

CONSOLIDATED HEARINGS BOARD

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

— and —

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

— and —

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

— and —

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

— and —

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

— and —

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

— and —

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

VOLUME: 19

HELD AT: Oakville, Ontario

DATE: Tuesday, June 9, 1987

OFFICIAL REPORTERS

NETHERCUT & COMPANY LTD.

185 RICHMOND ST. W.,

TORONTO, ONT. M5V 1V3

TEL: 593-4802



I N D E X

WITNESSES:

SOBANSKI, Alfred A., resumed
BEECHINOR, James, resumed

Examination-in-chief by Mr. Lederer (cont'd) 4250

E X H I B I T S

<u>No.</u>	<u>Description</u>	<u>Page</u>
H-0	Chart	4257
H-39-1	Map of Site D, Milton	4346
H-40-1	Map of Site F, Burlington	4346



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;
3 - and -
- 4 IN THE MATTER OF Sections 12(2) of the Environmental
5 Assessment Act, R.S.O. 1980, c.140;
6 - and -
- 7 IN THE MATTER OF Sections 30, 35 and 38 of the
8 Environmental Protection Act, R.S.O. 1980, c.141, as
9 amended;
10 - and -
- 11 IN THE MATTER OF Sections 24 and 61(2) of the Ontario
12 Water Resources Act, R.S.O. 1980, c.361, as amended;
13 - and -
- 14 IN THE MATTER OF Section 28(3) of, and Regulation 164
15 under, the Conservation Authorities Act, R.S.O. 1980,
16 c.85, as amended;
17 - and -
- 18 IN THE MATTER OF Section 40(12) of the Planning Act,
19 S.O. 1983, c.1, as amended; in connection with site
20 plan control of the sanitary landfill site;
21 - and -
- 22 IN THE MATTER OF Section 22(1) of the Planning Act,
23 1983 in connection with a referral to this Board by the
24 Honourable Bernard Grandmaitre, Minister of Municipal
25 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.

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



Nethercut & Co. Ltd.

Toronto, Ontario

Hearing conducted at The Oakville
Granary Commercial Centre, 105 Robinson
Street, Oakville, Ontario, on
Tuesday, June 9th, 1987.

VOLUME 19

APPEARANCES:

T.R. Lederer and
H.D. Hodgson

for the Regional
Municipality of Halton
(Proponent)

J.R. Tidball

for the Ministry of the
Environment

T. Vigod
J.F. Castrilli

for the West Burlington
Citizens Group

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

for the Corporation of the
Town of Milton

S.R. Garrod and
A. Nurvo

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

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

for National Sewer Pipe
Limited

L.F. Longo

for Azova Investments
Limited

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

for the City of Burlington

C. Mansfield

for the Ministry of Natural
Resources

P. Renaud

for Cumis



Nethercut & Co. Ltd.

Toronto, Ontario

APPEARANCES (Cont'd):

1	C. Stevenson	for Framgard Holdings,
2	P. Hancock	Fosseri Investments
3		Limited, Seriphos
4		Investments Limited and
5		Topic Investments
6		
7	J.H. Olah	for the Halton Region
8		Conservation Authority
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

* * * * *

Nethercut & Co. Ltd.
Official Reporters
185 Richmond St. W.
Toronto, Ontario
M5V 1V3

Per: C.F. Nethercut, C.V.R.



Oakville, Ontario.
June 9, 1987.

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

ALFRED A. SOBANSKI, resumed:

JAMES BEECHINOR, resumed:

EXAMINATION-IN-CHIEF BY MR. LEDERER (Cont'd):

MR.LEDERER: Thank you, Mr. Chairman.

As I indicated yesterday, I now have the documents which we prepared at the request of the Board, which I hope will in fact make it a little simpler to follow the decision-making process and will allow the Board to understand more clearly at what stage of the process each piece of evidence relates to.

We have, as you see, a large board which has been prepared and you will see a copy of that as the last page of the handout as well, and what this is is a more sophisticated version of the inverted triangle.

Now, if I could take a moment to explain how to read this, you will recall that the original hand-drawn triangle was based on the idea that the horizontal axis is really geography, the options, because it is a landfill I mentioned in terms of geography, which is the



1 entire Region of Halton, and the depth was meant to
2 show the detail of information. The Board requested
3 something be done to represent those parts of the
4 study which precede the actual site selection
5 process. We have separated that from the
6 triangle because the earlier parts of the program
7 were not based on geography and at that point they
8 weren't dealing with site selection, but to
9 indicate conceptually that you were in a different
10 kind of study and not yet specifically looking at
11 site selection.

12 We have indicated the two earlier
13 parts of the program within these dashed lines and
14 in oblong form above the triangle and the first is
15 the preparation of the work program and the second
16 is the waste needs and systems analysis and you
17 have Mr. Watson's evidence with respect to that.

18 You will also see if you look at
19 the site selection triangle, if I can call it that,
20 each level of study is represented by an increase
21 in depth which is meant to represent the increased
22 detail we have shown before, and each line across
23 the triangle or each solid line represents a
24 point of decision and each hatched line represents



1 what I in my submission have called the refinement
2 which was a decision, but a decision in slightly
3 different form and which reduced areas of size
4 rather than simply remove them totally from the
5 study.

6 In order to read this thing, this
7 board completely, it is necessary to understand
8 that each of the asterisks, as the legend shows,
9 indicates a decision and each triangle represents
10 a refinement.

11 To read where each asterisk fits
12 or each triangle fits in the larger triangle
13 itself, one only need read horizontally along the
14 drawing.

15 For example, you can see the first
16 asterisk appears immediately between the preparation
17 of the work program, Phase 1 and the waste needs
18 and systems analysis, Phase 2, Stage 1 and between
19 them the methodology was established and the EA
20 is initiated and the second point of decision
21 is between Stage 1 and the beginning of Phase 2
22 and you can see the decision is to proceed with
23 landfill site selection based on resource recovery
24 with a sanitary landfill component, which was
25 the evidence of Mr. Watson, and from there you can



1 proceed down through the decision-making process
2 associated with the landfill site selection and
3 again opposite the first solid line there is a
4 decision and the entire region is reduced to
5 forty-five candidate areas, which were put into
6 the districts we have heard about and most
7 recently Mr. Sobanski referred to it yesterday and
8 the seven pits and quarries for further investigation
9 and the first of the refinements in Phase 2, Stage
10 2B, the forty-five candidate areas are reduced,
11 resulting in forty-eight and seven pits and
12 quarry candidate sub-areas, which total fifty-five
13 candidate sub-areas, which are then reduced at a
14 point of decision at the end of 2B to six candidate
15 sites for more detail, so you go down in that
16 manner.

17 The other thing we have changed to
18 make it consistent is we have no longer ended it
19 in a point, but rather a line to consistently
20 describe the decision making.

21 DR. KINGHAM: I thought the reason
22 you didn't end it in a point is because it didn't
23 end at a single site.

24 MR. LEDERER: We could, but we could
25 put the Board's decision down here (indicating).



1 The second part of this is the sheets
2 of paper which I have handed to you and which appear
3 in front of the hard copy on the board. What we
4 have done -- we weren't always able to reduce each
5 phase to one piece of paper or we were able to do
6 it, but the typeface was so small that it was
7 difficult to read, and you will see in some cases
8 the entire phase is dealt with on two pages, but to
9 make it clear, we have started each new phase with
10 a new page.

11 Phase 1 and Phase 2, Phase 2, Stage 1
12 are perhaps not that difficult to understand, but
13 the points which the hearing has been concentrating
14 on start at Phase 2A and you will see generally 2A,
15 2B, 2C and Phase 3, the environmental assessment
16 preparation and technical studies, have been
17 generally organized into the same form of headings
18 and they are not entirely the same because there are
19 differences between each phase.

20 You have the purpose, the area that
21 was being investigated, which would represent the
22 horizontal axis, the evaluation method which was
23 undertaken and then the evaluation factors organized,
24 as you will see, looking at Phase 2, Stage 2A into
25 priorities, which was a matter of interest to the



1 Board.

2 In the case of 2A and 2B, there is
3 what is called additional evaluation, which is
4 meant to indicate to you that there is this added
5 component at those stages of the pits and quarries.

6 Of course when we get to Stage 2C, the remaining
7 pits and quarries become part of the fifty-five
8 candidate sub-areas and so there is no longer
9 an additional evaluation, but they are evaluated
10 with the remainder.

11 On the other hand, when you get to
12 2C, we have broken out what in effect is the
13 organization into priority because it was more
14 convenient to do that and called it the rating of
15 evaluation factors, but it organizes the five sub-
16 areas into their priority.

17 We have also included public
18 participation so you can see the public participation
19 entered into at each stage and then, at the end,
20 either a refinement and a decision, if in fact there
21 was a refinement that took place and that would be
22 essential 2B and 2C, and finally the decision that
23 was made. I am not sure that's entirely what
24 you wanted, but I hope it will be of assistance.

25 THE CHAIRMAN: Very well. Thank you.



1 DR. KINGHAM: This will help us,
2 particularly in understanding what we had difficulty
3 with before, which was how some of the evaluation
4 factors changed and there were many discussions
5 about why we were considering hydrogeological as
6 important as opposed to public safety and these
7 things are now clear.

8 MR. LEDERER: I hoped it would
9 assist the Board.

10 Mr. Hodgson raises with me the matter
11 of whether or not they should be exhibited and
12 they would have to be subject to some form of
13 proof, presumably from Mr. Walker, but they are
14 here and if you wish to have them exhibited, it's
15 of no importance to me in particular.

16 THE CHAIRMAN: Would you suggest
17 a number which would fit in?

18 MR. LEDERER: I am inclined to say
19 H-0, because it seems to be the point from which
20 everyone starts.

21 THE CHAIRMAN: I was going to say
22 plus one, possibly.

23 MR. LEDERER: H plus one?

24 Mr. Hodgson points out that the
25 Environmental Assessment supplementary document



1 to which I have referred to in what has been called
2 by others my second opening, is H-75, so perhaps
3 if you want to attach it to that, that might be
4 the appropriate place for it.

5 DR. KINGHAM: We still have numbers
6 open.

7 THE CHAIRMAN: I rather like H-0.

8 MR.LEDERER: I am happy with H-0.
9 H-0 and H-0-A for the documents.

10 THE CHAIRMAN: So it is meaningful.

11 --- EXHIBIT No. H-0: Chart

12 MR. LEDERER: At the end of the day,
13 yesterday, Mr. Beechinor had reviewed with you
14 the study methodology undertaken at Phase 2, Stage
15 2C and had reviewed with you the nine steps in the
16 study that was undertaken. I am now going to ask
17 him to review with you the results of that work;
18 not so much the conclusions as the substance of
19 the information that was gathered with respect to
20 each of these six sites. He is going to speak
21 to a series of overlays, all of which are contained
22 as fold-out maps within the report, and I don't propose
23 to exhibit them and anyone who is observant will
24 notice on each of them there is a blacked out area
25 and because he is speaking to these overlays and



1 not directly to the report, there are some handwritten
2 notes of the contents of the report as clearly he
3 can't remember some of these numbers like hydraulic
4 conductivity and there is nothing insidious as to
5 what is there and I would like to advise everyone
6 as to what it contains.

