your
23 review of the site, where do you believe the most
24 predominant pathway for contaminant migration is
25 located at Site F?



1 A. I believe the most prominent
2 pathway...

3 Q. In fact as opposed to theory?

4 A. ...is downwards and towards the
5 lake. There will be a lateral and downward component,
6 so I believe in fact it will tend to follow these blue
7 arrows, but there may be variations within that, within
8 the upper zone because of variations in the gradient of
9 the flow system. That is why I suggested that we
10 actually model the flow in that zone to be conservative
11 from that point of view.

12 Q. Are you saying then, Dr.
13 Charlesworth, with that remark, set aside the possible
14 pathway of the regional system and concentrate on the
15 next level of arrows?

16 A. I think it is conceivable that
17 some slow movement gets down into the regional system,
18 gets into the regional system, then it is my contention
19 it is not a problem.

20 I should say, just to draw the Board's
21 attention to one point, going back to where Dr.
22 Cartwright has said, he is talking about each
23 investigator described the flow path in slightly
24 different terms. There is little significant
25 difference between the descriptions. This is the second



1 paragraph on page 2. That probably does not stand,
2 that statement does not really apply to Trow's model
3 prior to their better-fit model. The concept that they
4 had, because it is my understanding that they rather
5 than having this pattern, they had a downward component
6 and an upward component, sorry, in this zone here.

7 Q. Sorry, which zone?

8 A. At the zone south of the 403.

9 So, they made, I think you could say
10 that would be a significant difference at least in the
11 scale of the site. I am just saying that his
12 description, written in 1982, that there was little
13 significant difference, is probably not valid at this
14 time. I just wanted to suggest a difference.

15 Q. You said that was the
16 case under Trow's model and interpretation before the
17 better-fit model; did I hear that correctly?

18 A. The better-fit model still has
19 that zone, but it is my interpretation that the model
20 shows, in that model the flow goes quite deep and I
21 can't remember the exact depth, and comes out. In
22 their better-fit model it doesn't go as deep and there
23 is less flow coming out. I would say their better-fit
24 model departs less drastically from the kind of
25 scenario that Cartwright is talking about.



1 Q. Could I ask you to go to -- still
2 on page 3 of Mr. Cartwright's document, and I direct
3 your attention to the third full paragraph, which
4 begins:

5 "Some ground water discharges between
6 the CN railroad tracks and the site.
7 Water levels in the piezometers in this
8 region (OW13-79, 16-81, 17-81 and 18-
9 81) indicate both recharge and discharge
10 in this region. Field reconnaissance
11 suggests that groundwater is discharging
12 in several areas. It is likely that
13 the recharge/discharge relationships
14 change with the seasons and climatic
15 factors."

16 Stopping there, Dr. Charlesworth, if we
17 could deal first with Mr. Cartwright's suggestion that
18 some groundwater does in fact discharge between the CN
19 railroad tracks and the site.

20 A. It's my interpretation.

21 Q. Excuse me, I haven't posed my
22 question yet, Dr. Charlesworth. Dealing first with that
23 suggestion he is referring, is he not, to the Morrison
24 Beatty wells which were in existence at the time?

25 A. Yes, he is.



1 Q. We have had your evidence with
2 regard to the discharge zone positted by Trow. The
3 area that Mr. Cartwright is talking about between the
4 CN railroad tracks and the site, I take to be, in
5 essence the same discharge area that Trow has
6 positted; do you agree?

7 A. He is covering a larger zone
8 there. He is covering from OW-18, OW-18 is in the
9 vicinity of Trow's HC-9 and then he is referring back
10 to the site, the NSP site, which I think was further
11 north, slightly further north than Site F. So he is
12 talking about the zone, I believe both north and south
13 of the 403.

14 Q. Is it fair to say that the area he
15 is discussing includes the area positted by Trow as
16 being the discharge zone?

17 A. Possibly. It is not clearly
18 defined, but I think yes, it is possible.

19 Q. I am sorry, Dr. Charlesworth, you
20 told us that, excuse me, you have told us that the area
21 being referred to by Mr. Cartwright is from the CN
22 tracks, further north on the site because the NSP site
23 was further to the north?

24 A. You are right. I stand corrected.
25 I was referring to the borehole locations. Certainly



1 from the CN track to the site includes Trow's discharge
2 zone.

3 Q. As I understood what you told me
4 it is a larger area?

5 A. Yes.

6 Q. Then dealing with the piezometers
7 that he refers to, he suggests that field
8 reconnaissance suggests ground water is discharging in
9 several areas. It is likely that recharge/discharge
10 relationships change with the seasons and climatic
11 factors. First of all, can we agree with respect to
12 the three wells that he mentioned, four wells that he
13 mentioned OW-13, 16, 17 and 18, they are in fact
14 located between the CN tracks and the area proposed by
15 the Region for landfilling?

16 A. No, 13 and 17 are north of Highway
17 403. I suppose, yes, 13 and 17 are to the east of the
18 actual area proposed for landfilling and just south of
19 it.

20 Q. The other two? Sixteen and 18?

21 A. Eighteen is south of the 403, I'm
22 sorry, what was the other one?

23 Q. Eighteen?

24 A. I am having trouble locating it.

25 I believe it is north of the 403. I am having trouble



1 locating it on this map.

2 Q. Perhaps I could invite you to do
3 this. Over the lunch break, Dr. Charlesworth, would
4 you examine, would you examine over the lunch break for
5 me drawing No. 2, to Exhibit H-40, the Trow report
6 which sets out the location of various wells and be in
7 a position to confirm for the Board, if you could
8 please, the exact location of those four wells?

9 A. I will do that.

10 Q. In relation to the 403 and the CN
11 tracks?

12 MS. CRONK: Sir, I am conscious of the
13 time. I am prepared to continue. This would be
14 convenient.

15 MR. LANCASTER: Two o'clock. That will
16 give Dr. Charlesworth time to look up these exhibits.

17 --- Luncheon (12:45 p.m.)
18
19
20
21
22
23
24
25



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

2 MR. LANCASTER: Please be seated.

3 MS. CRONK: Of course I will be
4 delighted to proceed in Mr. McQuaid's absence, but I
5 don't think it is appropriate to do so.

6 MR. LANCASTER: I don't think so.

7 MS. CRONK: Q. Dr. Charlesworth, over
8 the course of lunch, were you able to confirm the
9 location of the four wells we were discussing?
10 These were OW-13, 16, 17 and 18?

11 DR. CHARLESWORTH: A. Yes, I was, Mr.
12 Chairman. I was misreading a three and an eight,
13 which was throwing me into a certain amount of
14 confusion before lunch. Maybe I should just highlight
15 them on this plan?

16 Q. That would be fine.

17 A. This is a particularly dark copy
18 here; it is hard to read the numbers. I have high-
19 lighted or coloured in red, the four boreholes. OW-
20 18, south of 403, and Nos. 17, 13 and 16 north of the
21 North Service Road.

22 Q. All four of those wells are
23 Morrison Beatty installed wells?

24 A. These are Morrison Beatty
25 installed wells, yes. These are the ones we have



1 referred to as MB and Trow has referred to as MB and
2 Cartwright has referred to as OW.

3 Q. My question as I recall it before
4 lunch, I asked you to confirm that all four of these
5 wells were between the CN tracks and the area proposed
6 at Site F by the Region for landfill?

7 A. Yes, I think so. I was also a
8 little confused trying to clarify that. You must
9 remember that Cartwright was referring, when he refers
10 to the site, to the earlier proposal which I believe
11 terminated maybe a third of the way up Site F.

12 So, on the plan as I am looking at it
13 now, he was referring to the area from the CN tracks
14 northward to the point that I am showing with my pen,
15 which is maybe a third of the way up Site F.

16 Q. You are referring to Exhibit M-
17 437-D1?

18 A. M-437-D1, I am.

19 Q. Do I understand it that you are
20 saying that the site as referred to by Mr. Cartwright
21 was the site then proposed by National Sewer Pipe
22 Limited and that was considerably further north than
23 the southern line of the site proposed by the Region?

24 A. That is my understanding.

25 Q. Do I have it then that all four of



1 those wells are in fact, as I suggested, between the CN
2 tracks and the landfill area, as proposed by the
3 Region?

4 A. Yes, they are, they are slightly
5 offset to one side, to the east, but in terms of north
6 and south, yes they are south of the site and north of
7 the CN tracks.

8 Q. Of the four, Dr. Charlesworth, am
9 I correct that the only one which would appear to be in
10 the discharge area as positted by Trow is MB-18?

11 A. That is correct.

12 Q. Thank you.

13 Now, at page 3 of Mr. Cartwright's
14 article or paper, you will recall I drew your attention
15 to the last paragraph in which he suggested that those
16 four wells exhibited or indicated both recharge and
17 discharge in the Region. Do you see that?

18 A. That is correct, yes.

19 Q. Could I ask you to go to page 4-3
20 of your Site F report with me. You set out at page 4-
21 3 and page 4-4 the results of your review of the
22 gradients at various boreholes. I would ask you first
23 to look at HC-9, at page 4-3. Could you just locate
24 that in relation to the four wells we have just been
25 discussing?



1 A. HC-9 is in the vicinity of OW-18
2 or MB-18, which Cartwright referred to.

3 Q. You indicate with respect to HC-9
4 that on your review of the relevant cross-sections and
5 well particulars that it had horizontal gradients in
6 the upper zone and downward gradients in the lower
7 portion of the borehole, is that correct?

8 A. That is correct.

9 Q. As part of your work on Site F,
10 you also actually measured the water levels at HC-9,
11 did you not?

12 A. That is correct; we measured the
13 water levels at HC-9.

14 Q. Could I ask you to go over to page
15 4-6 then, if you would, and I direct your attention to
16 the first paragraph at the top of the page, which
17 appears to be where you set out the water levels in
18 borehole HC-9, which were measured, and you indicate
19 that they showed a similar pattern to that depicted by
20 Trow. A very small to non-existent gradient in the
21 upper three piezometers and a stronger downward
22 gradient between the two deepest piezometers. You
23 then go on to indicate:

24 "A close examination of the hydrographs
25 for the upper three piezometers shows



1 that the vertical gradients actually
2 changed from being slightly downward to
3 slightly upward."

4 Do you see that?

5 A. Yes, I see that.

6 Q. That suggests to me that based on
7 your measurements of the water level in HC-9, which is
8 immediately adjacent to MB-18, that you in fact saw
9 evidence of both recharge and discharge conditions. Is
10 that right?

11 A. It suggests that there could be
12 upward gradients within the till deposits at that
13 location.

14 Q. There is both?

15 A. It varies, it seems to vary on a
16 seasonal basis.

17 Q. There are both downward gradients
18 and upward gradients?

19 A. That is correct.

20 Q. I have not been able to find in
21 your report, Dr. Charlesworth, any water level
22 measurements for MB-18. Did you in fact measure the
23 water levels at that location?

24 A. I did not and I was not able to
25 find measurements by Trow on MB-18 although there is



1 information from the time that MB-18 was constructed.
2 The borehole logs which Trow reproduced and which I
3 think was probably some of the data that Cartwright was
4 referring to.

5 Q. Have you reviewed that data?

6 A. Yes, that data suggests that in
7 MB-18 there were downward gradients at that time.

8 Q. Is that data before the Board?

9 A. That data would be in Appendix 2
10 to the Site F report.

11 Q. Exhibit H-40?

12 A. Yes.

13 Q. In addition to MB-18, you also
14 reported on the water levels and gradients in MB-13,
15 which was also mentioned by Mr. Cartwright. I ask you
16 to look again at page 4-3 in your report, and I suggest
17 that there were only downward gradients at that
18 location?

19 A. At MB-13, yes. We found, Trow
20 found only downward gradients at that location.

21 Q. Did you measure the water levels,
22 did your firm measure the water levels at that
23 location?

24 A. MB-13, no we did not.

25 Q. Do we have then, bearing in mind



1 that Mr. Cartwright had suggested that there was
2 evidence of recharge and discharge water levels or
3 conditions in the location of those four wells, based
4 on your review of the data, there are downward
5 gradients at MB-13 and MB-18, but there was evidence of
6 both conditions at HC-9?

7 A. There was evidence of both
8 conditions, yes, at HC-9. At, the Trow data for 16 and
9 13, suggests downward gradients. The Cartwright data,
10 when I say Cartwright data, the Morrison Beatty
11 original data, original borehole logs suggest upward
12 gradients at 17 and 13 in the upper horizons. That is
13 17 and 13. So it appeared that the data that
14 Cartwright was referring to were the boreholes north of
15 the 403.

16 Q. Save that HC-9, you have told us,
17 is in the vicinity of MB-18, which clearly is south of
18 Highway 403?

19 A. Yes, but the information
20 Cartwright was referring to was the Morrison Beatty
21 data and the original log indicates that is a downward
22 gradient.

23 Q. I ask you to go to page 4-7 of
24 your report. Mr. Cartwright suggested that what he
25 took to be recharge, discharge relationships, changing



1 seasons and climatic factors, do you agree with that?

2 A. I think in terms of what I am
3 calling the shallow system, certainly, yes I think it
4 is fair to say that.

5 Q. I direct you to the first
6 paragraph on page 4-7. Is that in essence a
7 reflection of what you have just expressed?

8 A. 4-7:

9 "In summary this revealed the water
10 level data suggests that downward
11 gradients predominate at Site F and even
12 to the south of the site, though there
13 are very local complexities which
14 probably vary on a seasonal basis, in
15 the case of the shallow flow system."

16 Yes, that's probably right.

17 Q. Based on your firm's actual
18 monitoring of HC-9 and the other data available to you,
19 it would appear that depending upon when you measure
20 the water levels in those wells and under what climatic
21 conditions then existing, you may in fact find evidence
22 of recharge as well as discharge, I am sorry, of
23 discharge as well as recharge.

24 A. My interpretation of what we saw
25 at 9 was we were getting predominantly, we were



1 getting, maybe I could refer to the cross-section HC-9.
2 There seem to be downward gradients within the shale,
3 but horizontal to slightly upward gradients in the
4 surficial deposits. I am referring to Exhibit M-437-
5 D5, which was one of our cross-sections.