7 THE CHAIRMAN: They are the maps in
8 H-38?

9 MR. LEDERER: That is correct, sir.

10 Q. Mr. Beechinor, what I would like
11 you to do is review with the Board, please, the
12 location of each of these six sites and I would
13 like you to describe generally what you found and
14 then to review with them in detail, using as a
15 base these various maps and overlays, the
16 information gathered with respect to each of the
17 six sites?

18 MR. BEECHINOR: A. Very well.
19 I will start with candidate Site A. This is
20 Figure A1, site location map. Generally the site
21 is located between the Ninth Line and Trafalgar
22 Road north of Burnhamthorpe Road and south of the
23 Lower Baseline. The site is located in the Town of
24 Oakville and the site area is approximately 265
25 hectares.



1 This is Figure A2, the site drainage,
2 and generally the site slopes to the south or south-
3 east and there are several intermittent tributaries
4 of Joshua's Creek found on this site. This is
5 Figure A3, location of boreholes and observation
6 wells, and at this site there are ^{9 sites} nine drilling sites
7 and, as I mentioned yesterday, at each drilling site
8 two boreholes were advanced and observation wells
9 and monitoring wells were installed at each of these
10 drilling locations.

11 The line of geological cross-
12 section we prepared for this site runs generally
13 from the Ninth Line to Trafalgar Road through
14 boreholes A1, A3, A6, A8 and A7.

15 This is a geologic cross-section
16 running from the Ninth Line to Trafalgar Road
17 through those boreholes I just mentioned. The
18 bedrock is indicated by this brick-like symbol
19 and the bedrock at this site consists of the
20 Queenston shale. The overburden consists, and this
21 is the unconsolidated material above the bedrock,
22 it consists predominantly of a sandy silt to silty
23 sand till. On the west side of the candidate site
24 in the vicinity of boreholes A8 and A6, the sandy
25 silt till is underlain by a fairly continuous sand



1 and gravel unit.

2 DR. KINGHAM: Before you take that
3 off, how do you arrive at a cross-section like that?
4 It's not just by interpolation of the five boreholes,
5 or is it?

6 MR. BEECHINOR: It is. I will go
7 back to the previous overhead. What is done here
8 is that the locations of the boreholes are denoted
9 by these small circles and what we have done --
10 at this level for 2C, we are trying to establish
11 general site conditions through more or less a
12 reconnaissance level drilling program and what we
13 have done is install, for instance, a borehole at A1,
14 a borehole at A3, a borehole at A6, a borehole at
15 A8, a borehole at A7 and soil samples are collected
16 from each one of those boreholes and then it is
17 used to prepare then the geologic cross-section and,
18 as I just mentioned, there is borehole A1 and this
19 is the geology of borehole A1 and essentially the
20 geology of A1 was entirely overburden, the sandy
21 silt till units.

22 This is borehole A3, and it penetrates
23 again the sandy silt till and stops at the bedrock
24 contact, the bedrock/overburden contact. Borehole
25 A6 penetrates the sandy silt till and at depth it



1 comes across -- we encountered a sand and gravel unit
2 and then it was terminated at the bedrock contact.

3 DR. KINGHAM: We see that and that
4 is precisely my question. If you have done it
5 by interpolation between those five boreholes, how
6 do you know, for instance, that the sand and gravel
7 stops near A6 and doesn't extend almost to A3?
8 How do you know about the shaly clay till which
9 lines under A8 and that it doesn't extend more
10 towards A6 or less towards A6?

11 MR. BEECHINOR: These are
12 interpretations and we are forced to extrapolate
13 between boreholes because we can't have a borehole
14 within several metres of one another, it would be
15 too expensive, but what we do, and again we are
16 concerned about sand and gravel units and their
17 potential use as water supply. We always assume
18 the worst case and if we encounter a sand and gravel
19 unit in this borehole, say where I am standing, and
20 then say 500 yards from that point we find a sand
21 and gravel unit at the same elevation in that borehole,
22 then we would say it would be safe that this sand
23 and gravel unit is continuous from where I am
24 standing to that borehole over there.

25 When we get into the more detailed



1 analysis, our density of drilling increases so the
2 uncertainty with respect to the correlation between
3 borehole to borehole diminishes, but this you should
4 consider a reconnaissance level drilling program just
5 to generally establish what the site conditions are
6 for the comparison of the six candidate sites.

7 Again we are talking about candidate
8 Site A, and this is Figure A5, the overburden
9 thickness. The overburden thickness is referring to
10 the thickness of the unconsolidated soil material
11 or till material on top of the bedrock, and here we de-
12 fine four thickness categories--overburden thickness
13 predominantly greater than 15 metres and overburden
14 thickness between 10 and 15 metres, overburden
15 thickness between 5 and 10 metres and an overburden
16 thickness between 0 and 5 metres.

17 Relating this to the figure, we
18 find that the overburden thickness on the east portion
19 of the site is greater than 15 metres and in this
20 unit the overburden thickness is between 5 and 10
21 metres.

22 Now, essentially on the eastern
23 third, or I should say eastern two-thirds, I
24 suppose, of the site, the overburden thickness is
25 between 5 and 10 metres.



1 This is Figure A6, the location of
2 water supply wells in the vicinity of the candidate
3 site. There are a number of water supply wells found
4 up-gradient of the site along the Lower Baseline,
5 and there are a number of water supply wells found down-
6 gradient of the site, along Burnhamthorpe Road, and
7 there is a concentration of water supply wells at
8 the intersection of Ninth Line and Burnhamthorpe
9 Road. At this site, most of the water supply is
10 derived from large diameter bored wells which penetrate
11 the bedrock and groundwater therefore is the sole
12 source of water supply to residents of this candidate
13 site, or those in the vicinity of this candidate site.

14 This is Figure A6 and it is the
15 water table map. What this figure shows is the slope
16 of the water table and the slope of the water table
17 is towards the intermittent tributaries of Joshua's
18 Creek and therefore that defines the direction of
19 groundwater movement in the shallow till which,
20 in this case, is generally in an easterly direction.
21 The depth to the water table was measured on site to
22 be in the range of about .5 metres to about 1.8
23 metres below ground surface.

24 This is Figure A8 and it is the
25 potentiometric surface and this is measuring the



1 hydraulic head in standpipes installed at the
2 bedrock/overburden contact generally, and it is
3 essentially the groundwater movement at that
4 contact or at that depth and it generally follows
5 the same slope as the water table, so the groundwater
6 at depth is also moving towards the tributaries
7 or intermittent tributaries of the Joshua's Creek on the
8 site. The hydraulic conductivity, you will recall
9 it is the measure of the ease with which a fluid
10 moves through a geologic medium, and in this case it's
11 in the order of 10^{-6} centimetres per second in the
12 unweathered till and so this is generally a low
13 permeability for the till unit on this site.

14 Now, in terms of potential impacts,
15 perhaps I could put this figure up again which shows
16 the location of the water supply wells. We are
17 mostly concerned if a landfill was developed on this
18 site, we were concerned about the effect on ground-
19 water resources being utilized essentially along
20 Burnhamthorpe Road and at the intersection of the
21 Ninth Line and Burnhamthorpe Road. These wells would
22 be down-gradient of the landfill site. We are also
23 concerned about any potential impact of either
24 leachate or sediment on those tributaries of
25 Joshua's Creek.



1 Now, turning to candidate Site B,
2 this is candidate Site B, Figure B1, the site
3 location map, and the site is located between
4 Trafalgar Road and Sixth Line. In relation to Site A,
5 Site A is over here and Site C is over here.
6 Burnhamthorpe Road is found north of the candidate
7 site and Dundas Street or Highway 5 is found
8 generally south of the candidate site. The site
9 area in this case is about 164 hectares. All
10 three candidate sites, A, B and C, are located
11 within the Town of Oakville. I will point out just
12 for discussion purposes in terms of reference, I
13 am calling the roads north of the candidate sites
14 north, but in fact the configuration of the roads
15 are a bit different and I believe this came up once
16 before already. This is Figure B2, the site
17 drainage, and on this site the terrain is generally
18 rolling to flat and slopes from the northwest to
19 the southeast. The site is situated in the upper
20 reaches of Sixteen Mile Creek and it was formerly
21 called the Morrison Creek in this area.

22 This is Figure B3, which again
23 shows the locations of our boreholes and our
24 observation wells. The locations are generally
25 distributed over the candidate site, depending



1 upon the permission or access the landowners gave
2 us, and in some instances we couldn't get permission
3 to drill on a particular property, and so we were
4 constrained by that availability. The geologic
5 cross-section I will be showing extends from
6 Burnhamthorpe Road to generally Dundas Street
7 through boreholes B4, B3, and B1.

8 For the generalized geologic
9 cross-section from Burnhamthorpe Road to Dundas
10 Street, that is shown here and again this site is
11 founded on the Queenston shale bedrock. The over-
12 burden, which is denoted by this symbol and this
13 symbol, consists of both a clayey silt till and a
14 sandy silt till. In this case the site is
15 generally situated in a groundwater discharge area,
16 so groundwater has a potential to move in an
17 upward direction.

18 This figure is B5 which shows the
19 overburden thickness on candidate Site B. There
20 are three categories of overburden thickness that
21 we employed here; and predominantly where the over-
22 burden was between 10 and 15 metres and this is
23 found adjacent to Burnhamthorpe Road, an overburden
24 thickness of between 5 and 10 metres denoted by
25 this texture, and a thin overburden on the south



1 part of the site which had a thickness of between 0
2 and 5 metres.

3 This is Figure B6 and it shows the
4 location of water supply wells in the vicinity of the
5 site. As you can see, there are a number of them and
6 in fact I think there are roughly thirty water supply
7 wells in the near vicinity of this site. The wells
8 are concentrated along Trafalgar Road, Dundas Street
9 and the Sixth Line, and therefore these would be the
10 locations down-gradient of any proposed landfill
11 site at candidate Site B. Like Site A, the water
12 supply is derived from large diameter bored wells
13 that obtain their water from the bedrock. Ground-
14 water is the sole source of water supply to residents
15 in this area.

16 This is Figure B7, the water table
17 map, and it shows that the water table therefore
18 slopes in a generally southwestern direction, which
19 is defining the direction of movement in the shallow
20 overburden. The depth to water table ranged from
21 about .1 metre to about 3.3 metres.

22 This is Figure B8, the potentio-
23 metric surface at candidate Site B, and like the
24 water table this surface is also sloping in a south-
25 easterly direction, which is defining the direction



1 of groundwater movement in the deeper overburden
2 near the bedrock contact. The hydraulic
3 conductivity of the unweathered till or the
4 unweathered overburden at this site is in the order
5 of 10^{-6} , similar to Site A, and this is generally a
6 low permeability for that geologic unit.

7 In terms of potential environmental
8 impacts; again if the landfill were developed at this
9 site we are concerned about the effects the landfill
10 would have on water supply wells in the vicinity of
11 the Ninth Line -- I should say Trafalgar Road and
12 Dundas Street and the Sixth Line. We are also
13 concerned about sediment loading and leachate
14 egress to the tributaries of Morrison Creek found
15 on the site.

16 Now, I will move on to candidate
17 Site C. This is the general location of candidate
18 Site C. Just for a point of reference, candidate
19 Site B is located just west of candidate Site C
20 and candidate Site A is located north of candidate
21 Site C. Candidate Site C is located south of
22 Burnhamthorpe Road between the Ninth Line and
23 Trafalgar Road and north of Dundas Street. It is
24 about 318 hectares in size.

25 This is Figure C2, the drainage, and



1 generally the west portion of the site is extremely
2 flat, relatively flat, while the eastern portion of
3 the site is deeply incised by the river valleys
4 of Joshua's Creek.

5 This is Figure C3, the location of
6 boreholes and observation wells on the site, and
7 nine drilling sites were installed on or off this
8 site. This is one of those occasions where we
9 couldn't, for instance, get permission from land-
10 owners to drill in this portion of the site and
11 consequently we were forced to do some off-site
12 drilling to ascertain what the on-site geology was.
13 For instance, you will note there are drilling
14 sites C8, C7 and C3, which is off the candidate site.

15 Our geologic cross-section for this site generally
16 parallels Burnhamthorpe Road and it runs through
17 boreholes C5, C4 and C1 and the waterwell record
18 information which reports some of the geological
19 strata on those records were employed to help us
20 fill out this geological cross-section. since we
21 could not put in boreholes on the western side of
22 this landfill site or candidate site.

23 This is Figure C4, the geologic
24 cross-section of candidate Site C, running from the
25 Ninth Line at the east, Trafalgar Road on the west.



1 The bedrock, as with the other sites, consists of
2 Queenston shale and the overburden generally consists
3 of a sandy silt till denoted by this unit and a
4 clayey silt till denoted by this chicken-foot
5 symbol. You will notice on the east side of the
6 site there is a bedrock depression beneath the
7 Joshua's Creek tributaries and this was identified
8 by a borehole advanced at drilling site C5. In
9 that borehole we also encountered some incidence
10 of sand and I think another incidence of sand was
11 encountered from a domestic well record on the west
12 side of the site. Both recharge and discharge
13 conditions were measured on the site.

14 This is Figure C5, the overburden
15 thickness map, and four categories are defined, an
16 overburden thickness of predominantly greater than
17 15 metres, which is denoted by this symbol here,
18 overburden thickness between 10 and 15 metres, and
19 this is denoted by this cross-hatching in this area,
20 overburden thickness between 5 and 10 metres,
21 generally in these areas, and a shallow overburden
22 unit generally in the west portion of the site,
23 which has an overburden thickness of between 0 and
24 5 metres.

25 This is Figure C6, which shows the



1 location of water supply wells in the vicinity of
2 the site and generally the down-gradient water supply
3 wells to a landfill developed at this site would
4 be along Dundas Street and the Ninth Line in this
5 vicinity. As with the other sites in this area,
6 water supply is derived from large diameter bored
7 wells that penetrate the bedrock.

8 Again groundwater is the sole source
9 of water supply to residents in the area of this
10 candidate site.

11 This is Figure C7, which shows
12 the slope of the water table, which defines the
13 direction of groundwater movement in the shallow
14 till. The groundwater in the shallow till therefore
15 moves towards the tributaries of Joshua's Creek and
16 it tends to discharge at that location. The
17 depth of the water table ranged from between 1.5
18 to 3.7 metres below ground surface.

19 This is Figure C8, the potentiometric
20 surface at the overburden/bedrock contact, and again
21 the slope is similar to that of the water table,
22 sloping towards tributaries of Joshua's Creek. The
23 hydraulic conductivity of the unweathered till is
24 similar to Sites A and B, it's in the order of
25 10^{-6} centimetres per second, a low permeability again.



1 I will move on then to candidate
2 Site D. We are in the jurisdiction of the Town of
3 Milton now, and this is Figure D1 and the candidate
4 site is generally located between Highway 25 and the
5 First Line and south of Britannia Road. The site
6 area is approximately 185 hectares.

7 This is Figure D2, the site drainage.
8 The site is relatively flat throughout in extent
9 and surface water drains to a tributary of the
10 Sixteen Mile Creek, generally found east of the
11 candidate site, and it also drains on the west
12 part of the site to a tributary of Bronte Creek.
13 So, essentially there is a surface water divide
14 on this site and the portion of the site wants to
15 drain toward Bronte Creek and the westerly portion
16 of the site wants to drain towards -- sorry, the
17 eastern portion of the site wants to drain to
18 Sixteen Mile Creek and the western portion of the
19 site wants to drain to Bronte Creek.

20 This is Figure D3 which shows the
21 location of boreholes and wells installed at Site D.
22 We were fortunate to get a fairly even distribution
23 of boreholes on this site. Our geologic cross-
24 section runs south from Burnhamthorpe Road through
25 boreholes or drilling sites D1, D3, D5 and D8.



1 There were eight drilling sites advanced at this site.

2 This is Figure D4, our geologic
3 cross-section of Site D, again running from
4 Burnhamthorpe Road in a southwesterly direction.
5 The bedrock, as with all the other sites, consists
6 of shale of the Queenston formation. You will note
7 there is a slope to the bedrock surface and what
8 we encountered through the review of waterwell
9 records on file with the Ministry of the Environment
10 is an east-west trending bedrock depression below
11 the site.

12 There was generally two dominant
13 geologic units found on site, an upper clayey silt
14 till shown by this symbol and a lower sandy silt
15 till denoted by this symbol. At some of our
16 drilling sites we identified, for instance at
17 borehole D8, we identified a sand unit generally at the
18 interface between the two tills, between the upper
19 clayey silt till and the lower sandy silt till. In
20 this case, the site is situated in a recharge
21 environment, so infiltrating precipitation moves
22 to depth on this site.

23 This is Figure D5, the overburden
24 thickness map of Site D, and there were two
25 categories defined, an area where the overburden



1 thickness exceeds 15 metres, which is pretty much
2 the entire candidate site, and an area where the
3 overburden thickness is between 10 to 15 metres
4 in the northeast portion of the site. Generally
5 speaking, the overburden thickness on the site
6 exceeds 15 metres.

7 Q . Mr. Beechinor, if you could
8 put that back up for a moment and if you look at
9 the legend at the predominantly greater than 15
10 metres, it slants in the opposite direction, but
11 can I presume....

12 A. That is a drafting error.
13 This is a map of Figure D6, showing the location
14 of water supply wells in the vicinity of the site.
15 Seventy-five per cent of the wells, like candidate
16 Sites A, B and C, obtain their water supply from
17 large diameter wells which penetrate the bedrock.
18 In addition, about 25 per cent of the groundwater
19 supply is developed from sand and gravel units
20 found in the overburden on this site. Again, with
21 the other sites, groundwater is the sole source
22 of domestic water supply to residents in the area
23 of this site and there is also some agricultural
24 use of surface water in this vicinity.

25 This is Figure D7, the water table



1 map. The slope of the water table reflects the
2 surface drainage and, as I mentioned, there was a
3 water surface divide and there also seemed to be a
4 groundwater divide in the upper portions of the
5 overburden at this site which we noted when we
6 did this study. There is a groundwater divide
7 generally denoted by my marker and so the groundwater
8 in the shallow overburden east of my marker is moving
9 towards Sixteen Mile Creek and the groundwater on
10 the west side of the site in the shallow overburden
11 tends to move towards Bronte Creek or a tributary
12 of Bronte Creek.

13 The depth of water table on this
14 site ranges from about .5 to 1.2 metres below
15 ground surface.

16 This is Figure D8, which shows
17 the potentiometric surface measured roughly about
18 15 metres below ground surface. This shows that
19 groundwater at that depth tends to move towards
20 Sixteen Mile Creek. The hydraulic conductivity of
21 the clayey silt till, the upper till identified
22 on the site, is in the order of 10^{-7} centimetres
23 per second and so we are now an order of magnitude
24 lower permeability than candidate Sites A, B and C.

25 In terms of potential impacts, we



1 were concerned about the possibility of
2 contamination primarily of water supply wells that
3 utilize sand and gravel units in the overburden
4 for their water supply source. We were also concerned
5 about potential contamination of Sixteen Mile Creek
6 by either sediment or leachate.

7 I would move on to candidate Site E.
8 Again, candidate Site E, like Site D, is located in
9 the Town of Milton and is generally situated between
10 Tremaine Road and Bell School Line north of
11 Britannia Road. It is approximately 185 hectares
12 in size -- 285 hectares in size, excuse me.

13 This is again candidate Site E,
14 Figure E2, and it shows the drainage at this
15 candidate site. The drainage is generally in a
16 southerly direction towards a tributary of
17 Bronte Creek. In the northwest portion of the site,
18 if you follow my direction here, we delineated a
19 floodplain area on the candidate site.

20 Before I start that, this is Figure
21 E3, the location of boreholes. As Mr. Sobanski
22 indicated earlier, this is one of the sites where
23 there was previous investigation done and there was
24 a fair bit of drilling done on this site and so we
25 had a rather limited drilling program on the site,



1 but just to confirm some of the previous work. We
2 advanced three boreholes on this site, E1, E2 and E3.
3 Our line of geologic cross-section is from generally
4 the north part of the site to Britannia Road.

5 This is Figure E4, showing the
6 conceptualized geologic cross-section at candidate
7 Site E, and again the bedrock is denoted by this
8 symbol and consists of Queenston shale. You will
9 note that at the south portion of the site the
10 bedrock again drops off into an east-west trending
11 bedrock depression. We also discovered that
12 significant deposits of sand and gravel were found
13 in the base of this bedrock depression.

14 The overburden consists of two
15 dominant till units, somewhat similar to Site D,
16 an upper clayey silt till and a lower sandy silt
17 till. We were able to, at this stage, define a
18 fairly extensive sand and gravel unit between the
19 two tills.

20 This is Figure E5, showing the
21 overburden thickness on candidate Site E. There
22 are two categories noted here, a zone that
23 predominantly has an overburden thickness of greater
24 than 15 metres and a zone that has an overburden
25 thickness greater than 20 metres, that being the



1 south part of the site.

2 This is Figure E6 which shows the
3 location of water supply wells in the vicinity of
4 the site. As you can see, the water supply wells
5 are concentrated in the vicinity of Bell School
6 Line and Britannia Road. This would be an area down-
7 gradient of the proposed landfill site at this
8 location. About 50 per cent of the wells penetrate
9 the bedrock and use the bedrock water for their
10 supply and about 50 per cent of the wells utilize
11 sand and gravel units in the overburden for their
12 water supply. Here again, groundwater is the sole
13 source aquifer for water supply in the vicinity
14 of this candidate site.