6 Q. My point quite simply is this, Dr.
7 Charlesworth, that if you look at the wells that are
8 located in the proximity of the discharge zone that has
9 been positted by Trow, and you were to describe the
10 gradient patterns that existed there, it is not
11 entirely fair to suggest that all the gradients are
12 downwards in your interpretation?

13 A. No, certainly, I think in my
14 evidence in-chief I discussed this pattern.

15 Q. I ask you then to turn to Mr.
16 Cartwright's document. We have been discussing thus far
17 the area between the CN tracks and Site F and I direct
18 your attention to the last sentence at the bottom of
19 page 3, which appears to be directed to the area
20 between the CN tracks and the lake to the south.
21 He indicates:

22 "Between the CN tracks and the lake,
23 urban development has altered the
24 relationship of groundwater and surface
25 water by controlling the drainage.



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Almost no groundwater, if any,
discharges in this area."

Did you as part of the site, as part of
the site investigation you have told us about, inspect
the land south of the CN tracks?

A. We did not inspect the land
specifically. We did some, in terms of looking for
discharge, we did some conductivity measurements on
Falcon Creek.

Q. Did you, in doing those
measurements, obtain any data that in your mind
suggested an area of discharge, any wetlands, any swamp
areas?

A. No, we did not specifically
look for swamplands south of the CN tracks. Our
attention was concentrated on the area north of the CN
tracks because of the suggestion that this was a
discharge zone from the shale, but we didn't
specifically look for wetlands south of the, south of
the CN tracks. We have driven around here, but it
wasn't a detailed survey.

Q. Did you see any evidence of a
discharge zone south of the CN tracks based on
measurements you did take?

A. No, I haven't seen any evidence



1 and I haven't see any reference to it.

2 Q. Could I ask you to go back to page
3 4-3. I am going to direct your attention to the
4 measurements in HC-10. Could you locate HC-10 again
5 for the Board for ease of reference?

6 DR. KINGHAM: I wonder if map 2 from
7 HC-48, it is clearer from H-40.

8 MS. CRONK: Q. It might be easier,
9 Dr.Charlesworth. Do you have it, Dr. Charlesworth?
10 You have the map?

11 A. I have the map.

12 Q. Before we come to HC-10, I am
13 going to suggest to you, Dr. Charlesworth, that when we
14 look from the CN tracks south in terms of identifying,
15 when we look from the CN tracks south in terms of
16 identifying two patterns of wells that exist, if you
17 will, I suggest to you that there are really two north
18 south directions where these wells appear. The first
19 starts at, on the east and moves from HC-9, which is
20 just immediately north of the CN tracks. We have just
21 looked at that and then HC-10, just immediately north
22 of Plains Road?

23 A. Right.

24 Q. Then moving further south HC-12
25 and moving almost to the lake, HC-13?



1

A. Yes.

2

Q. Then if we look to the west, we

3

see the same line in the north-south direction of wells

4

that exist starting at HC-14 north of the CN tracks

5

about half-way between Highway 403 and the CN

6

tracks?

7

A. Yes.

8

Q. Then moving south of the CN tracks

9

and moving south of Plains Road, HC-11?

10

A. Right.

11

Q. Then close to the lake but not yet

12

at the lake, HC-16, further to the south?

13

A. Yes.

14

Q. Then with respect to HC-10, if I

15

direct your attention to page 4-3 of your report and

16

could you just refresh the Board's recollection and

17

ours as to what the gradients were that you measured at

18

that monitoring well location?

19

A. Upward gradients in surficial

20

deposits and horizontal in the upper portion of the

21

shale.

22

Q. That suggests that does it not,

23

Dr. Charlesworth, that no ground water from depth is

24

moving upwards in that location?

25

A. That suggests that there is no



1 movement upward there.

2 Q. Just to continue then in that line
3 down, if we could, could you look at HC-12 next and
4 then could you outline what the gradients were in that
5 location?

6 A. HC-12 has horizontal gradients in
7 the upper part of the shale but there is an apparent
8 upward gradient in the lower part of the borehole. So
9 we had a sort of different pattern there. There was a
10 horizontal gradient in the upper part of the shale.

11 Q. Were you in fact able to ascertain
12 the nature of the gradients in the lower part of the
13 boreholes?

14 A. It is not a highly instrumented
15 hole, there is a small number of piezometers. It would
16 be difficult to determine a pattern without more
17 piezometers, but based on the information we have, it
18 does show an upward gradient in the lower part of that
19 location.

20 Q. And horizontal gradients at
21 surface.

22 A. Yes.

23 Q. Then HC-13 is almost at Hamilton
24 Harbour?

25 A. That is correct.



1 Q. According to page 4-3, you saw an
2 upward gradient between the two upper piezometers and a
3 downward gradient between the lower of these and the
4 bottom piezometer?

5 A. That is correct.

6 Q. That suggests, and I would ask you
7 to agree or disagree that again with respect to the
8 downward flow, that what we are seeing when we trace
9 HC-9 through to HC-13, that the water at depth is
10 consistently moving downward?

11 A. I couldn't say it is consistently
12 moving downward because we had an apparent upward
13 gradient in 12, but there is no evidence of it being
14 from depth to the surface.

15 Q. Can we look then at the pattern
16 further to the west and start with HC-14 on the next
17 page 4-4, the third paragraph down you indicate the
18 results in HC-14. That is the well between Highway
19 403 and the CN tracks. You indicate that in the upper
20 part of the borehole the gradient goes downwards and in
21 the deeper part of the borehole it is horizontal; is
22 that correct?

23 A. That is correct.

24 Q. Then moving further south, the
25 next well from that is HC-11 and on the same, over the



1 page at 4-5, would you outline what you found there?

2 A. In borehole HC-15?

3 Q. No, in HC-11.

4 A. HC-11, there is an upward gradient
5 from the shale to the overburden.

6 Q. Moving then further south to
7 HC-16?

8 A. At HC-16, we get downward
9 gradients in that vicinity.

10 Q. How do you interpret those
11 results, Dr. Charlesworth, in terms of a prevailing
12 pattern?

13 A. HC-11 shows some discrepancy from
14 the overall pattern. We have to concede that there is
15 an upward gradient in the vicinity of that location.

16 Q. Taking into account the other
17 wells in the western to north-south line and the
18 eastern north-south line how would you characterize the
19 flows based on your gradient observations in the
20 context of all those wells?

21 A. We have seen some upward and some
22 downward. I think I would say this is still
23 predominantly downward, but I suspect the movement
24 would be predominantly lateral, but we do see evidence
25 of downward gradient.



1 Q. Well, indeed we see evidence at a
2 number of locations of downward gradient at a number of
3 depths, don't we?

4 A. That is correct.

5 Q. We have heard a fair amount in
6 this hearing, Dr. Charlesworth, obviously about Trow's
7 suggested discharge zone north of the CN tracks. We
8 have also heard it suggested that there may be in fact
9 a discharge zone further to the south, south of the CN
10 tracks. You told me earlier this morning you were not
11 present for Mr. Feenstra's evidence, but you read his
12 transcripts. Do you recall that?

13 A. Yes, I recall that.

14 Q. I would like to read a portion to
15 you of one of the cross-examinations of Mr. Feenstra
16 that took place. Mr. Chairman, I am going to be
17 referring to Volume 45 at page 10236. Perhaps if Mr.
18 Estrin has the transcripts here I can provide you with
19 a copy. Page 10236. Do you have that, Doctor?

20 A. Yes, I do.

21 Q. Beginning at that page at
22 approximately line 3, Ms. Vigod directed Mr. Feenstra's
23 attention to the water elevation appendices included in
24 Trow's appendix to the Site F report. I read
25 beginning at line 11:



1 "Q. Could you confirm that in fact the
2 gradients are upward at both HC9
3 and HC15 -- I'm sorry...

4 A. The gradients are down.

5 Q. I am sorry, the gradients are
6 downward.

7 A. I won't confirm they are upward.

8 At HC9 the hydraulic gradient is downward
9 with a head differential

10 of approximately a metre and a half
11 between the shallow piezometer at 5.2
12 and the deep piezometer at 30.9 and at
13 HC15 the gradients are slightly downward
14 with a head differential of
15 approximately -- it's also about a metre
16 and a half between the shallow
17 piezometer and the deep piezometer.

18 Q. But Mr. Feenstra, my question is
19 how, given the downward gradients at
20 these wells, that they be located in the
21 discharge zone and does this cause a
22 problem?

23 A. Obviously at those specific
24 locations the groundwater discharge
25 gradients are not upward, and so at that



1 location it would suggest that
2 groundwater discharge is not taking
3 place at these specific zones. The
4 downward gradients though are
5 considerably different in magnitude,
6 being much reduced from the hydraulic
7 gradients measured on-site in here and
8 if you continue looking at Appendix 5
9 you will see that there are in fact
10 upward gradients that HC10, HC11 and
11 HC12, somewhat south of the CNR
12 tracks.

13 Q. I guess my question is that we
14 really don't have any wells in the
15 discharge zone as illustrated in the
16 interrogatories by Mr. Beechinor and, in
17 fact, we may see as you have discussed
18 some upward gradients further south of
19 that area?

20 A. That is correct and for the
21 discharge zone as drawn on Figure 1 of
22 H-85, HC9 exists within that zone but
23 the gradients are still slightly
24 downward."

25 And then I draw your attention specifically, Dr.



1 Charlesworth to the following questions and answers:

2 "Q. That's right.

3 A. The downward gradients being
4 approximately .06 compared to gradients
5 of .05 or greater on-site.

6 Q. Would you predict then that the
7 discharge zone could in fact be -- could
8 perhaps start further south of HC9
9 and continue further south and would
10 that be a reasonable assumption?

11 A. That would be a reasonable
12 assumption, yes, given the upward
13 hydraulic gradients shown at HC10,
14 HC11 and HC12."

15 Now could I just review that with you
16 for a moment, Dr. Charlesworth, and then I have a
17 question for you.

18 Q. Over at page 10236, based on the
19 documentation that Mr. Feenstra was looking at, he
20 indicated the gradients were downward; do you see that?

21 A. Yes, I do.

22 Q. Based on your view of the water
23 levels that we discussed in the last half-hour, you
24 found they were downward and at the lower portion of
25 the borehole, but in fact you found upward and downward



1 gradients at HC-9, isn't that so?

2 A. Yes.

3 Q. Then moving to HC-15, the second
4 well discussed by Mr. Feenstra, based on what he had in
5 front of him at the time he suggested that the
6 gradients are downward, and that is consistent with
7 what you found?

8 A. Yes, that is true.

9 Q. At HC-10, Mr. Feenstra suggested
10 the gradients are upwards -- I'm over at page 10237 --
11 is that correct?

12 A. Yes.

13 Q. Based on the water levels that you
14 measured and were reviewing, those measured by Trow,
15 you found upward gradients in the surficial deposits
16 only and horizontal gradients in the upper portion of
17 the shale, is that correct?

18 A. Yes, that is correct.

19 Q. Would you like to check that?

20 A. I am somewhat confused.

21 Q. It is 4-3.

22 A. Yes, that is correct. Horizontal
23 in the upper portion of the shale.

24 Q. I'm sorry, your voice is trailing
25 off.





1 A. We had upward gradients in the
2 surficial deposits, horizontal in the upper portion of
3 the shale.

4 Q. Then at HC-11, Mr. Feenstra said
5 the gradients were upwards and you found them upwards
6 from the shale to the overburden?

7 A. Yes. I was commenting on Trow's
8 values here.

9 Q. Then finally at HC-12, Mr.
10 Feenstra, based at what he had available before him,
11 said that the gradients were upwards. You found
12 horizontal gradients at least in the upper part of the
13 shale, isn't that so?

14 A. Yes. Our review of the data
15 indicated horizontal in the upward part of the shale.

16 Q. Dr. Charlesworth, based on your
17 review of the data then and the water level
18 measurements which you took, do you regard them, at the
19 wells we have just discussed and those put to Mr.
20 Feenstra by Ms. Vigod, as suggesting uniformly upward
21 gradient?

22 A. No, I don't; they don't indicate
23 uniformly upward gradients.

24 Q. In fact at two of those locations
25 I suggest you found a mixture of gradients including



1 horizontal gradients in the deep shale?

2 A. Yes, that is correct.

3 Q. Given that pattern of gradient,
4 Dr. Charlesworth, may I say this without any criticism
5 at all of Mr. Feenstra, but given the data that you
6 have looked at and the gradients that you measured,
7 what is your opinion as to the existence of a discharge
8 zone south of the CN tracks?

9 A. Well, I don't believe that there
10 is a discharge zone. We have seen a variation in
11 patterns there and there is the possibility at some
12 locations there could be some upward movement. So you
13 cannot totally rule it out, but on the basis of the
14 salinity of the ground water, I don't believe that
15 there is a discharge zone, because I don't see any
16 evidence of saline water at the surface.

17 Q. Dr. Charlesworth, perhaps I could
18 direct my next question to Dr. Rowe. Dr. Rowe, dealing
19 with the same subject, the gradients that Dr.
20 Charlesworth has just been discussing, I would ask you
21 to assume for a moment, despite what Dr. Charlesworth
22 just said, assume for a moment that in fact there is
23 some discharge south of the CN tracks, what, based on
24 your work, with respect to the modelling that you have
25 done and your understanding of the attenuation



1 characteristics of the site, would you regard as being
2 the likely consequences of that in terms of impact on
3 ground water?

4 DR. ROWE: A. Mr. Chairman, based on
5 the results that I have obtained and which are
6 presented in my report, I have concluded that the
7 impact on the ground water quality south of the 403
8 would be minimal. If that ground water was coming up
9 through a till material, for example, there would be
10 further attenuation which would reduce already minimal
11 concentrations to even less minimal.

12 Q. I want to be sure that I
13 understand that, Dr. Rowe.

14 A. The impact would be negligible.

15 Q. Are you saying as well that
16 because of the distance that the contaminants would
17 have to travel, that they would be significantly
18 attenuated, based on the work that you have done?

19 A. Based on the work that I have done
20 and the results I reported in evidence, the
21 contaminants are significantly attenuated by the time
22 they have moved, the range of distances I looked at was
23 300 metres to 800 metres. So that is well south of the
24 403, well south of the 403. Based on those results,
25 the impact was minimal and I am adding that what I



1 didn't consider was coming up through till. If I did
2 consider that, that would further attenuate the
3 results.

4 Q. Where is your 300 metre distance,
5 Dr. Rowe?

6 A. I am referring, at the moment, to
7 Exhibit M-437-D1, and 300 metres south of the site, for
8 purposes of my consideration, I was treating the centre
9 of the site as being a representative position. So if
10 you went 300 metres south of there, you would be just
11 on the southern highway of Highway 403.

12 Q. That is measured from the centre
13 of the southern portion of the site?

14 A. That is correct.

15 Q. Where is your 800 metre
16 measurement, a line that you referred to in your model?

17 A. Approximately from the same
18 reference point, it is on the CN tracks.

19 DR. KINGHAM: When you say the centre of
20 the southern portion, do you mean the centre of the
21 southern boundary?

22 DR. ROWE: Essentially I am taking a
23 point, Dr. Kingham, a point in around here.

24 MS. CRONK: Q. Where is here?

25 DR. ROWE: A. Roughly in the centre of



1 400 metre wide zone I was modelling. Approximately
2 200 metres in from the western edge of the site.

3 If I wanted to take it from the
4 southern-most point of course, that moves the distances
5 down in the case of the most southern point to about
6 100 metres south of the 403 and about 50 metres south
7 of the CN tracks. That is the most southerly of the
8 points.

9 Q. Then if we were to look at the
10 figures which you have provided the Board by way of
11 overhead in terms of the contaminant concentrations at
12 800 metres south from the line you have indicated at
13 the site, that would put us in the vicinity of the CN
14 tracks?

15 A. That is correct, yes.

16 Q. The exchange that I just put to
17 Dr. Charlesworth that took place between Ms Vigod and
18 Mr. Feenstra involved the suggestion of a discharge
19 zone south of the CN tracks between the CN tracks and
20 the lake. That would be further south yet from your
21 800 metre line?

22 A. You would get additional
23 attenuation beyond what I considered in the model.

24 Q. Now, with respect to the
25 suggestion made by Trow, Dr. Rowe, that there is a



1 discharge zone between Highway 403 and the CN tracks,
2 does that essentially correspond with your scenario C?

3 A. Yes. The scenario C that I
4 examined, Mr. Chairman, was doing the contaminant
5 migration model that fits with the flow model proposed
6 by Trow as their better-fit model.

7 Q. Could I ask you then to go to
8 figure, in your witness statement, to Figure 26. I may
9 have the wrong one, Dr. Rowe, I would like your
10 assistance.

11 A. Can you just tell me what is on
12 the figure?

13 Q. Yes, it is a reproduction of
14 Figure 7 from your Site F report.

15 A. Right, I have got it. I have got
16 up Figure 26 from Exhibit 444, is that what you would
17 like?

18 Q. Yes. Thank you. Does that figure
19 set out the results which you measured under the cases
20 indicated for chloride concentrations at 300 metres
21 south of Site F?

22 A. Yes, it does.

23 Q. That shows, as you have told the
24 Board, peak concentrations of chloride, approximately
25 100 milligrams per litre at 450 years?



1 A. That is correct.

2 Q. Then if we look at Figure 27, is
3 that the same thing at 800 metres, the CN track
4 location?

5 A. Yes, that is approximately at the
6 CN tracks.

7 Q. Just to compare then the peak
8 concentration shown on this overhead at 800 metres down
9 the site, you are showing a peak chloride concentration
10 of approximately 60 milligrams per litre at a
11 considerably longer period of time, some 1100 to 1200
12 years, 1250?

13 A. 1250 for that particular case, or
14 less for the other cases.

15 Q. Do these two overheads apply to
16 your scenario C?

17 A. No. These cases correspond to my
18 scenario A. That is the vision, the interpretation of
19 the hydrogeology given to me by Dr. Charlesworth.

20 Q. And your scenario A, which is your
21 worst-case situation in which there was, perhaps you
22 can explain it briefly?

23 A. Yes, scenario A is the idea of a
24 general zone and in this case the results are for a
25 Darcy velocity of 0.05 metres per annum. So this is



1 going through a zone of the rock moving south through a
2 series of fractures without having clearly defined
3 weakly fractured unit and a highly fractured unit,
4 which was Trow's scenario and that is scenario C?

5 Q. What then are the companion
6 overheads to these two under scenario C, which would
7 show us what your modelling indicates the
8 concentrations would be in the area of the discharge
9 zone positted by Trow?

10 A. To try and answer that question I
11 will put up overhead 4. Now, when I modelled the Trow
12 scenario I was primarily focussing on what was
13 happening at the downgradient edge of the landfill. At
14 that point I got a concentration of 85 milligrams per
15 litre. I did a very crude calculation of attenuation,
16 which you might get with distance in this zone. If I
17 recall correctly, I ended up with about 60 milligrams
18 per litre or less at the CN tracks.

19 Q. What about further north of 403?

20 A. It would be somewhere in between
21 but it is very, very small.

22 Q. I was trying to get a fix, Dr.
23 Rowe, given that you took a 300 metre parameter which
24 equates with the location on Highway 403 that you have
25 told us about and then you took 800 metres, which is



1 the CN tracks? As I understood it, you really
2 straddled the area Trow was talking about?

3 A. That is correct, yes.

4 Q. Would it be fair then, based on
5 the concentrations that you have just outlined, to
6 suggest that were there discharge somewhere between
7 those two, between 300 metres and 800 metres south of
8 the landfill site that we would see concentrations
9 ranging from and assuming scenario C, a discharge zone,
10 we would see concentrations ranging from less than 60
11 milligrams per year of chloride to 60?

12 A. From less than 60 to 60. Yes, in
13 fact I hadn't noticed it, but it is about 60 in both
14 cases.

15 Q. What is the situation with respect
16 to volatile organics?

17 A. Volatile organics are more
18 attenuated with distance. That means that the impact
19 would be less. Perhaps if I can just illustrate that,
20 looking at 800 metres, we have, this is for a
21 conservative species, at 800 metres the impact as we
22 discussed just a moment ago is about 4 per cent of Co
23 or in numbers, 60 milligrams per litre.

24 I would like to compare the percentage.
25 It is 4 per cent for the conservative species. That is



1 chloride, and again I pointed out in the evidence, and
2 perhaps should point out again, that we are using
3 chloride here as representative of conservative
4 species.

5 If we look at an organic, and here I am
6 taking benzene and I am referring now to overhead 29
7 and contrasting it with overhead 27. We see that the
8 impact is 1 per cent, 1 per cent of Co or less.

9 Q. Dr. Rowe, still dealing with the
10 concept of discharge zones at one or two locations, I
11 should simply make it clear for the later assistance of
12 the Board what the effect of your work suggests in
13 either scenario. We have first Trow's scenario that
14 there is a discharge zone between 403 and the CN
15 tracks. Dr. Charlesworth has told us that he doesn't
16 agree that the evidence supports that interpretation.
17 You have now explained what the peak concentrations of
18 contaminants would be in that area; correct?

19 A. That is correct. My
20 interpretation is irrespective of whether I was
21 modelling it, adopting Dr. Charlesworth's
22 interpretation, or whether I modelled it adopting
23 Trow's interpretation. The effect is minimal.

24 Q. When you adopt Trow's
25 interpretation, that includes, I take it, necessarily a



1 discharge zone?

2 A. Well, their flow model, which
3 provides the input to my scenario C, was predicated on
4 a discharge zone.

5 Q. Then finally with respect to an
6 area of discharge suggested by Ms. Vigod south of the
7 CN tracks, you have indicated that at peak
8 concentrations contamination would be negligible?

9 A. Yes, that is right, less than the
10 small figures we have just suggested.

11 Q. Dr. Charlesworth, could I you to
12 come back if you please to the document, the report
13 authored by Mr. Cartwright that we were looking at a
14 few moments ago. I would ask you now to go to page 4,
15 if you would please, which deals with water quality.
16 I draw your attention to the first paragraph on page 4
17 at which he indicates:

18 "Analyses of water from piezometers
19 installed in the area show saline ground
20 water to be present over the whole area.
21 Water in the upper 5 to 10 metres
22 probably is potable, although low in
23 quality. The salinity increases
24 considerably with depth."

25 We have moved away from the discussion



1 of flow patterns and ground water flow paths discussed
2 by Mr. Cartwright, and he is now setting out his views
3 on the water quality data with respect to Site F. Do
4 you agree or disagree with the views expressed in that
5 first paragraph?

6 DR. CHARLESWORTH: A. Yes, I would agree
7 with that.

8 Q. Looking at the concluding paragraph
9 on page 4.

10 A. I should just qualify, if you are
11 talking about the whole area including the site, it's
12 not always potable in the upper 5 to 10 metres; it may
13 be in some cases, but not always.

14 Q. Then, looking at the last
15 paragraph:

16 "The chemical data strongly suggests
17 that leachate can be attenuated and
18 assimilated in the shale as it slowly
19 migrates towards the southeast."

20 I take it you would agree with that from
21 the evidence you have given?

22 A. Yes, I would agree with that.

23 Q. Continuing:

24 "However, the volume of leachate that
25 can be transmitted by the intermediate



1 ground water flow system is limited,
2 and, if this quantity is exceeded,
3 discharge may occur between the site and
4 Highway 403."

5 Stopping there, when he refers to the
6 site, I take it what you suggested to me earlier here,
7 referring to the site as then proposed by National
8 Sewer Pipe?

9 A. Yes, that is true.

10 Q. That being the case, were he
11 correct in respect of both the intermediate ground
12 water flow zone and the suggestion that the zone might
13 be saturated and there might be some overflow, that
14 would in fact be discharge on Site F as proposed by the
15 Region?

16 A. It would be, yes.

17 Q. Were that to happen, Dr.
18 Charlesworth, what consequences would that have, in
19 your view, in terms of impact on ground water or
20 ability to respond to that kind of situation on site?

21 A. If it occurs on site, it can be
22 dealt with by appropriate engineering.

23 Q. What do you mean by that, what do
24 you mean by appropriate engineering?

25 A. I mean you could intercept it with



1 berms and ditches. I don't think that scenario would
2 occur anyway. I should just note here that we run
3 into the problem of trying to get his zones to the
4 figure I had there. I think in this case I said his
5 intermediate zone is represented by arrows going down.
6 I think his thinking gets a little fuzzy here and he is
7 talking more about the shallow zone.

8 On site seepage I don't see as a
9 problem. It could be collected, it could be
10 intercepted.

11 Q. Then finally I would ask you to
12 turn, Dr. Charlesworth, to the last page of the
13 Cartwright document, page 6, the section beginning
14 Conclusion. In that section, as I understand it you
15 have set out in full in your own report that portion we
16 see at page 6-4?

17 A. Yes.

18 Q. Do you share the conclusions
19 expressed by Mr. Cartwright in that section of the
20 report?

21 A. I will just refresh my memory by
22 reading it. I mean I agree with him, I just want to
23 be sure. There are still questions about whether you
24 can detect it even a few tens of metres from the waste,
25 but in general principle, yes, I agree with it. The



1 point I was including it for was to show that although
2 different people had looked at different scenarios at
3 the site, there has been, a majority of people whatever
4 they think is the closest, have come to the conclusion
5 that this site would be safe on that last important
6 point. There are differences in interpretation, but
7 the general overall conclusion is that the site is
8 acceptable.

9 Q. And that was Mr. Cartwright's
10 conclusion?

11 A. Yes.

12 Q. And clearly based on the evidence,
13 that is your own?

14 A. Yes.

15 Q. Thank you, Dr. Charlesworth.

16 One of the other reports you indicated
17 to the Board that you reviewed was the Morrison Beatty
18 Phase III report, which is before you, Mr. Chairman, as
19 N-185. Do you have a copy of that, Dr. Charlesworth?
20 Exhibit N-185. It is a black binder. You told us, Dr.
21 Charlesworth, that you reviewed this report and the
22 other studies by Morrison Beatty as part of formulating
23 your own work and ultimately reaching your own opinions
24 with respect to Site F. Do I understand correctly?

25 A. That is correct.



1 Q. I direct your attention to the
2 summary and conclusion section of this report which
3 begins at page 1 and continues over to page 2, in
4 particular at the top of page 2. At the top of that
5 page, the authors indicate:

6 "The findings of our Phase III
7 investigation support our conclusion of
8 the Phase II report that the hydro-
9 geologic conditions at the NSP site are
10 ideal for landfilling operations. To
11 ensure long-term environmental
12 protection, however, it will be
13 necessary to incorporate the design
14 criteria and operating standards
15 outlined on pages 45 to 53 of our Phase
16 II report into the landfill proposal."

17 Just dealing with that passage, Dr.
18 Charlesworth, do you agree or disagree that the
19 conditions on the NSP lands, which are 90 per cent, you
20 have heard of Site F, are ideal for landfilling
21 operations in hydrogeologic terms?

22 A. I almost agree. The word ideal I
23 have difficulty with. I guess if it were ideal then
24 there would be absolutely no dispute. Obviously there
25 are differences of opinion about it, but I think



1 conditions, hydrogeological conditions at the site are
2 good for a landfilling operation. It is just a matter
3 of semantics as to whether any site is ideal.

4 Q. I think perhaps the statement made
5 by Morrison Beatty goes a little bit further than that,
6 Dr. Charlesworth. Apart from the site being suitable
7 for landfilling purposes, I took from the passage I
8 just quoted to you that there was something unusual or
9 something particular advantageous about that site in
10 hydrogeologic terms for use as a landfill site. Would
11 you describe for us that increased level of comfort?