15 I will just direct the Board to the
16 work done, and I don't know if this has been intro-
17 duced before or not, but this is the work done
18 by Gartner Lee & Associates, 1980 for the
19 Regional Municipality of Halton and it's the hydro-
20 geologic study of Site E. We utilized that
21 information to define for instance the direction of
22 groundwater movement on this site. Groundwater
23 movement on this site is in a southerly direction,
24 it slopes in a southerly direction, and groundwater
25 movement as measured at the overburden, deeper



1 overburden formation, also slopes in a southerly
2 direction. With respect to vertical gradients,
3 both recharge and discharge gradients were
4 measured at the site.

5 Q. I think what you might do is
6 take one of your original maps and just point to the
7 Board on the map the directions you are now referring
8 to?

9 A. Very well. The groundwater
10 movement in the shallow till and the water table
11 slopes in a southerly direction towards the
12 tributary of Bronte Creek, and the potentiometric
13 surface in the deeper overburden also slopes in that
14 same general direction, in a southerly direction.

15 With respect to hydraulic
16 conductivity, it is contained in this geological
17 report and it was in the order of 10^{-7} centimetres
18 per second and a similar hydraulic conductivity
19 to that found on Site B.

20 In terms of potential environmental
21 impacts, we were again concerned about the effects
22 of a landfill on the water supply wells,
23 essentially in the vicinity of Britannia Road and
24 Bell School Line where a number of those wells
25 utilized sand and gravel units in the overburden

4B



1 for their water supply.

2 Now, moving on to candidate Site F;
3 again this is one of the sites where considerable
4 work had been done and Mr. Sobanski has in his hands
5 two hydrogeologic reports prepared by Morrison
6 Beatty Limited, the Phase 2 and Phase 3 report
7 for National Sewer Pipe. This is candidate Site F,
8 and it's not a very good reproduction, but F1 is the
9 site location map and the site is generally situated
10 east -- west I should say of King Road and north
11 of Highway 403 and the Niagara Escarpment is
12 located north of the site in this vicinity up here.

13 The site area is approximately 94
14 hectares in size.

15 This is Figure F2 showing the drainage
16 on candidate Site F. The site is situated south of
17 the Niagara Escarpment and located in the Indian
18 Creek watershed. There are a number of intermittent
19 tributaries of Indian Creek found on Site F and
20 the drainage is generally south and southeasterly
21 towards Hamilton Harbour.

22 This is Figure F3, which shows the
23 location of boreholes and observation wells on this
24 candidate site. Like Site E, we didn't advance
25 many boreholes on this site, since there was work



1 done previously by Morrison Beatty and so we utilized
2 some of their borehole information to help generate
3 the cross-sections through the site. We did, however,
4 advance two boreholes, denoted F1 and F2 on the
5 north part of the candidate site, since there had
6 been no drilling done in that area at that time.
7 So, our geologic cross-section runs from north of
8 the site south to Highway 403.

9 This is Figure F2, the geologic
10 cross-section at Site F from the north portion of
11 the site to the south portion of the site. Here
12 again you can see the Queenston shale underlies
13 candidate Site F and much of the overburden is
14 found in the north end of the site where it is
15 underlain by up to 18 metres of clayey silt till.
16 In the centre of the site the overburden has
17 generally been eroded and in those areas it has
18 exposed the Queenston shale. There is more over-
19 burden found at the south end of the site. The
20 hydraulic conductivity of the unweathered portion of
21 the Queenston shale was defined by previous
22 investigators to be in the order of 10^{-6} centimetres
23 per second, again a low permeability.

24 We employed the work of previous
25 investigators to define the direction of groundwater



1 movement, and I can use this map to show that. The
2 water table slopes in a southeasterly direction
3 towards Hamilton Harbour and that defines the
4 direction of groundwater movement. The direction
5 of groundwater movement is largely defined by, in
6 all levels, both in the shallow overburden, in the
7 shale and in the deeper shale, is defined by this strong
8 relief and groundwater essentially moves with
9 gravity downhill and so groundwater is flowing from
10 the site in a southerly direction.

11 The site is situated in a recharge
12 environment and therefore infiltrating precipitation
13 moves to depth. In terms of groundwater chemistry,
14 the following was reported by previous investigators
15 at this time. No. 1, there was a dramatic
16 deterioration of groundwater quality with increasing
17 depth in the shale. No. 2, the natural quality
18 of groundwater within the shale is poor and does
19 not comply with the Ministry's drinking water
20 quality criteria. I should point out that we
21 could not define, based on work of some of the
22 previous investigators, there was no identified
23 groundwater use or groundwater users for domestic
24 purposes south of Site F. It is a fully serviced area
25 with municipal piped water supplied, drinking water



1 to residents south of Site F, and this is what we
2 understood at this level of investigation. Therefore,
3 ~~our concern with respect to potential impacts~~
4 focused solely on the potential for leachate egress
5 into surface water south of Site F.

6 DR. KINGHAM: Did you say the
7 groundwater at depth in the shale was already
8 contaminated?

9 MR. BEECHINOR: The groundwater in
10 the shale is highly mineralized. For instance,
11 the chloride concentration at depths in the shale
12 can exceed about 10,000 milligrams per litre of
13 chloride.

14 DR. KINGHAM: When you say
15 contaminated, you mean natural....

16 MR. BEECHINOR: Naturally, it is
17 not from a landfill, but it is naturally highly
18 mineralized to a point that it is so hard it's
19 not potable and it is essentially getting close
20 to seawater concentration at depth in terms of
21 chloride and sodium.

22 MR. LEDERER: Q. Perhaps you could
23 return the microphone to Mr. Sobanski.

24 Now, Mr. Sobanski, when you reviewed
25 with the Board yesterday the tasks undertaken at



1 Stage 2C, you indicated they were twofold; firstly,
2 the type of site investigation Mr. Beechinor has
3 reviewed and, secondly, that work was done with
4 respect to conceptual designs for landfill at each
5 of these six sites and I would like to review with
6 you the results of the work done with respect to that
7 second task.

8 What I propose to do is point out
9 where in the reports you will find this because it
10 is interspersed with the work done at each site.
11 If you turn to page 22 of what is Exhibit H-38,
12 and if you could review with the Board the results
13 of the work done with respect to conceptual landfill
14 design for Site A.

15 DR. KINGHAM: Did you say 32?

16 MR. LEDERER: Page 22, Dr. Kingham,
17 of Exhibit H-38.

18 MR. SOBANSKI: If I could review
19 briefly, and I will be following the notes in the
20 report, but Mr. Beechinor has reviewed the general
21 findings of the hydrogeology of the area, Mr.
22 Chairman, and we found the overburden thickness on
23 the east side of the site....

24 MR. LEDERER: Q. What site are we
25 talking about?



(A)

MR. SOBANSKI: A. The east side of Site

A... than it was on the west part of the site.

We did have overburden thickness exceeding 15

metres on the east side and therefore it would be

desirable to locate the landfill as close to the

thicker overburden as is feasible. We found,

however, that we had an existing site use constraint

which was an easement for TransCanada Pipelines

and for Ontario Hydro which is located -- I don't

know how to describe it, the dark area just to the

east of the area we finally selected for potential

landfill and we had to avoid these easements, they

are in place and are major lines. They are in place.

So, these essentially isolate the much thicker

overburden deposits and split the site into about

roughly a four-fifths area and a one-fifth area

that we can't use on this side.

So, to have a landfill it wouldn't make sense to put a piece of landfill on this small

area and put the other portion on this area,

west of the easement. You can see another little

piece of land in here which is the right-of-way

for the new 403 highway being constructed in that

area and you can see portions of it have been

constructed and Highway 403 will be running along



1 the north edge of the property.

2 Mr. Beechinor indicated that the
3 discharge gradients were measured on the site in
4 the overburden sediments and this would tend to
5 keep any leachate generated close to the ground
6 surface and this would provide us with ease of
7 collection of leachate with a tile underdrain system
8 on the site. There are relatively few down-
9 gradient groundwater users south of Burnhamthorpe
10 Road, but there are a couple. We found it would
11 be necessary to run some creek diversions. Firstly,
12 the main tributaries of Joshua's Creek will be
13 diverted by the MTC when they construct Highway 403.
14 They will take the surface water in this tributary of
15 Joshua's Creek north of the site and will take it
16 in a deep drain and I understand they will run it
17 into Mississauga on the other side of 403 and from
18 there it would go to Lake Ontario by a surface
19 watercourse. I might mention that that provided
20 us with a design constraint of unknown magnitude
21 in that this would be quite a deep drain, in the
22 order of 20 feet or so, and that is my recollection
23 and right off the top of my head, and that could
24 provide us with a potential contaminant pathway
25 that may take leachate somewhat northward and



1 then divert it down the route of the underground
2 channel they are putting in.

3 We would then have to divert, however,
4 this small tributary of Joshua's Creek on the west
5 side of the site, and that can be accomplished by
6 taking it down the west side of the landfill and
7 taking it back to the main channel on the southerly
8 route or taking it across the road and putting it
9 to one of the other channels.

10 If we consider a 100-metre buffer
11 as we have in the conceptualization we discussed
12 yesterday, we would have a pit area of 65.1/2
13 hectares, which equates to 162 acres, and if we then
14 use the 4.1/2 metre excavation that we discussed
15 and four to one side slopes on the side of the
16 landfill site and a 15-metre high landfill, we
17 would have a refuse capacity of about 12.7 million
18 cubic yards. Conceptually the base of the pit
19 would be sloped to the southeast and this would
20 provide us with a drainage gradient for a system
21 of leachate tile collectors to be installed along
22 the bottom of the disposal pit. They would feed
23 to a trunk which would run across the south and
24 east sides of the landfill and those would be taken
25 to an appropriate sanitary sewer for treatment in



1 a sewage treatment plant.

2 Another constraint we found on the
3 site was that we ran into sand units in the area,
4 I believe, of nest 5, which was constructed at
5 the north end. These had unknown significance at
6 this time and there were gravel units and they
7 are possibly associated with the Trafalgar moraine
8 located to the north, and we did not know their
9 significance, but we felt we may have to use
10 special treatment on the west side of the site
11 to overcome this water problem and possibly by
12 raising the cell bottom in that area.

13 The service area was to be contained
14 on the south side of the site. This actually
15 represents an area of bedrock high we identified
16 with our drilling, so it would be a good place to
17 put the service area and use the thicker soils for
18 attenuation.

19 The plan for access, I believe, was
20 to put in a service road that would actually enter
21 on the west side, well west of the site off
22 Trafalgar Road, and follow near the 403 easement
23 and then enter onto the site finally to the service
24 area. This was to overcome perceived traffic
25 hazards, but I believe, however, the traffic



1 experts could better speak to that than I.