12 A. It is suitable because it has poor
13 quality ground water beneath the site. It is suitable
14 because we have two existing sites that enable us to
15 draw certain conclusions about it.

16 Q. Could I ask you then finally to go
17 to page 12 of this report, which is the last page
18 before we reach the appendices, and I direct your
19 attention to the last paragraph, which reads:

20 "There is no evidence of swamps or
21 wetland areas anywhere within the water
22 shed south of the CN railway. The base
23 flow which does discharge to the stream
24 bed appears to be from the shallow
25 ground water flow system and the



1 surficial sands rather than the deep
2 regional flow system."

3 I take it from the discussion we have
4 had this afternoon, that you would share those views?

5 A. I would share those views, yes.

6 Q. Now, you told me earlier today,
7 Dr. Charlesworth, that in addition to the Phase I
8 through III reports prepared by Morrison Beatty and in
9 preparing your own review and reaching your own opinion
10 on Site F, you also had regard to a 1985 review
11 document prepared by Morrison Beatty Limited, is that
12 correct?

13 A. That is correct.

14 Q. Did you take the contents of that
15 document as well as the Phase I through III reports by
16 Morrison Beatty into account in formulating your own
17 conclusions?

18 A. Yes.

19 Q. I am showing you, Dr.
20 Charlesworth, a letter dated July 23, 1985 on the
21 letterhead of Morrison Beatty Limited entitled "Re:
22 Review of Technical Reports on the Hydrogeologic
23 Suitability of Site F for the Proposed Region of Halton
24 Landfill." Can you tell me, is that the 1985 review
25 document by Morrison Beatty Limited that you reviewed?



1 A. Yes, it is.

2 MR. McQUAID: Mr. Chairman, before that
3 is tendered, I would like to see a copy of it. Again,
4 It appears to be another opinion on the site and the
5 author is not going to be called and I am going to
6 object.

7 MR. LANCASTER: I suppose the opinion
8 expressed can be read to the witness. He can give an
9 opinion on it.

10 MR. McQUAID: These are direct comments
11 on a report of CRA and we will not be hearing from the
12 author, we will not have the benefit, I have no idea
13 what Dr. Charlesworth has done with it. This is
14 strictly, directly an attempt to put opinion evidence
15 in through letters without the ability to cross-examine
16 the authors, Mr. Chairman.

17 MR. LANCASTER: The question can be put
18 to the witness and it is his opinion that we are taking
19 as evidence, whatever the question is.

20 MR. McQUAID: If that is the case then,
21 the questions can be put without the letter going in,
22 sir; if it is strictly a case of do you agree with
23 these principles, they can be put. What is the point
24 of having it put on the Morrison Beatty letterhead and
25 put in through a witness that way? That is indirectly



1 putting in opinions from a witness we won't hear from.

2 MR. LANCASTER: We are not taking it as
3 Morrison Beatty evidence.

4 MR. MCQUAID: I guess I'm saying I
5 don't know how at the end you will be able to
6 disassociate yourself from doing that. I don't think
7 it will be physically possible. I think you are
8 putting yourself in an almost impossible position. You
9 are basically getting opinions sent from Illinois or
10 wherever this one is from, Champaign, Illinois, by
11 letter and saying, okay, we will disregard it later.
12 I just think the Board is putting itself in a very
13 unenviable position.

14 MS. CRONK: Need I respond to that, Mr.
15 Chairman?

16 MR. LANCASTER: You better.

17 MS. CRONK: Mr. Chairman, twofold.
18 First, with the greatest of respect, my friend to a
19 certain degree, it appears he is calling, the pot is
20 calling the kettle black and I refer to some of the
21 discussion we had earlier this morning, and I don't
22 mean that in a critical way, but the fact of the matter
23 is we have had a number of opinion reports go in in the
24 course of this hearing to various expert witnesses, and
25 by that I mean witnesses who are called to give opinion



1 evidence during the course of cross-examination. I
2 referred you to one this morning, for example, the
3 environmental appraisal report prepared by Proctor &
4 Redfern that was put in by Ms. Vigod in cross-
5 examination to a witness; it was an opinion report.

6 MR. LANCASTER: Mr. Estrin too.

7 MS. CRONK: That's seven I can give
8 you.

9 MR. LANCASTER: I have to agree with Mr.
10 McQuaid. However, this is what we've been doing,
11 we've been allowing it to go in.

12 MS. CRONK: Thank you, sir, and could
13 I --

14 MR. LANCASTER: For the method of
15 putting forward.

16 MS. CRONK: Could I just respond before
17 Mr. McQuaid responds any further to one of the other
18 remarks he made with regard to the assistance it may or
19 may not provide to the Board.

20 You are, of course, aware, sir, that the
21 Board has the broadest latitude both by practice
22 precedent and also by the Statutory Powers and
23 Procedures Act to receive pursuant to Section 15 of
24 that Act, any evidence that you regard as relevant.

25 There are certain limitations as to what



1 evidence may be tendered to you pursuant to that
2 Section, but they don't apply here, they relate to
3 privilege or documents that are restricted by statute.
4 The jurisprudence that is developed under that section
5 of the Act goes so far as to say that opinion evidence
6 and hearsay evidence can be directed and admitted in
7 evidence if it is of any relevance to the matters at
8 issue before the Board.

9 In my submission, I believe it will
10 become quite clear within about fifteen minutes that my
11 question to Dr. Charlesworth, why this document on its
12 face is quite relevant and that is my submission to
13 you.

14 MR. LANCASTER: Mr. McQuaid, do you wish
15 to....

16 MR. MCQUAID: I read that this is
17 directly commenting on a report by an engineering firm
18 that I will be calling, CRA, and another firm, Golder
19 Associates from the Town of Oakville, a report for the
20 Town of Oakville. Morrison Beatty are commenting on
21 two reports of Proctor & Redfern. Just because
22 Dr. Charlesworth read it, you are being asked to take
23 this.

24 MR. LANCASTER: Not necessarily take
25 it, perhaps consider it.



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MS. CRONK: I ask that it be marked.

MR. LANCASTER: We will mark it, we have done before.

--- EXHIBIT No. N-471: Letter dated July 23, 1985.

MS. CRONK: Is that N-471, sir?

MR. LANCASTER: N-471.

MS. CRONK: Q. Dr. Charlesworth....

DR. KINGHAM: Maybe we should have a copy.

MS. CRONK: Q. Dr. Charlesworth, as Mr. McQuaid alluded to a few moments ago, this document appears to be a report setting out comments by the Morrison Beatty Limited firm with respect to documents that originated in the course of the Region of Halton's landfill study review; is that correct?

DR. CHARLESWORTH: A. That is correct.

Q. They are suggested by Mr. McQuaid or set out at page 1, report 1 and report 2. One is by, he has identified the consultants Conestoga Rovers and the other is a report by Golder Associates. Are you familiar with the firm of Golder Associates?

A. Yes, I am.

Q. My understanding is they are geo-technical consultants?



1 A. They are and they also do
2 hydrogeological work.

3 Q. Could I ask you to go first to the
4 last page of the document, if you would, please, page
5 8. I direct your attention to the Conclusion of the
6 report. First it is expressed by Morrison Beatty and
7 seems to have been signed by Mr. Brian Beatty of that
8 firm?

9 A. That is correct.

10 Q. It appears also to have been
11 signed by Ms Janet Hewetson?

12 A. That is correct.

13 Q. Do I understand Ms Hewetson was at
14 that time, that is in July of 1985, a hydrogeologist
15 with Morrison Beatty Limited; is that correct?

16 A. That is my understanding.

17 Q. That is the same year, is it not,
18 in which her thesis document is dated?

19 A. Yes, I believe so.

20 Q. Could I ask you to direct your
21 attention if you would please to the third full
22 paragraph on page 8. This whole section appears to be
23 a summary of the comments made by the authors in the
24 document; is that correct? The whole section?

25 A. Yes, the whole section is a



1 summary.

2 Q. In the third paragraph it is
3 indicated, and I quote:

4 "Based on a review of the various
5 consultants' reports, no new information
6 has been put forward that changes our
7 hydrogeologic assessment of Site F.
8 We are satisfied that there will be no
9 risk to human health and safety as a
10 result of landfilling at the site. There
11 are few landfill sites in Ontario where
12 one can be so confident."

13 Do you see that?

14 A. I see that, yes.

15 Q. Those are the opinions expressed
16 by Mr. Beatty and Ms Hewetson at that time?

17 A. Yes, I presume they are, they
18 signed the letter.

19 Q. Do you agree or disagree with the
20 suggestion that there would be no risk posed to public
21 health and safety as a result of landfilling at Site F?

22 A. From a hydrogeological aspect?

23 Q. Absolutely.

24 A. I see that there is little risk.
25 I always hesitate to say no risk, but I would think



1 there is little risk at this site from the evidence I
2 have seen and I used that, I am very carefully
3 qualifying that.

4 Q. I would ask you to turn now, if
5 you would, to page 2, which is the section of the
6 document entitled Fracture Flow; do you see that?

7 A. Yes, I see that.

8 Q. In the first paragraph under that
9 discussion, the authors record that a concern was
10 reported by CRA and I take that to be Conestoga-Rovers
11 Associates?

12 A. That is correct.

13 Q. Relating apparently to their
14 alleged view of the complexity of the ground water flow
15 systems in fractured rock. The authors indicate that
16 CRA suggested that complexity led to uncertain
17 predictability of ground water movement and contaminant
18 migration; do you see that?

19 A. I see that, yes.

20 Q. I direct your attention to the
21 next paragraph which says:

22 "On a micro scale, say of tens of cubic
23 metres of fractured Queenston shale,
24 groundwater movement may be considered
25 complex. It is very difficult to



1 identify actual groundwater flow paths
2 and accurately estimate groundwater
3 velocity along these paths."

4 Stopping there for a moment, and mindful
5 of the discussion you had at some length with Mr.
6 Tidball concerning a micro approach to the assessment
7 of the flows of the fracture paths at Site F, he
8 referred to macro approach. Do you agree or disagree
9 in your review of the area that on a micro scale
10 identification of actual ground water flow paths in the
11 area, particularly in recognizing the medium of
12 Queenston shale might in fact be considered complex?

13 A. I would agree with that statement.

14 Q. Do you view it as such on a macro
15 scale?

16 A. No, on a macro scale, as I
17 indicated, I think that you can make reasonable
18 generalizations with regard to the process on a macro
19 scale.

20 Q. Continuing on in the paragraph,
21 perhaps you could just read the next few sentences, if
22 you would:

23 A. "On a regional scale, however,
24 between the Niagara escarpment and Lake
25 Ontario, groundwater movement through



1 the Queenston shale appears to exhibit a
2 general trend that is not complex. As I
3 read, silty mudstone, the Queenston
4 formation is remarkably uniform over its
5 entire thickness.

6 The regional groundwater flow
7 system in fractured shales in the
8 vicinity of Site F has been effectively
9 defined using conventional methods of
10 groundwater monitoring."

11 Q. Stopping there if you would, I
12 understand and I suggest to you and I would ask for
13 your confirmation or disagreement as the case may be,
14 that what is really being suggested in these passages
15 is precisely what you put to Mr. Tidball and that is
16 that in assessing or attempting to identify flow
17 patterns at Site F, there are two ways at least to go
18 about it. One is on a micro level of the localized
19 kind described by Mr. Tidball and the other is on a
20 macro or broader scale of the kind that you positted?

21 A. Yes, I think that is a fair
22 assessment.

23 Q. With respect to macro scale and
24 approach, do you agree with the suggestion that there
25 appears to be, on a regional basis, a general trend in



1 the flow patterns that is not complex?

2 A. In a general sense on a regional
3 scale, I think the system is not complex. I would say
4 something even less than regional, I don't know how you
5 define regional, but on a macro scale relative to the
6 site and its environment and environs.

7 Q. Is that, in effect, Dr.
8 Charlesworth, what you did with regard to Site F in
9 identifying and discussing flow patterns, is that the
10 approach you used?

11 A. In terms of, I evaluated all the
12 data, the existing data and as explained before, I made
13 a simplification, not on a regional scale, but on a
14 sort of macro scale relative to the site I made a
15 simplification for the purposes of modelling.

16 Q. As between the two approaches
17 discussed in these portions, this document by Morrison
18 Beatty, in which camp would you describe your own
19 efforts, macro localized camp or in the macro regional
20 approach?

21 A. I would say it falls between the
22 two. I am just quibbling about regional.

23 There are still, obviously, questions
24 about the regional flow. I think most people will
25 accept the pattern, but on a regional scale, meaning



1 flow from the escarpment, at depth, to the lake, if you
2 are talking about regional scale, there is still an
3 amount of supposition. We do not have piezometers
4 measuring heads inland.

5 On a regional scale, there is reasonable
6 supposition involved, but on a macro scale relative to
7 the site, I think, is where my approach is lying.

8 Q. And how, in that continuum, would
9 you characterize the work that has been done by Trow?

10 A. I would say that Trow have looked
11 at somewhere between the regional and -- I mean their
12 classification was on a more detailed scale than I
13 suggested. Whether it was strictly micro, their model
14 was on, they certainly weren't modelling tens of feet,
15 they were modelling over larger distances, i.e. the
16 whole distance of the site. Their classification was
17 more detailed than the classification that I proposed
18 for the purposes of modelling.

19 Q. Closer than the micro approach
20 that is being discussed in this document?

21 A. I am sorry, are you asking me if
22 Trow's approach to the study of the site was closer to,
23 close to the micro scale that is referred to here?

24 Q. Closer to the micro scale
25 approach, certainly, I suggest, than yours, and that in



1 fact what they were doing was approaching it on a
2 detailed localized basis as they felt they could?

3 A. Yes, certainly. They were making
4 a serious attempt to define the details of the closest,
5 quite detailed scale.

6 Q. I ask you then to go to page 3.
7 The paragraph at the top of page 3, the first sentence:

8 "From available stratigraphic
9 information, candidates Sites D and E
10 appear to have more complex regional
11 ground water flow systems than that in
12 the shale."

13 Stopping right there, based on your
14 analysis of Site D, Dr. Charlesworth, do you regard the
15 regional ground water flow system at Site D as become
16 complex?

17 A. The regional flow system, here
18 again we are down to definitions, Mr. Chairman. I
19 don't think anybody has addressed the regional flow
20 pattern in any kind of detail. I would have difficulty
21 comparing the regional, making a distinction between
22 the regional flow patterns of the two sites. I
23 suppose you could say it is simpler at Site F because
24 it is all going one way, but I would have some
25 difficulty distinguishing between the two regional flow



1 systems. It is just I haven't looked in detail at the
2 regional flow system at Site D.

3 Q. When you consider, Dr.
4 Charlesworth, the approach that you took with respect
5 to Site F, and what you have described as being
6 somewhere between a micro approach and a macro review
7 of the regional ground water flow system, and you
8 consider as well the approach taken by Trow, in your
9 view are the two compatible?

10 A. Compatible, yes, I think there is
11 a role for both. Trow had made their attempt to
12 classify the system in detail and Dr. Rowe wished to
13 try to model the attenuation process. I suggested an
14 alternative approach so I think there are more
15 approaches.

16 Q. Do you see them as being
17 inconsistent in the result?

18 A. In terms of the overall outcome, I
19 guess they are not inconsistent. I have some
20 problems. I don't think the discharge zone functions
21 as a major discharge zone; that is a real disagreement.
22 I am not sure, I think now we have the evidence that
23 Trow does not place as much weight on the discharge
24 zone. I have difficulty going to the level of detail
25 that they went. I think it was reasonable for them to



1 attempt to do that and I think they made a good effort
2 in trying to do that, but I have some problems actually
3 going from the data to the final scenario.

4 Q. The difficulty that I have,
5 Dr.Charlesworth, is simply this: the Board has heard
6 lengthy and detailed evidence about the approach to
7 interpretation of Site F adopted by Trow. They now have
8 received your evidence and that of Dr. Rowe concerning
9 a different type of approach. Is that fair so far?

10 A. That is fair, yes.

11 Q. You have advanced certain
12 criticisms of the work that was done by Trow in
13 arriving at its interpretation and in particular with
14 respect to certain findings, you have challenged
15 certain findings; is that correct?

16 A. Yes, principally. Yes, I think
17 that is fair. I have said that I don't see the
18 evidence for the detailed classification they have
19 produced going from their stratigraphic to their hydro-
20 stratigraphic and I don't see the evidence for the
21 discharge zone. I think these are the two main areas
22 of disagreement.

23 Q. You have also cast some doubt,
24 have you not, on the existence of the highly fractured
25 zone in the form in which it was suggested by Trow?



1 A. Certainly in terms of it being,
2 the dimensions and the permeability of it.

3 Q. Then on behalf certainly of my
4 client, Dr. Charlesworth, I would like to be very clear
5 as to whether you are telling the Board that you are
6 presenting them with something entirely different and
7 something that you perceived as being fundamentally at
8 odds with the work that Trow did, or are you saying
9 something different?

10 A. I am not saying fundamentally at
11 odds. I am saying Trow have made one attempt and I am
12 suggesting another approach to answer one of the
13 questions which is the attenuation processes. I
14 wouldn't say, except for this issue of the discharge
15 zone, I wouldn't say that they are totally
16 inconsistent. They have tried to do a much more
17 detailed interpretation. As I say, I have difficulty
18 agreeing with their step from their stratigraphic to
19 their hydrostratigraphic. I have doubts about the
20 discharge zone.

21 Those, I suppose are the fundamental
22 differences. My interpretation of Site F is that this
23 site appears to be a good site. We have the evidence
24 we have poor quality ground water, we have the evidence
25 of two existing sites and now Dr. Rowe has suggested a



1 mechanism whereby we can explain why we are not seeing
2 the contaminant plumes at those sites.

3 Q. Dr. Charlesworth, quite simply,
4 regardless of which direction you came at it or which
5 direction Trow came at it, did the two analyses arrive
6 or lead to different conclusions regarding the
7 suitability of this site?

8 A. No, they arrived at the same
9 conclusion.

10 MS. CRONK: Sir, I don't know if you
11 intend to take a break?

12 MR. LANCASTER: This is an appropriate
13 time.

14 --- Recess

15
16 MR. LANCASTER: Please be seated.

17 MS. CRONK: Q. Dr. Charlesworth, you
18 recall that in the discussion you had with Mr. Tidball
19 concerning his micro approach versus macro approach
20 issue that Mr. Tidball took you to Exhibit 220, which
21 was the drawing produced by Mr. Beechinor regarding the
22 stratigraphic units at Site F, the coloured version; do
23 you recall that?

24 DR. CHARLESWORTH: A. Yes.

25 Q. There was one matter in the course



1 of that discussion between you that I did not fully
2 understand so I would like to go back to it if I might.
3 Mr. Tidball suggested to you that on a local scale, and
4 that was his preface to the question, on a local scale
5 the detail given on Exhibit H-220 was the kind of
6 detail needed to understand the flow system at Site F.
7 As I wrote down your answer, you indicated that there
8 were two ways to approach the situation. The first
9 one, you tried to work out all the details of the site
10 and then make a prediction and the second was to look
11 at it in broad terms and then make a projection. Do
12 you recall that discussion?

13 A. Yes, I do.

14 Q. My question to you, you may wish
15 to have Exhibit H-220 before you, but my question quite
16 simply is, on a general approach basis, on a general
17 scale overall, is it your opinion that the kind of
18 detail set out on Exhibit H-220 is a pre-condition of
19 gaining an understanding of the hydrogeologic flow
20 systems at Site F?

21 A. It is not a pre-condition towards
22 obtaining the necessary understanding of the flow
23 system as it relates to Site F for the purposes of
24 evaluating its suitability under the circumstances that
25 we are faced with in that area.



1 Q. On a micro scale, I think Mr.
2 Tidball in fact used both phrases on a micro scale or
3 on a local scale, need each particular of that type of
4 localized detail be accurate in your view to arrive
5 with a sufficient level of confidence at conclusions
6 regarding the site?

7 A. Under the circumstances that
8 pertain at that site, no it is not necessary.

9 Q. Could I ask you then to go back if
10 you would please to the Morrison Beatty document that
11 we were looking at just before the break and I refer
12 your attention now to page 3, the section dealing with
13 ground water resources.

14 A. Yes.

15 Q. I refer you to the second
16 paragraph which reads, starting at the line:
17 "To evaluate a potential impact," this is the bottom of
18 page 3 of the letter review report, Exhibit N-471.

19 "To evaluate a potential impact on
20 groundwater resources, a comparison must
21 examine the groundwater resource most
22 likely to be affected by a proposed
23 landfill."

24 Stopping there for a moment, do you
25 agree or disagree that that is an appropriate approach?



1 A. I would agree that is an
2 appropriate approach.

3 Q. Continuing then with the passage
4 recorded in the Morrison Beatty report,

5 "In the vicinity of Sites D and E, local
6 aquifers found in the till are potential
7 sources of water supply. Unlike the
8 area downgradient of Site F, none of the
9 properties around Sites D and E are
10 serviced with municipal water supplies.

11 The development of a landfill at
12 Sites D and E therefore creates a
13 potential risk to the existing and
14 future groundwater supplies. There is
15 no such risk associated with the
16 proposed landfill at Site F."

17 And do you subscribe to those views, Dr.
18 Charlesworth?

19 A. Yes, there is no such risk. There
20 is a potential risk that needs to be defined at D and
21 E. There is no comparable risk at F because of the
22 nature of the ground water quality.

23 Q. With respect to the nature of the
24 risk that is positted in these passages of this
25 document, it is suggested there is a potential risk not



1 only to the existing water user, but as well in respect
2 of future ground water supplies. Do you share that
3 view or do you disagree with that or do you have any
4 comment?

5 A. Yes, at Site D for example there
6 is obviously a risk if there is a water supply and
7 there is a risk. My position on Site D is that the
8 case has not yet been proven as to the degree of risk
9 that exists at Site D, whereas at Site F, I think that
10 we know, we do know that.

11 Q. At Site D, do you regard that risk
12 as extending to the future supplies of ground water as
13 well as existing supplies?

14 A. The risk which has not yet been
15 adequately defined at Site D would apply to future
16 water supplies as well as existing water supplies.

17 Q. Then the point dealt with in the
18 balance of that paragraph is one that I understand you
19 have addressed in your evidence and I am going to seek
20 your confirmation or disagreement with that. It
21 continues:

22 "An additional risk associated with
23 Sites D and E is that the use of ground
24 water from aquifer zones cannot be
25 controlled in abutting properties.



1 A high capacity well on a neighbouring
2 property, for example, could create
3 unforeseen contaminant impacts."

4 Stopping you there, I would ask you to
5 go to your own report on Site D, Dr. Charlesworth, to
6 page 6-6. At page 6-6?

7 A. Yes.

8 Q. The Site D report?

9 A. Right.

10 Q. You are discussing at that page,
11 Dr. Charlesworth, and in particular at paragraph 3, as
12 I read it, the construction of purge wells and water
13 levels in nearby domestic wells at Site D. I draw
14 your attention particularly to the last two paragraphs
15 which read:

16 "Such a well could be constructed for a
17 dairy farm or similar operation."

18 Stopping there, what type of well are
19 you talking about?

20 A. A well pumping at the kind of rate
21 that Trow were referring to in their, a well which
22 pumped at a rate comparable to the purge wells that
23 Trow talked about.

24 Q. And that rate, reading the
25 preceding paragraph, is 2.8 gallons per minute?



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A. That is the rate, yes.

Q. Is that a high, moderate or low level of yield, in your view for a domestic well?

A. For a domestic well it is moderate, but it is really not a high yielding well.

Q. Then continuing in our fourth paragraph:

"Whilst it is extremely unlikely that the well would operate continuously, it is possible that it would pump at 2 to 3 gallons per minute and if this was sustained for only twenty-four hours, it would still draw the water level down beneath the landfill.

Such a drawdown would produce the same effect as the mounding of the leachate as modelled by Dr. Rowe and combined with mounding, could lead to the onset of off-site migration of leachate."

Are you in essence making the same point in these paragraphs as is made in the paragraph at the top of page 4 of the Morrison Beatty document?

A. I would just like to read page 4. I am making a similar point. They have set an additional risk associated with Site D, is that the use



1 of ground water from aquifer zones.... they are making
2 a statement that you cannot control the use. I am
3 saying, yes, I guess we are coming at it from slightly
4 different wording, but a similar suggestion. I am
5 saying it's conceivable additional wells could be
6 drilled adjoining Site D and they are saying that you
7 cannot control future use.

8 Q. They go on to say:

9 "That a high capacity well on a neigh-
10 bouring property, for example, could
11 create unforeseen contaminant impacts."

12 You have spoken about it on page 6-6 and
13 in your judgment need it be a high capacity yield that
14 would have that impact or need it only be a moderate
15 well?

16 A. If we accept Trow's calculations
17 of the impact they have projected for the hydraulic
18 trap, that would suggest to me that a moderate well
19 could produce unforeseen circumstances if the units
20 extended to that, the granular units extended onto the
21 adjoining property.

22 Q. Are the circumstances that you
23 have in mind those set out at page 6-6, namely that a
24 well in place on a property abutting Site D with that
25 level of yield, could actually draw the water level



1 down beneath the landfill?

2 A. I am saying that it's possible
3 based on Trow's calculations that a well on an
4 adjoining property could lower the head sufficiently to
5 reverse the gradient beneath the landfill and affect
6 the hydraulic trap. It is a conceivable scenario.

7 Q. Well, do I understand the
8 principle correctly, Dr. Charlesworth, that if the head
9 in the landfill were affected in that way, it could
10 result in reversal of the trap?

11 A. Yes, we are talking about the head
12 in the upper granular unit in this case below the
13 landfill. If the head in that was lowered combined
14 with the mounding, it could affect the functioning of
15 the trap.

16 Q. Very briefly, could you explain
17 how that could occur, what is the process at work that
18 would cause that to happen?

19 A. The process would simply be that
20 you would be pumping a well on an adjoining property,
21 Mr. Chairman. There would be a cone of influence
22 extending from that well and it is conceivable that
23 cone of influence could extend from beneath the
24 landfill to affect the well on the adjoining property
25 and would lower the head in the upper granular unit to



1 beneath the landfill and therefore you would then get a
2 downward gradient combined with the mounding, you would
3 get a downward gradient and you would start to get
4 movement down into the lower granular unit.

5 I am just using the calculation there.
6 Trow have said the hydraulic trap will produce this
7 effect on adjoining properties, and I'm saying
8 similarly a well on an adjoining property could produce
9 the same effect if the unit does extend there.

10 Q. That in effect is what Morrison
11 Beatty said as well in the passage I have just read to
12 you?

13 A. Yes, I would say so.

14 Q. Now we have moved some distance
15 away, Dr. Charlesworth, from the discussion of the
16 various reports that you reviewed with respect to Site
17 F. I would just like to obtain finally your
18 understanding with respect to the hydrogeology reports
19 that are currently available to the Board. We have
20 Trow's reports on Site F and you have reviewed those
21 and the opinion expressed in those reports and by Mr.
22 Sobanski and Mr. Feenstra is that Site F is suitable
23 for landfilling and indeed from a public health and
24 safety point of view, it is preferable to Site D, is
25 that your understanding?



1 A. Yes, that is my understanding.

2 Q. Then we have the work that you
3 have done and the opinion you have expressed, which as
4 I understand it, is essentially to the same effect,
5 although you arrive at it by a different process of
6 evaluation?

7 A. Yes, that is right.

8 Q. Then as is evident from the
9 Morrison Beatty documents we have looked at, that seems
10 to be the opinion of that firm as well as with respect
11 to their acceptance of the NSP proposal?

12 A. Yes, that appears to be.

13 Q. Then with respect to the latest
14 Morrison Beatty document in point of time, the 1985
15 review document, that one was specific to a
16 consideration of Site F, and that was the opinion
17 expressed by them with respect to Site F?