2 So, in conclusion, this was a
3 conventional type of design planned for this site,
4 an upward gradient, giving us good capture efficiency
5 on our leachate, an underdrain system to capture
6 the leachate and then it would be taken to a sewage
7 treatment plant. All of the excavation would be under-
8 taken in overburden and there were, however, two
9 potential groundwater problems identified associated
10 with the sandy units we found on the west side of
11 the site and also the deep drain that MTC was
12 installing on the north side. In addition, one
13 that isn't mentioned in the report, of course, is
14 that we also had -- not concern, but we would have
15 to look as well in terms of the Hydro and TransCanada
16 corridors, as to whether or not they might offer a
17 potential escape route for contaminants, although
18 we did not get that far in our considerations.

19 DR. KINGHAM: You said the deep
20 drain that MTC was installing?

21 MR. SOBANSKI: There is a deep
22 drain planned to be installed, and in fact I believe
23 it is installed now. If you drive up Highway 403,
24 the Ford plant is off the picture down in this
25 area, and Highway 403 starts its swing from the Ford



1 plant and comes up past this site and then it makes
2 a turn heading eastbound again.

3 MR. LEDERER: Q. Let's see if we
4 can describe that in a way everyone will understand
5 in the transcript.

6 MR. SOBANSKI: A. Highway 403,
7 or the present Highway 403 is shown running roughly
8 north-south on the east side of the site. In the
9 area in the northeast corner of the site one can see
10 the works they are planning for the intersection
11 at Burnhamthorpe and going to the west and there will
12 be an intersection at this location, which is north-
13 east of the site, and one can see the ramps that have
14 been built there already.

15 My understanding is that the
16 diversion work they were undertaking was also supposed
17 to have been completed, and I am not sure because
18 I haven't followed up on it, to see if it is
19 already done, but Joshua's Creek flowing from the
20 north in a couple of channels will be picked up
21 at the MTC boundary and then it will be transported
22 by a drain to Mississauga for discharge to Lake
23 Ontario. With this deep drain that would actually
24 be below the bottom of our landfill site, unless
25 this was constructed in such a way that it is



1 relatively impermeable, which can be done, then
2 there was a risk that leachate could be forced to
3 flow backward against the gradient into the MTC
4 channel.

5 DR. KINGHAM: I was focusing on
6 the word that they "had constructed," but have they
7 or will they?

8 MR. SOBANSKI: Definitely it is
9 planned, but I don't know if it is in or not. It
10 is definitely going in because all the overpasses
11 are there already and they are waiting to construct
12 this leg of the highway.

13 MR. LEDERER: Q. Could we then
14 turn to page 28 of Exhibit H-38 and could you review
15 with the Board the work done with respect to
16 a conceptual design for Site B?

17 B MR. SOBANSKI: A. The conceptual
18 design for Site B is shown on Figure B9 of the
19 report, and again just a general overview of the
20 hydrogeology. We found generally thin till on the
21 south side of the site which increased in thickness
22 towards the north end of the site, being somewhat
23 in excess of 10 metres along Burnhamthorpe Road
24 on the north end of the property. The overburden
25 is thinner than 15 metres and once the site -- we



1 have moved it up to the north to get to the thicker
2 overburden, but even here, once we excavate to
3 bottom contours, parts of this site will be on
4 shale and the four and a half metre excavation
5 will take us onto shale at places. Presently there
6 is an upward gradient on the landfill site, but
7 however we felt that mounding within the fill could
8 reverse those gradients and it could cause some
9 leachate to move out of the site. The shale is
10 the sole source aquifer in this area, the only
11 aquifer which people generally utilize, and there
12 may be the odd overburden well constructed within
13 sandy units within the till, but, in general, this
14 is an area of rock wells.

15 In addition, we could have leachate
16 emerging in the creek, Morrison Creek, which
17 traverses the site, as well as another creek on
18 the north end of the property and so leachate might
19 show up in those.

20 We decided from a conceptual point
21 of view, having this level of information, that we
22 would not have sufficient natural protection to
23 ensure the quality of these wells. Consequently we
24 considered here using a synthetic membrane to line
25 the site and this would be installed and overlaid



1 with tiles to capture leachate which would infiltrate
2 through the cover.

3 Diversions would be required. We
4 would divert this small tributary of Morrison
5 Creek down past the west side of the site and
6 consequently then back into its original channel
7 and another diversion would be required for the
8 tributary located about mid-point along Burnhamthorpe
9 Road. It would be diverted along Burnhamthorpe
10 Road and then southwardly down Trafalgar Road and
11 finally back into its original channel again, and
12 both of these are tributaries of Morrison Creek.

13 Locating in this area would keep
14 us away from wells which are certainly all located
15 within the bedrock along the Sixth Line and along
16 Trafalgar Road, though there are a few, and then along
17 Dundas Street which demarcates roughly the southern
18 border of this drawing. If we leave a 100-metre
19 buffer zone, as we have proposed in the past, we will
20 have an area of about 70 hectares for filling, which
21 amounts to 173 acres. Here we used an excavation
22 average of 4.8 metres, and we are going to
23 construct a landfill about 15 metres above ground
24 level and with four to one side slopes again and
25 this would give us a refuse capacity of 11.8 million



1 cubic yards. The base of the pit would be sloped generally
2 to the south and this would provide drainage for the
3 tile drains which would then be discharged to a
4 sewer.

5 The relatively high groundwater levels
6 on the site and the discharge gradients gave us
7 problems in our conceptualization of installing a
8 liner, because if we have an upward gradient on the
9 site and we dig into this, the groundwater coming
10 into the pit will actually exert a force on the
11 liner as we lay it, and it is a roughly impermeable
12 barrier, roughly impermeable, and it has some hydraulic
13 conductivity but very low, but even small amounts of ground-
14 water coming up into the pit could force the liner
15 up once it is installed. Consequently, we felt
16 this would require some significant works which would
17 require dewatering to intercept groundwater in the
18 up-gradient area so as to relieve the pressure
19 that would occur on the liner on the site. This
20 groundwater would be collected in its own system
21 and it would be transmitted back to one of the creeks
22 for discharge.

23 The service area was planned for the
24 southwest corner of the site on Sixth Line. So,
25 if I can just sum up again, parts of the landfill



1 would be on shale, which could pose a risk to
2 groundwater users and to surface watercourses. Our
3 conceptualization here, in order to protect that
4 aquifer, is that we would install a liner, at least
5 at the conceptual level. The liner would have over-
6 drains installed on it to collect the leachate
7 that would infiltrate through the cover material.

8 However, there is a major constraint to developing
9 that type of system because of the upward gradients
10 on the site and we would have to intercept that
11 groundwater to prevent our liner essentially from
12 floating, and that would require some extensive work
13 in terms of dewatering and that dewatering water
14 would be discharged in a system of its own back to
15 a surface watercourse.

16 Q. If you would turn to page 34,
17 and Mr. Sobanski if you could, with reference to
18 that page, review with us the work done in relation
19 to a conceptual design for a landfill at Site C?

20 A. If I could have one of the
21 other drawings that shows the bulk of Site C. If
22 I could have a moment, I would like to have a
23 drawing showing the rest of the site.

24 THE CHAIRMAN: Perhaps we should break
25 at this point.



1

MR.LEDERER: Very well, sir.

2

3

--- Recess

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

MR. LEDERER: Q. Mr. Sobanski, are we ready to review the work you did with respect to a conceptual design for Site C? As I indicated before the break, you will find the substance of this evidence on page 34 of H-38.

MR. SOBANSKI: A. If I could perhaps review here as well some of the constraints we saw from the engineering point of view, some of the things Mr. Beechinor has talked about; on the east side of Site C....

Q. You have to be careful because you are beginning to block the overhead.

A. Sorry.

On the east side of Site C we have the thicker overburden. However, we run into a significant problem with the tributaries of Joshua's Creek, which are emerging in this area. The gradients on the site are generally upward and near the creeks the groundwater flow is toward the creeks and on the west side of the site, groundwater flow is more in a southerly direction towards



1 Dundas Street or Highway 5. Now, we saw two very
2 severe constraints in operation in the thicker
3 overburden, and one is the easement which continues
4 on down from Site A to the north, and it isn't shown
5 on this map but it is there, and the second is this
6 great morass of water that we would have to deal
7 with, which gives us some very major constraints,
8 considering that when we consider this site there
9 would no longer be an active landfill to the north
10 of us, so Joshua's Creek becomes a problem again,
11 with the exception of that water which MTC is
12 diverting. We felt that with these constraints
13 and with a lot of the thicker overburden being
14 taken away by the easement and Joshua's Creek giving
15 us major problems in the eastern third of the site,
16 that it made sense to us to look at a design that
17 was similar to the one we just looked at for Site B,
18 and that would call for moving the landfill onto
19 the thinner overburden and then mitigating the
20 problems of the thinner overburden.

21 If we can now refer to Figure C9
22 from the report; firstly we located the landfill
23 in the northern area of this thinner till area to
24 take us away from wells along Highway 5 and the
25 intersection of Highway 5 and Burnhamthorpe Road.



1 This gives us the maximum distance we can get between
2 the site and those wells as a precautionary measure.
3 The site would be dug into the shale and we would
4 have some overburden for cover, but most of the site
5 would be in the shale bedrock itself. Again this
6 wouldn't leave any protection for the natural
7 groundwater resources in the area. Therefore, as we
8 did at Site D, we incorporated the concept of a
9 synthetic membrane liner into the Site C design and
10 I believe I might have said C, but we are using the
11 same concept as Site B which is just across the road
12 and we will now use it for Site C.

13 There are two tributaries of
14 Joshua's Creek that would require diversion -- I am
15 sorry, one of Joshua's Creek and then a small portion
16 in the southwest that is part of Morrison Creek that
17 would have to be diverted. However, these are not
18 major diversions. They would be diverted to flow
19 around the landfill and then be discharged into one
20 of the tributaries.

21 In terms of design, if we look at
22 leaving again the 100 metre buffer around the site,
23 a pit area of 68 hectares results, 68.1, or about
24 168 acres. Our average excavation depth was going
25 to be about 4.9 metres and then we would fill to a



1 height again of about 15 metres above ground level.
2 Again the side slopes would be four to one. You can
3 see that the shape is somewhat irregular and this
4 is taking into account the shapes of the farms in
5 this particular area.