18 A. That is correct.

19 Q. Then we have seen as well that Mr.
20 Cartwright in the document of his that you reviewed,
21 expressed a similar opinion that Site F was suitable
22 for landfilling?

23 A. Yes, that is correct.

24 Q. You have outlined for us in some
25 detail, Dr. Charlesworth, the specific areas in which



1 you disagree with Mr. Sobanski's firm with respect to
2 Trow's interpretation of Site F. You have stated your
3 views clearly with respect to those issues.

4 I would like to explore with you very
5 briefly, if I might, before the conclusion of the day,
6 those areas where in fact, as I understand it, you are
7 in agreement with them with respect to Site F. You
8 have said, for example, perhaps the best way to start
9 is you have told me you have reviewed Exhibit H-14 the
10 comparative analysis report prepared by Walker Wright
11 Associates?

12 A. Yes, I did.

13 Q. You recall that Appendix A to that
14 report is a comparative analysis prepared by Trow
15 setting out the hydrogeological features of both Sites
16 D and F and comparing them?

17 A. Yes.

18 Q. Trow has suggested that Site F has
19 a number of advantages for sanitary landfilling that
20 Site D does not have. I reference specifically that
21 document and to save time I will just put them to you
22 and ask for your views. If you need the document, by
23 all means.

24 They suggest and express the opinion
25 that Site F has no downgradient ground water users



1 within a kilometre of the site and they perceive that
2 to be an advantage of the site over Site D. Do you?

3 A. Yes, I do.

4 Q. They suggested secondly that the
5 ground water at Site F was of a poor quality and was
6 essentially non-potable and they perceived that to be
7 an advantage of Site F over Site D as well; do you?

8 A. Yes, I do.

9 Q. We know that with respect to Site
10 D, there are water-bearing units based on your review
11 of the site, is that so?

12 A. Yes, that is so.

13 Q. Do you see that as being a
14 distinguishing feature between Sites F and D or not?

15 A. It is one of a number of, they are
16 different hydrogeological environments. That is one of
17 the differences. We don't know how extensive they are
18 at Site D, that is my concern.

19 Q. Trow also suggested in their
20 comparative analysis that the fact that there was a
21 municipal piped water supply available to residents
22 downgradient of Site F, was an advantage of Site F over
23 Site D; do you perceive that to be an advantage?

24 A. Yes, I think that is an important
25 advantage.



1 Q. Fourthly, Trow suggested that
2 there were no surface water users downstream of Site F
3 and as they had with respect to ground water users they
4 perceived the lack of surface water users as being an
5 advantage of Site F over Site D. Do you?

6 A. I have to confess I am not sure
7 about the extent of surface water users at D. I would
8 be misleading the Board if I said that I could compare
9 those. If there are no surface water users
10 downgradient of Site D and I have difficulty recalling
11 that, then that would be an advantage, yes.

12 Q. Are there any to your knowledge at
13 Site F?

14 A. Not to my knowledge, no.

15 Q. Then fifthly, Trow suggested and
16 expressed the opinion that the lack of foreseeable
17 future ground water users or surface water resources at
18 Site F was a distinct advantage of Site F over Site D?

19 A. Yes, I would agree with that.

20 Q. The next advantage articulated by
21 Trow was that the ground water flow system at Site F,
22 as they perceived it, was nearly uni-directional.
23 That's how they described it. They suggest that the
24 control systems at Site F would be easier and cheaper
25 to install if they were required.



1 In combination, they regarded those
2 features as being advantages at Site F over Site D. Do
3 you agree or disagree?

4 A. Certainly the flow direction is
5 essentially uni-directional. In the worst case at
6 either site, it would definitely be cheaper, I would
7 expect it to be cheaper at Site F than at Site D. You
8 have to be careful. If it turned out it only required
9 purge wells along one side of Site D, then there may
10 not be an added advantage, but there is the potential
11 for an advantage in that area.

12 Q. With respect to the first aspect
13 of the opinion expressed by Trow, that is an opinion
14 that you share in terms of the flow system?

15 A. Yes.

16 Q. Then as a seventh advantage, Trow
17 indicated the fact that sewers were in place and
18 available near Site F to receive leachate as an
19 advantage of that site over Site D. Do you regard that
20 as an advantage in comparative terms?

21 A. Yes, that would seem to be an
22 advantage. It's not a hydrogeological advantage, but
23 it would seem to be preferable to trucking.

24 Q. Overall, as I suggested to you a
25 few moments ago, it was the opinion of Trow, as



1 expressed to this Board that from a public health and
2 safety point of view, Site F was to be preferred over
3 Site D. From that perspective and with that focus, do
4 you agree or disagree with that opinion?

5 A. Yes, from a hydrogeological aspect
6 I would agree. Well, sorry, could you say that again?

7 Q. Overall, Trow expressed the
8 opinion that from a public health and safety viewpoint,
9 Site F was preferable to Site D for regional
10 landfilling. Do you agree with that or disagree?

11 A. I think the case, the case at D,
12 as I have said, is not proven, as there are no ground
13 water users at Site F that would be likely to be
14 impacted, yes I would agree.

15 Q. I am going to suggest some other
16 potential areas of agreement between you as well, Dr.
17 Charlesworth, and if I am incorrect, please tell me.

18 Mr. Feenstra indicated in his evidence
19 before the Board that based on the contaminant
20 migration work which he had performed, Site F possessed
21 natural attenuation characteristics which he regarded
22 as being superior to those at Site D. Do you share
23 that view?

24 A. Based on what I understand from
25 Mr. Feenstra's testimony and Dr. Rowe's work, yes, I



1 would agree.

2 Q. Mr. Feenstra also expressed the
3 opinion to the Board that in the case of Site F, we
4 need not be concerned about adverse impacts from any
5 possible contamination south of the site. Given the
6 nature of your evidence, I take clearly that that is
7 also your opinion?

8 A. I am sorry, could you repeat that,
9 please?

10 Q. Mr. Feenstra indicated that it was
11 his opinion that in the case of Site F, the Board need
12 not be concerned about the possibility of adverse
13 impact from contaminants south of the landfill site?

14 A. Yes, from everything that I have
15 seen, I think, it is my opinion that the Board need not
16 be concerned.

17 Q. Mr. Sobanski in his evidence,
18 indicated and expressed the view that Site F was an
19 unusual site in Ontario in many ways and agreed that in
20 his view the advantages it affords should be utilized.
21 Do you regard Site F as unusual in hydrogeological
22 terms?

23 A. Yes. Yes, I would agree with
24 that.

25 Q. In what respect?



1 A. You have got poor quality ground
2 water. You have got poor quality ground water and you
3 have test cases located beside it. I think from that
4 point of view it is extremely unusual and it does
5 afford a valuable resource in terms of waste disposal.

6 Q. Do you agree or disagree with the
7 suggestion that the presence of those unusual features
8 encourages the acceptance of Site F for landfilling?
9 Let me put that very clearly. Are there features of
10 sufficient significance to your mind that they warrant
11 approval of Site F?

12 A. The features that I just
13 mentioned, yes.

14 Q. Could I ask you to go to page 2 of
15 your report on Site F? That is Roman numeral ii,
16 and I direct your attention, Dr. Charlesworth to the
17 concluding paragraph at page ii which reads:

18 "With a gravity fed leachate collection
19 system, greater slopes on the landfill
20 base, naturally poorer ground water
21 quality, no essential water supplies
22 being placed at risk and a proven track
23 record from existing landfills, it is
24 our opinion that Site F is clearly
25 preferable to Site D as the location for



1 a regional landfill."

2 Now some of those features we have
3 discussed because they were raised by Trow. Do you
4 regard the fact that at Site F there is a gravity-fed
5 leachate collection system as being an advantage of
6 that site over Site D in terms of a comparative
7 analysis?

8 A. Yes, I am not an expert on
9 landfill design and leachate collection systems, but it
10 seems to me, it seems to be an obvious advantage.

11 Q. And why is that, in general terms?

12 A. The factors that Dr. Rowe
13 outlined, sorry, in my mind I was combining the two,
14 the greater slopes and the gravity-fed system. The
15 greater slopes will tend to reduce clogging and the
16 gravity-fed system means you are not relying on a
17 pumping system that may fail.

18 Q. So those two features are, to your
19 way of thinking and in your professional opinion,
20 advantages of Site F?

21 A. I would think so, yes. As I say,
22 I am not an expert on leachate collection systems, but
23 it would seem to me they are an advantage.

24 Q. Than a further factor, which you
25 reference, which Trow did not, specifically listed in



1 the same fashion what you called a proven track record
2 from existing landfills and given the nature of your
3 remarks throughout your evidence, do I take it you
4 regard that as a significant advantage of Site F over
5 Site D?

6 A. I think that is a very important
7 factor of the site. For whatever reason, it can be
8 debated about why a problem has not occurred at those
9 sites. The bottom line of it is that there has not
10 been a problem and one site has been there for a
11 considerable period of time. I think that is a very
12 important factor to take into account when assessing
13 the suitability of Site F.

14 Q. Are there, Dr. Charlesworth, any
15 other advantages of Site F over Site D, apart from
16 those that I have mentioned in your professional
17 opinion?

18 A. I think you seem to have covered a
19 pretty comprehensive list. There may be some you have
20 missed, but at this moment they don't come to mind, Mr.
21 Chairman.

22 Q. There has been some considerable
23 discussion during Mr. Tidball's cross-examination and
24 discussion with you about the results obtained by
25 Gartner, Lee at their GL-24 testing well 25 metres



1 downgradient from the landfill. Do you recall you had a
2 discussion yesterday with Mr. Tidball about it and
3 again today? Do you recall that?

4 A. Yes.

5 Q. Could I ask you to go to the plume
6 delineation study, please, that is Exhibit H-83, Mr.
7 Chairman.

8 I ask you to go to page 58, please,
9 Dr. Charlesworth.

10 A. Yes.

11 Q. You recall that your attention was
12 drawn to the depth from grade as recorded in the gravel
13 packs for the three piezometers at GL-24?

14 A. Yes, I do recall that.

15 Q. Piezometer 1 appears to have been
16 screened, as suggested by Mr. Tidball, over a length of
17 1.2 metres?

18 A. Yes, that is correct.

19 Q. That was at a depth of 17.1 to
20 18.3 metres?

21 A. That is correct.

22 Q. Piezometer 2 appears to have been
23 screened at the same interval, 1.2 metres, the same
24 length of interval, 1.2 metres?

25 A. That is correct. Or at least that



1 is the gravel pack, yes.

2 Q. At depths of 11.2 to 12.4 metres?

3 A. Yes, that is correct.

4 Q. Piezometer 3 was placed at a depth
5 of 2.1 to 6.2 metres and appears to have been screened
6 over 4.1 metres; is that correct?

7 A. That is correct.

8 Q. As I understood, at least part of
9 the discussion that took place, it was suggested to you
10 that it was possible, given the nature of the drilling
11 technique used by Gartner, Lee that all of those
12 piezometers might not have been located in the fracture
13 zone, so that there might in fact be contaminants there
14 that were not detected by virtue of the misplacement,
15 if I can put it that way, of the piezometers? Do I
16 have in essence the suggestion?

17 A. I was asked if it was possible
18 that they would fill two....

19 Q. You agreed it was?

20 A. Yes, I agreed it was possible.

21 Q. Could I ask you now to go to page
22 48, which is the borehole log for GL-24.

23 DR. KINGHAM: I wonder if before you
24 turn to that you can just clarify, what is the
25 difference between screened interval and gravel pack?



1 DR. CHARLESWORTH: The screen is, you
2 have the casing in the borehole and then you have a
3 slotted section which is the screen. The gravel pack is
4 placed in the annulus around the screen and fills the
5 annulus between the screen and the outside of the
6 borehole. It is not always, sometimes the gravel pack
7 may be over a longer distance than the screen which
8 will still permit water to enter, although there is
9 some discussion about that.

10 DR. KINGHAM: So when you were asked the
11 question about the screened interval, it referred to
12 the stratum that was sampled and hence you referred to
13 the numbers listed under gravel pack?

14 DR. CHARLESWORTH: Gravel pack, that is
15 the length, yes.

16 MS. CRONK: Q. Could I ask you now to
17 go to page 48, Dr. Charlesworth, the borehole log.
18 There is there set out a description of the
19 stratigraphic conditions for borehole 24?

20 DR. CHARLESWORTH: A. There is.

21 Q. These are, I should ask, are
22 these, as I understand them to be, descriptions that
23 would have been recorded by the Gartner, Lee Associates
24 personnel in the field who actually conducted the
25 drilling test?



1 A. That I presume is correct, that is
2 normal procedure.

3 Q. Could I direct your attention, let
4 us just move down from depth, from surface down. It
5 appears that the first 0.2 metres were topsoil?

6 A. That is correct.

7 Q. From 0.2 metres down to 1.2 metres
8 it was till, described as a red brown clayey silt till?

9 A. Yes, that is right.

10 Q. Then from 1.2 metres right down to
11 18.3 metres, we have the description set out under the
12 title weathered shale, is that correct?

13 A. Yes, that is correct.

14 Q. Perhaps we could just read that.
15 It provides red brown weathered shale with few random,
16 very thin grey-green silt lenses below 1.5 metres, plus
17 or minus up to 4 millimetres thick?

18 A. That is correct.

19 Q. Becoming less weathered with depth
20 below 4 metres plus or minus, also with grey-green thin
21 hard bands at random intervals, particularly below 8
22 metres plus or minus to 9 metres, plus or minus and
23 generally fractured and wet below 8 metres, plus or
24 minus, correct?

25 A. That's the description, yes.



1 Q. Dealing first with the weathered
2 shale, which is described as having been in place down
3 to about a depth of 4 metres, first of all am I
4 interpreting the depths correctly, from 1.2 metres to
5 about 4 metres, plus or minus, it was quite weathered
6 and then became less weathered?

7 A. Yes. Yes, that is right.

8 Q. Does the term weathered in your
9 experience, connote a dryness, fractures, fissuring,
10 general break up of material, or can we take anything
11 from that term one way or the other?

12 A. It can be quite variable. It
13 implies it has been weathered and is starting to break
14 down, a competent shale.

15 Q. If it had broken down, is it
16 possible there would be fracturing in that type of
17 material?

18 A. Well, you may well get the
19 reverse. You may get a fractured shale that when it
20 weathers, the fractures become less clear because the
21 shale is breaking down and weathering.

22 Q. So we can't take anything
23 one way or another from that?

24 A. It's difficult to know what to
25 take from that description.



1 Q. It is certainly not determinant of
2 whether the fractures were present?

3 A. I wouldn't think so, no.

4 Q. Then we have the notation that at
5 plus or minus 8 metres and below it was generally
6 fractured and wet, is that correct?

7 A. That is correct.

8 Q. If we look back at the piezometer
9 depths at which the three piezometers at which GL-24
10 were placed and the intervals over which they were
11 screened, am I correct that at least two of them were
12 placed at depths greater than 8 metres in the area that
13 is described as being generally fractured or wet?

14 A. Yes, the scale is illegible on
15 mine, but I am referring back to 24; two of them were
16 below that, yes.

17 Q. Indeed, in the case of one of the
18 ones, I am sorry, in combination, the two that were
19 below a depth of 8 metres were screened over an
20 interval of 2.4 metres?

21 A. That is correct.

22 Q. Mr. Tidball suggested to you that
23 it is possible that based on the depths of those
24 piezometers and their screening intervals, that they
25 had not been screened in fractured areas and you



1 confirmed that you indicated that was possible.
2 Looking now at the borehole description obtained for
3 the stratigraphic materials at depths of 8 metres and
4 more, do you regard that as a probability or can you
5 express any judgment on it?

6 A. It is difficult to tell. Once,
7 they appear to have, they were drilling with air
8 rotary, they took split spoon samples in the upper
9 part. I guess the TC is when they were....
10 it is difficult to know how good the samples were they
11 were working on. I think you can say, I have to
12 concede, faced with the question that it is possible
13 that fractures were missed, I don't think it is
14 probable and I certainly don't think it is probable
15 that any serious plume that was passing through would
16 be missed by those piezometers, but in hydrogeology,
17 ground water there is always the possibility.

18 Q. Short of a metre by metre
19 description of the stratigraphic characteristics of the
20 materials at a depth below 8 metres, what would the
21 general practice be in describing, I am phrasing it
22 badly, let me back up.

23 We have in the borehole description log
24 a suggestion that below 8 metres the materials were
25 generally fractured - let me just finish the question.



1 Had that condition altered or had there been any marked
2 difference in that general description would you, in
3 accordance with normal practice, have expected that to
4 be noted?

5 A. One would expect it to be noted.

6 Q. Clearly it was not?

7 A. It is not noted.

8 Q. Could I ask you as well to look at
9 HC-15. Perhaps just very quickly you could look at the
10 map that is already marked as M-437-D1. That well is
11 further south from GL-24, is it not?

12 A. Yes. I am now just pointing to it
13 on the exhibit.

14 Q. Could I ask you to go to Exhibit
15 H-40, actually H-40A, the appendices of Trow's report
16 and I am going to refer you, Dr. Charlesworth, to
17 Appendix 4 which includes the observation well
18 construction details for the Trow monitoring wells?

19 A. Right.

20 Q. Conveniently it is only the second
21 page in. You shouldn't have any trouble finding it.

22 A. HC-15?

23 Q. Yes, do you have that?

24 A. Yes.

25 Q. I would like you to confirm for



1 me, if you would please, the depths at which the four
2 piezometers at HC-15 were placed and the intervals over
3 which they were screened?

4 A. They were, starting from the top,
5 which is piezometer No. 4, it was at a depth of 5.8.
6 It appears to have a sand pack from 104.9 to 107.4.
7 So, 1.5 metres.

8 Q. Piezometer 3?

9 A. Piezometer 3, the depth would be
10 11.9 from 99.8 to 100.7. So it would just have a sand
11 pack of 0.8 of a metre and piezometer 2 is at a depth
12 of 18 metres, while 93.7 to 94.6, so 0.9 of a metre.
13 Piezometer 1, a depth of 25.9 from 85.8 to 87.1. 1.8
14 metres.

15 Q. Thank you. Perhaps you could keep
16 your hand or a pen at that page and I would ask you to
17 go back if you would please, to the borehole logs for
18 the Trow wells which are Appendix 2 to the core log for
19 HC-15. I am sorry, you are just going to have to flip
20 through those till you get to HC-15. They are numbered
21 in sequence. Do you have it?

22 A. I have it, yes.

23 Q. I draw your attention, I am
24 looking at sheet 1 or 3 for HC-15-86?

25 A. I have that.



1 Q. I draw your attention to the
2 general description of the stratigraphy in that
3 corelog, in particular to the portion of the
4 description which indicates that there were fractures
5 located at various depths below surface; do you see
6 that? I am sorry, it's about the sixth paragraph down?

7 A. Yes, I see it.

8 Q. And the depths at which fractures
9 are recorded are 15.2 metres, 18.10 to 18.38 metres,
10 25.69 to 25.76 metres; am I reading that correctly?

11 A. Yes, you are reading that
12 correctly.

13 Q. Would you relate that please to
14 the four piezometers at HC-15 that we have just looked
15 at and tell me if any of those four piezometers were
16 situate in areas noted to have fracturing?

17 A. Well, the depth I am assuming
18 refers to the tip, in which case it extends up from
19 25.9, the bottom one could coincide with the fracture
20 from 25.6 to 26.76. The next one it says depth 18
21 metres. It could coincide with 18.10 to 18.38. That
22 is the depth of the tip.

23 Q. So stopping there for a moment,
24 those two appear to have been in areas denoted as being
25 fractured?



1 A. Denoted as being fractured, that
2 is correct.

3 Q. Based on my calculations which I
4 hasten to add may not be correct, the other two were
5 not. Could you confirm it?

6 A. It looks as though they are not.

7 Q. I don't know if you have available
8 to you, Dr. Charlesworth, and perhaps very quickly if I
9 could just show it to you, I am going to refer Dr.
10 Charlesworth, Mr. Chairman, to Exhibit N-189C, which
11 was one of a series of overheads put in through Mr.
12 Sobanski setting out the results, the concentrations of
13 contaminants measured by various testers, including the
14 Trow results at HC-15. Do you have it?

15 A. Yes.

16 Q. N-189 deals with the organic
17 readings obtained by Trow at HC-15?

18 A. Yes. I have a hole punched
19 through it, but those are the numbers on the lefthand.

20 Q. Can you confirm for me that in
21 these three piezometers tested for volatiles, none were
22 detected?

23 A. None detected, that appears to be.

24 Q. And the three tested were
25 piezometers 2, 3 and 4?



1 A. That is correct.

2 Q. Which includes, is it one or two
3 of the ones that were in fractured areas?

4 A. I think it is two of them; I will
5 have to go back to the table, 3 and 4 were in
6 fractures.

7 Q. No...

8 A. Sorry, 1 and 2 were in fractures.

9 Q. So it includes one of them and no
10 volatiles were detected at that location; is that
11 correct?

12 A. That is correct.

13 Q. Do you have available to you there
14 a copy of Exhibit N-189A and B; those are the sulphate
15 and chloride readings for that well location obtained
16 by Trow in their sampling?

17 A. Sulphate and chloride, yes.

18 Q. Can you confirm for me that with
19 respect to chloride at HC-15, very high levels were
20 obtained at the four piezometer depths tested, in the
21 thousands?

22 DR. KINGHAM: I think we have a problem.
23 We have got a 189 and a 189C but we don't have the 189A
24 or B.

25 MS. CRONK: I think the problem, Dr.



1 Kingham, as I now recall it is that HC-15 was one of
2 those that was subsequently tested and I wrote those
3 numbers in my copy from the oral evidence. I apologize
4 for that. I tend to forget with the passage of time.
5 I will find that over the evening.

6 As I recall, Dr. Kingham, there was a
7 separate document provided to us by Trow.

8 DR. CHARLESWORTH: There is an exhibit
9 with those analyses on it in the form of a letter. It
10 is Exhibit 190, it appears to be.

11 MS. CRONK: Q. I am sorry, Dr.
12 Charlesworth. Can you confirm for me as I don't have
13 the letter in front of me that the readings for the
14 chloride measured at that well location are in fact in
15 the thousands at each piezometer?

16 DR. CHARLESWORTH: A. They start from
17 19,750 in piezometer 1, the deep piezometer, 17,150 in
18 piezometer 2, 6,800 in piezometer 3 and the other
19 piezometer is actually probably almost at the contact,
20 but it is 3,700.

21 Q. And that well location you have
22 already confirmed, is between the CN tracks and Highway
23 403?

24 A. Yes, directly downgradient of the
25 Burlington landfill.



1 MS. CRONK: Mr. Chairman, I will not
2 finish this evening, and there is a matter that counsel
3 wish to raise with you, so if it is convenient to you,
4 perhaps it would be appropriate that that occur now.

5 MR. LANCASTER: All right.

6 MS. CRONK: Q. Perhaps for ease in
7 the morning, would you go over the same exercise in the
8 evening with GL-26 so you are in a position to confirm
9 for us the piezometer depths, the piezometer depths,
10 the screening intervals and how they relate to the
11 borehole log description and stratigraphy?

12 DR. CHARLESWORTH: A. Yes, I will do
13 that.

14 MS. CRONK: Thank you, sir.

15 MR. McQUAID: Mr. Chairman, Dr. Kingham,
16 to this point in the proceedings, at least in this
17 portion of the proceedings by agreement between the
18 Regional counsel and the counsel for the City of
19 Burlington, we have been able to work out the order of
20 cross-examination, but we are at the point where we
21 have a disagreement and we have to ask for a ruling on
22 what the order should be after Ms. Cronk.

23 My position on behalf of the City of
24 Burlington as I have indicated to Mr. Hodgson, is that
25 we should go after the Region and of course he says



1 that he should go after me. So that is basically, and
2 after I should say the City of Burlington and Ms. Vigod
3 as well.

4 My position, just so you have it, sir,
5 is this. Milton, and I ask you to look at it from the
6 point of view of this panel of witnesses, Milton has
7 put forward a case which says F is far superior to D.
8 As a matter of fact, D should not be approved at all.
9 The Region, their basic case is F is somewhat
10 adverbially ahead of D, marginally is the word we have
11 used from time to time, but it is ahead of D.

12 It is my submission that insofar as this
13 panel of witnesses is concerned, that the regional
14 position is closer in interest than of course the
15 interest of the City of Burlington. Our position of
16 course is that we say D should be approved and F should
17 not be approved. We are much more adverse, if I can
18 put it that way, in terms of cross-examination.

19 Accordingly because we are much more
20 adverse, it is my position that the City of Burlington
21 and Ms. Vigod's clients will be much more prejudiced by
22 being required to go ahead, then having the Region
23 after and then having re-examination by Mr. Estrin
24 after.

25 I ask the Board to bear in mind when



1 they are considering what the order will be, that of
2 course Milton does have the right to re-examine.
3 They, in a sense, are in a very friendly interest with
4 the Region. Therefore if there was something that
5 because I went last and Ms. Vigod went last, that Mr.
6 Hodgson wanted buttressed or redressed, he has the
7 opportunity by speaking to Mr. Estrin, who has the last
8 series of questions that are to be put.

9 On the other hand, if the Region goes
10 after me, there are aspects with respect to this
11 overall position of which site is ahead, F ahead of D
12 and so on, that I would not be able to address, nor
13 would Ms. Vigod.

14 So, on the grounds first of all of more
15 prejudice, I am asking that I be allowed and Ms. Vigod
16 be allowed to go after Mr. Hodgson.

17 There is a second, although I concede
18 not as important an aspect, it has also been, I think
19 it would be much more expeditious for everyone if the
20 Region went ahead and then if things developed as, I
21 believe, we might expect or hope, we might have much,
22 much reduced in terms of questions.

23 I think on the grounds of efficiency and
24 expedition, there would also be reasons for the Region
25 going ahead. On those two reasons, I am asking that



1 you rule that Mr. Hodgson go next and I follow and Ms.
2 Vigod after that.

3 MR. LANCASTER: Thank you.

4 Ms. Vigod, do you have some comments?

5 MS. VIGOD: I support Mr. McQuaid's
6 position. I guess we feel like we may be a bit of
7 bologna in the middle of the sandwich. We may not be
8 able to, obviously with Mr. Hodgson and Mr. Estrin both
9 following to buttress the position, that we would be
10 left out in the cold. I think it is more prejudicial
11 to us.

12 MR. MCQUAID: I might say also, sir, I
13 thought ahead to the fact that this order cuts, the
14 sword cuts both ways and when I am leading evidence on
15 behalf of Burlington, our position in fact will be the
16 reverse of what it is right now on the basis of the
17 evidence and the material that we will be supplying.
18 In which event Mr. Estrin would be, based on the ruling
19 of the order that I am suggesting, would be also going
20 after the Region in that particular area, at which
21 point I would have the right of re-examination and if
22 there was something that needed buttressing and so on,
23 Mr. Hodgson could come to me if there was something.

24 I am saying that the fairness cuts both
25 ways. Milton will be entitled, I think, subsequently,



1 based on the thrust of our evidence to do the same
2 thing.

3 MR. LANCASTER: Thank you.

4 MR. HODGSON: Thank you, Mr. Chairman.

5 The Region's position obviously is that
6 it regards itself as severely prejudiced if it is
7 required to cross-examine ahead of the City of
8 Burlington and Ms. Vigod on behalf of her clients.

9 I want to remind the Board that the
10 Region set out to find a new regional landfill site in
11 1974, January, 1974. Sorry, this is February, 1988. We
12 are fourteen years into this little event and
13 presumably on the home stretch, perhaps at least on the
14 home stretch. There isn't any party in this proceeding
15 that has more at stake than the Region. I want to
16 remind the Board this is the Region's application.