6 The resultant is that we would have
7 a refuse capacity of about 12 million cubic yards.
8 We felt that if the shale was sufficiently weathered,
9 we could use it for cover material, otherwise if it
10 would not weather well, then we would have to
11 supplement the cover by importing about .4 million
12 cubic yards of soil. The concept was to slope the
13 base of the pit to the northeast and this would
14 provide drainage for a system of leachate tile
15 collectors which would be installed on top of the liner.
16 These we would then pump to a sanitary sewer when
17 required and that would be treated at a sewage treat-
18 ment plant. We find we have the same problem on
19 Site C as we had on Site B. Again, there are upward
20 gradients and this would give us problems with
21 installing the liner, the uplift pressures that
22 would occur on the liner, and even small amounts of
23 groundwater on an impermeable membrane trying to lift
24 it out of the landfill. This creates a problem
25 of ensuring the integrity of it. If you raise it up

cross
the
cover



1 with a water layer underneath it and then dispose of
2 waste on top of it, you could puncture the liner, for
3 example, and create a problem because it is no longer
4 founded on something that is fairly solid. So, a
5 fairly extensive system of dewatering, we felt, would
6 be required to relieve these pressures on the liner
7 and that water would be pumped to a nearby watercourse,
8 as in the case of Site B. Here the service area is
9 located in the southwest corner of the landfill area.

10 So, again in conclusion, the site
11 is sited on the west side of the candidate area
12 because of poor ground conditions on the east side,
13 basically being a problem with surface water and with
14 easements and so it has come to be moved onto the
15 shale. This has now required in order to protect the
16 sole source wells which obtain their supplies in the
17 shale, it requires protection and we felt in this
18 case a membrane liner would be the answer to that.
19 The engineering required to install a liner is
20 extensive.

21 I should point out what I referred
22 to as the sole source. That means there is one
23 aquifer present that people can use and if there were
24 a multitude of aquifers available at various depths,
25 we are no longer dealing with what you would call a



1 sole source aquifer, but all the people in this area
2 do indeed rely on groundwater supplies.

3 Q. If we could turn to Site D and
4 you would find this on page 41 of Exhibit H-38. Mr.
5 Sobanski, could you give us the conceptual design work
6 with respect to Site D at the Phase 2, Stage 2C level?

7 A. Again in recapping Mr. Beechinor's
8 evidence just briefly, on Site D we do have 15
9 metres of overburden over the site. However, the
10 constraint we found here was another service corridor
11 where Sun-Canadian Pipeline has an easement running
12 along this area, from the area defined on the area
13 as buffer zone over to the Sun-Canada pipeline.
14 This was a constraint and we wouldn't want to split
15 our landfill as it's not a good use of land and we
16 lose capacity from the side slope areas that are not
17 filled.

18 We felt here the best method of
19 approach would be to move south of the pipeline area.
20 We found there would be some minor stream diversions
21 required with respect to the area we have selected
22 here. There is a small intermittent tributary that
23 flows down the west side of the property, enters
24 the property roughly at the Sun-Canadian pipeline
25 and traverses it for a short distance and then



1 flows westward, west of the words "landfilled area"
2 and southward to a culvert and then moves westward
3 again. This is an intermittent stream, it is not a
4 permanent feature, but obviously we are going to have
5 to take it into account or during wet weather we
6 will have a stream flowing into the landfill.

7 The overburden is clayey silt till
8 overlying a sandy silt till, and we believe this would
9 provide us with a good degree of natural attenuation
10 for the local groundwater resources. If we again
11 use our typical design of a 100-metre buffer, a
12 depth of excavation of about 4 1/2 metres, 15 metres
13 of height and four to one side slopes, we would come
14 up with a refuse capacity of 12.1 million cubic yards.
15 The concept was to slope the base of the pits towards
16 the southwest and a tile collector system would be
17 installed on the base of the site. It would drain
18 toward the southwest, and from there, as required,
19 leachate would be pumped off the site to the nearest
20 sanitary sewer. The service area was to be located
21 in the southeast corner of the site off Highway 25.

22 Again, as a summary, we are in a glacial till environ-
23 ment and our constraints are the Sun-Canadian pipeline
24 which has moved us south on the site. This would be a
25 relatively conventional landfill design, taking earth



1 and using it for cover, placing a tile collector
2 system on the base of the site and then extracting
3 the leachate produced in order to protect the environ-
4 ment.

5 Q. Now, if we could turn to page
6 47, Mr. Sobanski, with reference to that page, if
7 you could review with us the work done on the
8 conceptual design for Site E? *E*

9 A. In the report this is Figure
10 E-7. We found the overburden on this site exceeded
11 30 metres in the Britannia Road area and in the
12 remainder of the area it was in the 15 to 20-metre
13 thick range. The site was located in this L-shaped
14 manner for several reasons, and one was to avoid what
15 we perceived could be a buried valley, a bedrock aquifer--
16 a bedrock valley buried aquifer complex along the south
17 end of the site near Britannia Road and the second
18 consideration was an agricultural consideration on
19 how to split the farms and the third was that we
20 identified a floodplain area to the north which we
21 would have to avoid.

22 So, those are the basic reasons
23 for ending up with this L-shape of land for a landfill
24 on Site E. Here again we have generally fine-
25 grained materials at surface, clayey silt till, and



1 Mr. Beechiner described another till unit beneath
2 that similar to Site D, but between these two units
3 we have a granular unit which may be extensive over
4 the area.

5 There is generally a discharge gradient
6 on this landfill site and so this would provide for
7 ease of collection of any leachate that would be
8 produced. The one problem factor with the shape of
9 the site was that it brought us into close proximity
10 to wells along Bell School Line and Britannia Road,
11 that general area.

12 So, while we felt there was good
13 attenuation capability, we have more wells to deal
14 with here.

15 Leaving our normal criterion in place
16 for buffers and side slopes and height of landfill,
17 we come up with a refuse capacity for this site of
18 about 11.9 million cubic yards. The design would be
19 conventional, it would have a tile collection
20 system placed at the bottom of the cells and the
21 base of the cells in the conceptual design would
22 slope toward the west and these would be picked up
23 into a trunk running along the west side of the pit
24 and from there the leachate would be taken to a
25 sewage treatment plant for appropriate treatment.



1 The service area in this case was
2 selected in the southeast corner of the site along
3 Tremaine Road. So, in summary again, Mr. Chairman,
4 the overburden is fairly thick and we feel it has
5 good attenuating capabilities and there is a general
6 upgradient area or discharge area on the site. The
7 design is conventional where we will fill in earth and
8 use it for cover and there will be an underdrain
9 system on the site and the leachate will be taken to
10 a sewage treatment plant.

11 Q. If we could now turn to page
12 55, Mr. Sobanski, can you give us the work done
13 with respect to the conceptual design for a landfill
14 at Site F at this level of study?

15 A. The concept of the design for
16 this site was somewhat different than for the other
17 two sites where we found we had shale on the property.
18 In this case, following the report on the rationale
19 for the design of this site, we recognised that
20 concerns could arise because a site in this location would
21 be situated on fractured shale which will have
22 less attenuating capabilities than some of the over-
23 burden sediments. However, the data we had on hand
24 indicated that the loss of some leachate at this site
25 would not pose a threat to the environment.



So, in considering the design, we have a series of factors of rationale which are shown on pages 55 and 57 and I will summarize these briefly if I can to give the Board a feeling for what our thoughts were.

First of all in terms of buffer; the land area is somewhat restricted on this site and if we were to use our conventional criteria here with 100-metre buffers, we would end up with an area that was only about 43 hectares in size and would give us a capacity of about 6.3 million cubic yards, which is far short of the projected requirement of 11.3 million cubic yards. If we ran the 100-metre buffer around the entire site, there wouldn't be sufficient capacity there. We felt we could rationally increase the capacity by eliminating the buffer against the existing Bayview landfill site. The Bayview site abuts this property and there may well be some impacts from the Bayview site on the NSP property and putting waste against waste, considering we are engineering this system, didn't give us any concern, that the two waste mounds might meet. We used a similar rationale on the west side of the site for the Burlington landfill located immediately adjacent to the NSP property, which also



1 abuts the NSP property. Again, leachate from that
2 zone, although we have never investigated this, but it
3 may be impacting the NSP property. We felt again that
4 putting waste against waste shouldn't constrain us
5 and have us put 100-metre buffers around this site.
6 It is also the consideration in that the groundwater
7 flow direction is lineated so the control works we
8 may use to remedy problems would be located along
9 the south side of the site.

10 The other thing we considered was
11 that we have a hydro corridor that passes down in
12 the southwest corner of the site, and we felt it would
13 be reasonable to reduce that buffer to 50 metres as
14 opposed to 100 metres, for where we have a 100-
15 metre buffer, and the rationale was that this would
16 protect the hydro lines from any of our equipment
17 and the concern is not so much one of contamination,
18 I don't believe, it would be a permanent corridor, but
19 also south of that we do have some more property
20 available to NSP and we have the rights-of-way for
21 the North Service Road and for 403, which still gives
22 us a considerable distance for attenuating buffer and
23 areas in which any additional control works could be
24 constructed.

25 On the northern side of the site on the Azova



1 property, we left the conventional 100-metre buffer as we did
2 along King Road and along the North Service Road to
3 the point where the North Service Road meets the
4 Ontario Hydro corridor.

5A

5 Based on the information we had at
6 this stage, we felt that some of the leachate generated
7 at the landfill would move into the groundwater flow
8 systems, essentially into the deep groundwater flow
9 systems which Mr. Beechinor has described as being
10 of extremely poor natural groundwater quality. We
11 would, however, install a leachate collection system,
12 a conventional leachate collection system on the
13 site. The site would be excavated for the most part
14 into the Queenston shale.

15 Another consideration that we felt
16 was important is that there is a sanitary sewer
17 located along the North Service Road and there is
18 another extension of the sanitary sewer that comes
19 up to south of the landfill on King Road which is
20 another source for leachate to be discharged for
21 treatment.

22 At this level of thinking, by
23 utilizing this L-shaped area, we felt there would
24 be a potential advantage here to constructing a
25 site in this manner because we would be able to pick



1 up the leachate seeps that were occurring at the
2 Bayview Site at that time. Now, as you are probably
3 aware, or may be aware, a leachate collection system
4 has been installed by the City of Burlington
5 independently to capture those seeps, but at this stage
6 of our thinking, that was not in place and we felt
7 there would be an advantage to this type of design to
8 pick up existing problems.

9 I got ahead of myself on my notes,
10 but point 5 expresses our thoughts that any leachate
11 that does seep and by-passes the leachate collection
12 system, would go into deeper zones which are of
13 extremely poor quality and non-potable.

14 The concepts of investigators were
15 that leachate moving from the site to depth would
16 enter the deep water ground flow systems and would
17 discharge into Hamilton Harbour ultimately. This
18 would give us a mile or more of attenuating capability
19 /and dilution
20 so that the amount of leachate, the small amount of
21 leachate that might leave the site would not impact
22 Hamilton Harbour adversely. So, the design concept
23 that we utilized was that we would eliminate the
24 buffers between the Bayview landfill site and the
25 Burlington landfill site and we would reduce the
size of the buffer against the Ontario Hydro right-



What
info

1 of-way corridor. According to the information we had
2 received, the weathered shale can be used for cover
3 material and apparently we understand it is extracted
4 and it is left out to weather for a season and it
5 results in material that is suitable for making bricks.
6 Piles we saw exhibited clayey to slightly gravelly
7 textures and it appeared that it would be feasible
8 to extract clay, weather it and use it for cover
9 material.

10 The design criteria would be
11 conventional, about a 4.5 metre excavation, four to
12 one side slopes, and this would give us a capacity
13 of 11.4 million cubic yards.

14 Now, going back to where we said
15 with conventional buffers we could not meet the
16 capacity, the 11.4 million cubic yards compares with
17 the required 11.3 million, so it is essentially right
18 on.

19 At this level we are going to
20 arrange collection tiles on the base of the landfill
21 site, as we have on all the others, and so we are
22 looking again at a fairly conventional site except
23 that we are dealing with shale as opposed to over-
24 burden. They would drain generally southerly to a
25 sewer connection that could be installed either to the



1 west or to the south of the site. This would then
2 go to a sewage treatment plant for treatment. We
3 felt again -- another point I failed to mention
4 is that in this particular case, the risk to groundwater
5 users was very low. At the last stage of development
6 we didn't know there were groundwater users in this
7 area at all, but at this stage of development, in
8 reviewing reports and looking at the data base, we
9 again weren't sure. However, at some of the meetings
10 we were attending with the public, there were some
11 rumblings that there were some limited uses of ground-
12 water some distance to the south of the site and these
13 were being used, apparently for lawn watering and
14 gardening purposes. However, we felt there was no
15 necessary risk to anybody who may be down-gradient
16 from the sites some distance, because we knew there
17 are municipal services in place in that area and so
18 if any wells were to be affected by an operation like
19 this, we could immediately hook the user onto a
20 surface water supply that is right in front of their
21 door. So, because of that and the fact that we
22 are going to put this leachate into a water quality
23 which we will examine in the next level of examination,
24 and the water quality was quite poor, we felt this
25 site didn't give us the concern that we had on Sites



1 B and C where we had numerous water uses relying on
2 the shale bedrock as the sole source aquifer. We
3 felt in this case we did not have to install a liner.

4 I believe, Mr. Lederer, and again I
5 will briefly summarize the site....

6 Q. Please.

7 A. Essentially it's a shale site and
8 there is some overburden which would be used for
9 cover, but the site would be dug over a large area
10 into the shale itself. There is the potential for
11 some leachate to move off-site here -- sorry, I
12 will come back -- we reduced the buffers to get
13 the capacity that was required and we feel that
14 those buffer reductions are justifiable in light
15 of the adjacent land uses also being landfill.

16 Some leachate will likely escape
17 the site in our proposed design. The design is
18 essentially conventional with a tile drain system
19 that will collect the bulk of the leachate that
20 will go to a sewage treatment plan. However, some
21 may go to depth, and at depth the groundwater quality
22 is very poor and we did not feel this would impact
23 any of the resources severely. We are talking about
24 impacting or putting chlorides in at 1500 parts
25 per million, into a material that has 20000 parts



1 per million of chloride to start with.

2 In terms of groundwater users at
3 this site, we had identified some, or it was
4 rumoured at this stage there were some users.
5 However, we didn't feel that would be a problem
6 and we don't think that the system would be
7 connected to this bad quality system we are talking
8 about and if they are using it, they can't use 10,000 or
9 20,000 milligram per litre chloride water and they are
10 likely dealing with a freshwater rind which may occur

11 on top of this bad quality zone. As a result, we
12 felt there wasn't a need to protect them. If
13 we are wrong, we can connect them immediately to
14 a water service which crosses everybody's door.

15 DR. KINGHAM: Did you say ground-
16 water that has 20,000 parts per million and
17 leachate that has 1500?

18 MR. SOBANSKI: About 1500, yes,
19 that is correct.

20 DR. KINGHAM: Is that a revision
21 to paragraph 5 on page 57?

22 MR. SOBANSKI: Not really. I suppose
23 I am putting in knowledge we have gained in
24 subsequent investigations, but 15,000 is fine as
25 well. This was a statement made by M.M. Dillon



1 in one of their reports and I might as well read it.
2 into the record, and this was their concept:

3 "For example, chloride, which is often
4 used as a conservative tracer, has
5 a leachate concentrate of 750 mg/L
6 and a groundwater concentration of
7 up to 15,000 mg/L at some monitors."

8 This is a statement attributed to
9 Dillon and it's not ours, and it helps us
10 certainly in that we are thinking along the same
11 paths, but unfortunately I have some knowledge of
12 what we found in the next phase of the investigation.

13 MR.LEDERER: Q. Mr. Sobanski, having
14 completed all of this work, the work described here
15 by Mr.Beechinor and now by yourself, did you
16 subsequently do work to rank these six sites?

17 MR. SOBANSKI: A. Yes, we did.

18 Q. What I would like you to do is have you
19 take us through that process of analysis and ranking,
20 and what I would like to start with is to ask you to
21 turn to page 70 and the subsequent pages, the page is
22 entitled Table 1, and perhaps you could begin with
23 page 71 and review the contents of this table.
24 Perhaps what you could do is begin by explaining
25 what's on the table?



1 A. Yes. Give me just a second to
2 review it and collect my thoughts.

3 We can see that this is Table 1
4 continued, and I will come back in a moment to
5 how this started, but it's a summary of this data.

6 First of all, on the lefthand side
7 we have the word "factor" and secondly the
8 consideration, the thing we need be concerned about
9 in terms of our assessment, third our comments
10 and finally the level of constraint that we have
11 assigned to it.

12 First of all, let's look at that
13 title, because it's very important. This is
14 existing constraints to site development and this is
15 how, after the 2C level, we see the sites in an
16 unengineered condition if we were to place a
17 landfill into the natural environment. We are
18 actually going to look at it three ways, and I can
19 lead into it better by saying that we will firstly
20 look at existing constraints, then we will see what
21 the effect of putting a landfill on these sites is,
22 an engineered facility which has some of its own
23 affects on the environment, such as the collection
24 of leachate, and how it can affect how much water
25 is available in an area and it would reduce the



1 amount of groundwater, for example, and finally we
2 will look at the effect of having a failed leachate
3 collection system on the environment.

4 First of all, the first table is
5 existing constraints to site development and firstly
6 we have factor and then consideration, our comments
7 as to what our thinking was at this time and the
8 level of constraint development that we applied.

9 Q. Perhaps the best thing to do,
10 because of the way this was developed, is to take
11 us in detail through the considerations that
12 apply to Sites D and F as shown on this chart and
13 then move us back to the summary table?

14 A. That is page 77. These charts
15 are available for all six sites in the tables.
16 However, for discussion we thought it would be best
17 to go to Sites D, E and F for a review of their
18 characteristics. The first factor we are considering
19 is attenuation capability and the consideration is
20 off-site degradation of water resources. Our
21 comments are that the soil is a low permeability,
22 silty clay till and therefore our constraint is low.
23 In other words, our attenuation capability is high.
24 The stratigraphic complexity at this level, and
25 our concern was the off-site degradation of water



1 resources again; the stratigraphy is uniform with
2 occasional sand lenses and therefore the constraint
3 level again is low. The overburden thickness
4 was our next factor and again the off-site degradation
5 of water resources is our concern. There is more
6 than 15 metres of soil present across the entire
7 site and therefore the level of constraint was low.
8 The complexity of the groundwater flow system,
9 and again off-site degradation of water resources
10 is important, and we are concerned about being able
11 to predict. The deep flow is predominantly uni-
12 directional and the shallow flow is on a divide.
13 The flow system is in a recharge condition, a
14 pipeline trench passes along the north side of
15 the site and the trench may create a preferential
16 flow path. Consequently we rate the level of
17 constraint as moderate to high, so there are
18 some complexities in the flow systems at that site.

19 The buried valley, aquifer complex;
20 our concern is contamination of a major water
21 supply aquifer and major would be a better word
22 here, but none exists at this site and therefore
23 we rated it as nil. The surface drainage; our
24 consideration is the leachate and sediment
25 contamination of surface water. There are some



1 minor tributaries which flow across the site and
2 there is a concern and therefore our level of
3 constraint is moderate. The site capacity; the
4 maximum required capacity is 11.3 million cubic
5 yards and a sufficient capacity is available and
6 therefore the level of constraint is nil.

7 On the next page of the table we
8 look at three more factors, and these are new
9 factors coming in now as we look at the sites in
10 a higher level of detail. The complexity to engineer
11 this site, which is a measure we feel of the
12 reliability of the engineered systems. Our
13 comments essentially are that there are some
14 inner stream diversions required and, other than
15 that, in terms of complexity to engineer, it was
16 not too difficult and we give it a low level of
17 constraint.

18 Down-gradient well users and
19 degradation of water supply wells, including
20 number and distance; some down-gradient wells
21 close to the site and we give it a moderate level
22 of constraint. In terms of the ease of supply
23 restoration should any of these users become
24 affected, we consider the proximity of an alternate
25 water supply, and this would be a high impact



1 if an alternate water supply is distant, and the
2 comments are here that we could deepen wells, the
3 shallow wells into the shale for example, and if
4 a well near the road would become contaminated, we
5 could construct a well much further back on the
6 property to give it greater distance for
7 attenuation or we could connect to municipal services.
8 Now, given that the municipal services here are
9 far away, and yet there is the potential to provide
10 an alternate water supply to these people, we
11 rated it as moderate to high and the high reflecting
12 the distance to go to the pipeline and the moderate
13 reflecting the need to restore wells or move wells.

14 F If we could now consider Site F,
15 which is found on page 81, this is the same table
16 and set up in the same way except for Site F.

17 With respect to attenuation capability, the
18 consideration again was the degradation of water
19 resources and the shallow soil gives poor attenuation
20 and our level of constraint was moderate to high.

21 Under stratigraphic complexity;
22 the stratigraphy of the site is in fact fairly
23 uniform and consists of a thin glacial till over-
24 lying a fractured bedrock and so in terms of
25 stratigraphic complexity, it is a two-layer system



1 at this level of examination and it has a low level
2 of constraint. The overburden thickness, and again
3 the level of constraint is obviously high over most
4 of the site because there is little or no overburden
5 and most of the site will be situated right within
6 the shale, although at the north end of the site we
7 do have up to 18 metres, but it is of limited area
8 of extent. The complexity of the flow system we
9 rated as moderate to high. It is predominantly
10 south or southeast. The shallow bedrock system is
11 in a recharge condition and the fracture flow has
12 uncertainties, but the steep gradient makes the flow
13 pattern more predictable and in all likelihood it
14 is moving toward the lake. The existing groundwater
15 quality is poor. This is, however, a complex
16 groundwater flow system so we give it a moderate
17 to high rating.

18 In terms of a buried valley, aquifer
19 complex, we certainly do have valleys in the rock
20 on the site, but we don't have any overburden
21 deposits within them, so we aren't concerned about
22 contaminating major water supply aquifers on this
23 site as none exists, and therefore the level of
24 constraint is nil.