17 Now, where we are in the evidence is
18 that the Region has led its hydrogeological and design
19 and operations evidence and what we have seen to date
20 from the Town of Milton is very critical, a very
21 critical review of the Region's evidence at Site D and
22 a very critical review of the Region's evidence at Site
23 F.

24 That, going into this situation, I might
25 have expected that I would find a little help from the



1 Town of Milton on Site F, but in fact I don't see any
2 help at all. I see unrelenting criticism. It is the
3 Region's case that is being attacked. It is being
4 attacked on both sides.

5 In my respectful submission, before the
6 Region stands up and exercises its right to cross-
7 examine these two witnesses on behalf of the Town of
8 Milton, the Region is entitled to hear everything, all
9 of the criticisms that these two witnesses have to
10 offer against the evidence of the Region. We have heard
11 some of that criticism during examination-in-chief, we
12 have heard more under cross-examination, and I fully
13 expect that before Mr. McQuaid and Ms. Vigod sit down,
14 we are going to hear more still. They are in a
15 position to elicit a lot more criticism on both sites.

16 In my respectful submission, it is not
17 fair that the Region have to cross-examine until it has
18 heard all that these witnesses have to offer.

19 Now, dealing directly with Mr. McQuaid's
20 submissions, first of all he suggests it is more
21 expeditious. I think he thinks it would be more
22 expeditious on the basis that presumably I am going to
23 do what I can to test the evidence of these two
24 witnesses at both Site F and Site D and that if I do my
25 job properly, there won't be anything left for Mr.



1 McQuaid and Ms. Vigod to do. Perhaps that can be
2 equally turned around. If they do their job on these
3 two witnesses, there won't be anything left for the
4 Region to do. I don't know. I suggest it won't be
5 any more or any less expeditious, one way or the other.
6 I don't think you should make the decision based on
7 that consideration.

8 Mr. McQuaid is concerned about
9 prejudice to the City of Burlington. I would like to
10 remind the Board that more or less since this hearing
11 started, Burlington has had the opportunity to cross-
12 examine each one of the Region's witnesses last.
13 Therefore, Burlington has been in the position in
14 respect of Milton that it now finds itself in, should
15 the Region be permitted to cross-examine after
16 Burlington. That is to say that after Burlington has
17 sat down, it faces the possibility that somebody else
18 is going to cross-examine behind it and perhaps raise
19 some issues that it doesn't like.

20 First with respect to that, you have
21 already ruled on more than one occasion that a party
22 that feels prejudiced in that circumstance has the
23 right to ask for the opportunity to cross-examine again
24 and you have offered that right at least to Mr. Estrin
25 on one occasion. I don't know whether or not Mr.



1 McQuaid has asked for that. I would assume that that
2 offer is still open by you and therefore I don't think
3 that Mr. McQuaid or Ms. Vigod are going to be
4 prejudiced by going after the Region.

5 The other thing I wish to remind the
6 Board is that not only has Mr. McQuaid had the right to
7 cross-examine last, he also has the right to lead his
8 evidence last. That has meant that on the 3rd of
9 February 1988, some two years after the Region has
10 produced its hydrogeological reports, we haven't seen
11 Mr. McQuaid's evidence, Mr. McQuaid's hydrogeological
12 evidence. He now has the right to cross-examine, he
13 has the right to look at everybody else's evidence and
14 examine everyone else's evidence before he runs out his
15 evidence for public review and public criticism.
16 Mr. McQuaid has a very severe advantage already in this
17 hearing in that he gets to lead his evidence last and
18 that he gets to lead it behind Mr. Estrin, and
19 obviously behind the Region.

20 In my respectful submission, he
21 shouldn't have it both ways, he shouldn't have the
22 right to always cross-examine last and always lead his
23 evidence last and therefore always get the last word.

24 To go back to my first point, the Region
25 is the proponent. No other party has as much at stake



1 in this hearing as the Region and I would like
2 respectfully to remind the Board, the City of
3 Burlington and the Town of Milton are part of the
4 Region and therefore they have a lot at stake in the
5 Region's case and not just in their own cases. I
6 would ask that we should have the right to cross-
7 examine after it has heard everything these witnesses
8 have to say with regard to these two sites.

9 MS. CRONK: Mr. Chairman, I wonder
10 before you hear from Mr. McQuaid...

11 MR. MCQUAID: I would like to address in
12 reply.

13 MR. ESTRIN: I may have a comment.

14 MS. CRONK: I rise, sir, because Mr.
15 McQuaid has enlarged the issue from one as between only
16 the Region of Halton and the City of Burlington,
17 because he has suggested to you that the ruling you
18 make now works both ways in that the principle of
19 fairness that goes into this ruling will affect the
20 order of cross-examination of Burlington witnesses.

21 Now as compelling and attractive as that
22 is to me, because he quite rightly anticipates that we
23 will be taking the position when his witnesses are
24 called, that we follow the Region in cross-examination,
25 at least in respect to some of them, it is difficult to



1 predict with any accuracy, because we haven't seen any
2 of their evidence and we don't know what they are going
3 to say.

4 I rise to address that because it seems
5 to me that the situation is, with these two witnesses
6 it is what I perceive to be and suspect will prove to
7 be at the end of the day an anomaly, quite different
8 from what will happen with Burlington's evidence and
9 what has happened to date. The reason for that is
10 because, and Mr. Hodgson alluded to it.

11 The evidence that has come from these
12 two witnesses has been highly critical of the Region
13 with respect to Site D. It has also been critical with
14 respect to Site F. That might not have been anticipated
15 in advance. In any event, that is the result. That
16 puts Mr. Hodgson in the position where he is against
17 Milton with respect to Site D with these witnesses but
18 he is also against Milton, certainly in part, taken
19 from his submissions to you, in large part with respect
20 to Site F. That is not quite the situation that might
21 have been envisaged. That is precisely Mr. McQuaid's
22 position. He is against Milton with respect to Site D
23 and he is against Milton with respect to Site F with
24 these witnesses. It seems they are in precisely on
25 their own submissions to you, the same position. That



1 arises because these witnesses, in reaching their
2 opinions on Site F, have done so in a way that is
3 critical to the Region's case and calls into doubt the
4 nature of the evidence you have heard from the Region.

5 When we come to hear the witnesses
6 called on behalf of Burlington, one might fairly assume
7 that what we will hear is that Site D is wonderful and
8 Site F is terrible, it should never have been
9 considered. That is a considerably different position
10 for the Region to be in than the one it is in now.

11 I don't suggest obviously that I can see
12 into the future, but certainly all legal counsel in the
13 room don't need a crystal ball to see that perhaps that
14 is the way the evidence will flow. If that is the
15 case, a very different fairness issue arises in cross-
16 examination in those circumstances than arises now. I
17 felt obliged, Mr. Chairman, to put my position to you
18 now, because I do not support the view that the ruling
19 you make today predetermines the ruling that will be
20 appropriate with respect to future witnesses. That is
21 point A.

22 Secondly, I perceive the evidence of
23 these witnesses to be of a different kind in terms of
24 interest than you may anticipate in the future. For
25 example, let me say I had discussions with Mr. Hodgson



1 before I rose to cross-examine today and made it quite
2 clear that my agreement that I would do so quite
3 appropriately with these witnesses before he should do
4 so, was in no way binding nor reflective of the
5 position I take with respect to Burlington's witnesses
6 or Ms. Vigod's witnesses. I think it quite premature
7 and possibly quite inappropriate to suggest that the
8 ruling you make today shall govern in the future. You
9 will see the positions will be quite different.

10 MR. ESTRIN: I can understand Mr.
11 McQuaid's initial suggestion that he feels in some
12 difficulty in equating that to how Milton might feel
13 after his case is put in and where we would want to
14 come, but for all the reasons given by Ms. Cronk, I
15 believe the situations are not comparable.

16 Having heard what Mr. Hodgson has had to
17 say and how he regards the Town of Milton's evidence,
18 hydrogeological evidence, with respect to Site F,
19 certainly I can understand the reasons why he is making
20 the submissions that he is now, and certainly I don't
21 oppose those submissions.

22 As Ms. Cronk has said, I certainly think
23 that we will have to, what I say right now should not
24 be taken as any indication of the submissions that I
25 may make as to what order is appropriate in cross-



1 examination of Burlington's hydrogeological evidence
2 because if indeed it turns out that their evidence is,
3 that D is an appropriate site and F is not, then I
4 believe that would make it appropriate and necessary
5 for me to take the position that we indeed should go
6 last.

7 MR. McQUAID: Sir, I would submit when
8 you look at Mr. Hodgson's point, it is that the degree
9 of criticism is not what determines the order. The fact
10 that there has been criticism of Site F by Milton's
11 panel of witnesses is really to the point that they
12 have not gone far enough, that the regional consultants
13 have not gone far enough in saying, as the Region does
14 in its position, that F is better than D, criticizing
15 in effect to say it is much, much better and by the
16 way, D is much, much worse. So the gap is wider. The
17 position is still the same, the Region's position and
18 the Town of Milton's position is the same, F is better
19 than D.

20 Now, Mr. Hodgson said, on the issue of
21 whether it is more expeditious, if I do my job and so
22 on, and if he does his job, where the position would
23 be. That is exactly the problem. If he does his job
24 for the Region, his job is to set F ahead of D in the
25 end analysis. He may try and widen or narrow the gap



1 between F and D as put forward by Milton, but it is
2 certainly not the thrust of his position to put D ahead
3 of F. That is exactly why I say that the City of
4 Burlington will be more prejudiced. If I and Ms.
5 Vigod were able to do what we would set out to do for
6 our clients and put D ahead of F in this race, that
7 would be something different. We can only probably
8 narrow the gap, the odds of us being able to put D
9 ahead of F, and see what comes out of the cross-
10 examination, that is very difficult, having examined
11 the position realistically that Milton has put forward.

12 Mr. Hodgson may be very content just to
13 narrow the gap and leave F ahead of D, whereas it is
14 our responsibility on behalf of our clients to go as
15 far as we can in order to reduce that gap and to put D
16 ahead of F if at all possible at this point in the
17 cross-examination.

18 Finally, the third point about us filing
19 our evidence at the end and so on, that really is
20 irrelevant. It is not a case of your turn, my turn,
21 you go last because you went -- I would urge you, sir,
22 that you look at the witness, look at the issues, look
23 at the nature of the evidence and who is prejudiced at
24 each particular panel. It is not a case of well,
25 you've had an opportunity to go last in the past, nor



1 should we be punished for the fact that because we are
2 most at risk, the Board ruled earlier on, quite
3 correctly in my submission, that we have a certain
4 right to go last in the order in terms of presentation
5 of evidence. Most risk is usually in most judicial
6 proceedings, last. That is exactly the position we
7 were put in in terms of adducing our evidence. That
8 really accounts for the reason that at this point we
9 are where we are in the order of presentation of
10 evidence.

11 So, when you come back to the two points
12 that Mr. Hodgson has addressed, I would submit that we
13 are entitled to go after him. I really do not see the
14 differentiation that Ms. Cronk and Mr. Estrin have
15 made. I think really in terms of what the real thrust
16 of the Region's cross-examination and the Town's case
17 has presented, really come down to the same thing.
18 They both say F is better than D and accordingly it is
19 my submission we should be entitled to go last and Ms.
20 Vigod should be able to go after us as well.

21 MR. HODGSON: Mr. Chairman, I wonder....

22 MR. LANCASTER; I wonder if Ms. Vigod
23 has anything she wishes to say?

24 MS. VIGOD: It just comes down to the
25 basic fact that the Region and the Town are of similar



1 interest and position. We can argue as to what these
2 positions would be, our interest is adverse reason.
3 For those reasons we would be prejudiced and I suppose
4 Mr. McQuaid.

5 MR. HODGSON: I would just like to
6 remind my friends and the Board that the concept of
7 this hearing is that it is not an adversarial hearing.
8 I think we had all perhaps forgotten and perhaps we
9 should all be reminded. The Region's case is not to
10 show that F is better than D. The Region conducted an
11 environmental assessment to find a suitable landfill
12 for the Region. It gave its consultants, including its
13 hydrogeological consultants, instructions to come back
14 with a range of good sites and they came back first
15 with 55 and then with six and the six were screened
16 down to two and the two are the two that are before
17 you.

18 The Region's case is that each one of
19 those two sites is a very good site. As it happens, on
20 hydrogeological grounds, which is really the only thing
21 we are discussing at the moment, one site is slightly
22 ahead of the other. If it should happen in the course
23 of this hearing that evidence emerges that persuades
24 you that the Region has got its case backwards and D is
25 better than F, the Region isn't concerned if you decide

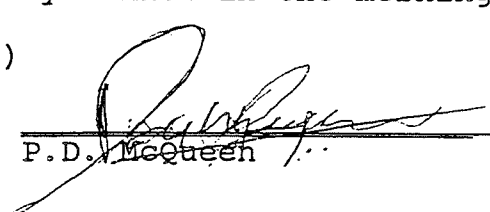


1 to approve D and go for F. Mr. Lederer and I do not
2 have instructions to come here and make sure that F
3 gets approved over D. Those are not our instructions.
4 Our instructions are to bring our witnesses forward,
5 lead our evidence, allow the evidence to be tested and
6 then by all means listen to the evidence of all of the
7 other parties and having heard the evidence, and I
8 stress all of the evidence, which is the reason I would
9 like to cross-examine last, to have an opportunity to
10 test that evidence and let us see if at the end of the
11 day where it all sits. The Region's case is not that F
12 is better than D. The Region is the honest broker in
13 this case and it's the only honest broker. Every other
14 party has got a row to hoe here, but not the Region, in
15 my respectful submission, not the Region's experts.
16 They did not have instructions to come here and get F
17 approved over D.

18 MR. LANCASTER: We are going to consider
19 it overnight and discuss it in the morning between
20 ourselves. We will let you know in the morning. ---
21 Adjournment (4:50 p.m.)

22 CERTIFIED CORRECT:

23 (Page 20400 Follows)

24 
P.D. McQueen
25