25 Under surface drainage, the opportunity



1 to contaminate surface water with leachate or
2 sediment, there is a complex surface drainage pattern
3 on the site, including at that time leachate seeps
4 from the abandoned Bayview site and therefore our
5 level of constraint on surface water we ranked as
6 high.

7 MR. TANNER: Excuse me, but you were
8 saying that the leachate springs are gone?

9 MR. SOBANSKI: I am not sure of the
10 present condition, but a system has been installed.
11 Unfortunately, I am not aware at this time of its
12 effectiveness. There is a leachate collection system
13 in place around part of the west side of the site
14 and along the south side of the site to capture the
15 springs.

16 MR. LEDERER: You may recall that in
17 the first opening when I went through the various
18 hearings that were before you, there was some
19 discussion to deal with the fact that the City of
20 Burlington has issued a notice to expropriate certain
21 lands to the south of the Bayview landfill and some
22 portion, a thin portion to the west of the landfill.
23 Without going through all the complications of who
24 is expropriating what and what is happening, the
25 reason for that, as I understand it, and either



1 Mr. McQuaid or Mr. Tidball may want to catch me
2 on this, but there were leachate seeps coming out
3 of the Bayview landfill and the Ministry of the
4 Environment required or in some way indicated that
5 something ought to be done about it. While the
6 expropriation is in issue there is, nonetheless an
7 agreement, as I understand it, between Ms. Cronk's
8 clients and presumably Mr. McQuaid's clients that
9 have permitted the construction of the necessary
10 remedial works and they have been constructed.

11 MRS. TANNER: Thank you.

12 MR. SOBANSKI: The next factor for
13 Site F is site capacity, and the maximum required
14 capacity is 11.3 million cubic yards. We have,
15 however, come back to ~~existing constraints~~ in this
16 consideration, although we have recommended changes
17 to them, but if we had a 100 metre buffer around
18 all the boundaries, our capacity would only be
19 6.8 million cubic yards, and that provides us with
20 a high level of constraint, using our basic landfill
21 design. This becomes low, using the adjusted design
22 we described a few moments ago.

23 In terms of the complexity to
24 engineer the site and the reliability of the engineering
25 systems, complex leachate drains may be required



1 and at the conceptual stage they were looking at a
2 two-tiered system and seepage from the abandoned
3 Bayview site is to be collected and we put a
4 moderate constraint on this factor of engineering.

5 The down-gradient well users; our
6 ~~comments are first of all that few are present and~~
7 we are concerned, certainly, that there would be
8 degradation of any wells, but given that there are
9 few present, we give it a low constraint.

10 Ease of supply restoration; a low
11 constraint because municipal services are in place
12 throughout the down-gradient area.

13 This is table 1, which we have lost
14 the "continued" on and this summarizes the constraints to
15 site development for the six sites. On the lefthand
16 side we have the factors we discussed in some detail
17 for each of the sites going from those that affect
18 the environment, such as attenuation and stratigraphic
19 complexity, down to those which involve engineering
20 and finally the well users. Across the righthand
21 side, going from left to right, we have the six
22 candidate Sites A through F. Now, this table
23 represents a precis of the impacts, the levels of
24 constraints we identified in the main tables and
25 here they are in front of everyone to look and



1 compare one site with the other. The types of
2 constraints -- as I say, we have redified them and
3 we have high, moderate and low, which indicate the
4 definitions on these letters and nil, I hope, is
5 self-explanatory.

6 DR. KINGHAM: It is quite self-
7 explanatory, but what is not clear is the degree of
8 inter-connectedness between one and the other. It
9 seems to me there would be a high degree of inter-
10 connectedness. Do you take into account when you
11 look at your last two items, down-gradient well
12 users and ease of supply restoration, do you take
13 into account the absence of aquifers or very thick
14 overburden with a considerable attenuation capacity,
15 or when you put the numbers there, are you looking
16 at them one by one?

17 MR. SOBANSKI: Here you are looking
18 at them one by one, Dr. Kingham. This is for this
19 particular site, how many wells are near the site.

20 DR. KINGHAM: It doesn't matter in
21 that case, and if it's a thick overburden but high
22 attenuation capacity, it's strictly numbers.

23 MR. SOBANSKI: These are strictly
24 numbers and not in the sense of judgment, taking
25 into account that in one case you may have one or



1 two wells and in another case you may have a dozen
2 wells within a reasonable distance of the site, and
3 are there down-gradient well users at all? For
4 example, even on Site F, there were still some
5 uncertainties and we could have said that to our
6 knowledge at that time, since we could connect down-
7 gradient well users to the municipal system, we
8 could have put a nil in there, but there is still
9 the uncertainty at this level of investigation so
10 we rank it and recognise there may be some there and
11 I don't think there are many, so we put it as low
12 and there will also be a fairly large distance
13 between the site and any users. We haven't
14 written it off and said nil, but we have tried to
15 compare even site-to-site in our minds on how they
16 compare with one another in establishing these levels
17 of constraints for the various sites.

18 MR.LEDERER: Q.Having reviewed this
19 work and summarized this analysis, did you subse-
20 quently refine this aspect of your work with
21 additional considerations?

22 MR. SOBANSKI: A.Yes, we did. We
23 developed table 2, which is a consideration of the
24 effects on the environment of an engineered landfill
25 site and the types of factors we considered here



1 are shown on page 63 of the report. First of all,
2 we would have the tile underdrain systems under
3 the sites which would lead to a sump and the sumps
4 would be periodically drained to reduce the leachate
5 levels in the refuse. There would be a sewer
6 connection from the sump to a water pollution control plant to allow
7 for leachate treatment and, where required, we would
8 install low permeability liners to protect the
9 hydrogeologic environments possessing sensitive
10 water resource, significant ones; a drainage system
11 would be provided to divert surface water from the
12 disposal areas and this has an impact potentially
13 as well. We would provide sediment control systems
14 to prevent siltation of surface waters and, if
15 necessary, we would have control systems to control
16 landfill gas and odours and, finally, we designed in
17 buffer zones to reduce the property boundary impacts.
18 With those considerations in mind, which we have
19 already covered in some detail, we went on to
20 develop table 2, which starts -- if I can find it here.

21 Q. At page 83?

22 A. Page 83. This is the summary,
23 so perhaps we could look at Site D, which is the
24 individual site consideration, which is on page 87.
25 Now, here we are collecting leachate and we have a



1 good system in operation and it is handling most of
2 the job, all of the job, and we are now going to look
3 at the impact on various waters in the area. We
4 have provided our comments and we have given an
5 estimate of the level of impact that this would have
6 on these various uses on the lefthand side.

7 The first item we considered was
8 the groundwater users in the area, and we are going
9 to consider the impacts of a designed landfill site on
10 both the quality of the water and the quantity of
11 the water that they have available to them.

12 We are next going to do an estimate
13 of what impact this facility will have on the
14 groundwater resource itself. It may be that our
15 concern isn't just for an individual well user,
16 but for an aquifer, for example, and what effect
17 does taking leachate have on that and so again
18 this is the resource in terms of quality and
19 quantity.

20 Next we are going to look at the
21 surface water resource in terms of quality and
22 quantity.

23 So, for Site D, looking first to
24 the groundwater users and the effect an engineered
25 landfill would have on quality, our comment is that



1 because of the leachate collection system, there is
2 little potential for leachate to migrate into the
3 groundwater flow system and again at the conceptual
4 level our design is conventional and in overburden,
5 but with a leachate underdrain system from which we
6 will extract leachate at the site. Given, however,
7 even here this level of detail and what we know
8 about this site, we have still assessed the
9 potential impact level as low and we could have said
10 nil, but we are still saying it is low until we
11 know more about the site.

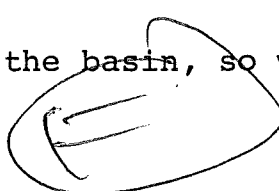
12 In terms of groundwater users, we
13 have quantity, how much water will they have
14 available if we operate this system. Because of
15 the low permeability silty clay till and the few
16 down-gradient well users, we felt the influence
17 on the amount of groundwater would not be too
18 significant. The recharge rates through these
19 materials are relatively low, so our extracting some
20 of the infiltration that may have gotten to the
21 aquifer will have a low to moderate impact and
22 we have rated this a little higher because we are
23 taking some water from the system.

24 In terms of the resource, in terms
25 of the quality and because of the leachate collection



1 system, there is little potential for leachate to
2 migrate into the groundwater flow system and this
3 is the same comment we had for the quality for the
4 groundwater users, and so the impact level is
5 considered to be low. In terms of quantity, we
6 feel that dewatering as a result of our leachate
7 collection system, which after all will be installed
8 15 feet below ground level, but in fairly tight
9 soils, will have only a local effect on any ground-
10 water levels and so the impact level again is low.

11 In terms of the surface water quality,
12 because of the stream diversions, there is little
13 potential for leachate to migrate into the surface
14 water flow system and so we have given it a low
15 impact and in terms of quantity, how much water
16 would still be flowing in those streams, we felt
17 there would be a small local effect due to the
18 capture of precipitation on the landfill, but the
19 landfill itself is relatively small with respect to
20 the basin, so we have given it a low impact.

21  If we move now to the same analysis
22 for Site F, which is shown on page 89, again we
23 are looking at the impacts of an engineered site
24 development and for the same factors. In terms of
25 groundwater users, in terms of quality, there are



1 no users who need be dependent on groundwater down-
2 gradient of the site. They can be hooked to
3 municipal services if there are any. The impact
4 level we rate as nil. In terms of groundwater
5 quantity, again the same comment and again our impact
6 level is nil and no one need be dependent on ground-
7 water in this area.

8 In terms of groundwater quality,
9 our comments are that because of the leachate
10 collection system, leachate migration into the
11 groundwater flow system will not significantly
12 affect groundwater quality because existing ground-
13 water quality is very poor. The two words of
14 importance are "very poor" and "significant effect"
15 and we don't feel there will be a significant effect
16 on that poor quality water and so we rated that
17 impact level as low, and recognising that there
18 is an impact.

19 In terms of the groundwater quantity,
20 the leachate collection system would have a small
21 effect due to the interception of precipitation on
22 the landfill which would go off as contaminated
23 water for treatment, and the impact level we have
24 rated again as low.

25 Now, interms of the surface water



1 resource, the quality, this factor has changed now.
2 At this time when this report was prepared, we felt
3 there would be a beneficial effect through our
4 reasoning that we could combine any type -- we could
5 combine the collection system from this site to
6 use it to clean up the problems at the Bayview site,
7 but as we have heard now a couple of times, this
8 factor no longer is a beneficial factor and it
9 would be a low factor in all likelihood. I haven't
10 really reassessed it, but we will reassess it at the
11 next level.

12 In terms of the quantity, we would
13 be picking up surface leachate springs that would
14 have an influence on the general flow qualities in
15 the area, but we are near the headland areas of
16 the creek, so we would have a relatively low impact
17 on the quantity of water available in the surface
18 water resource.

19 Now, table 2 on page 83 is our
20 summary table where we have again brought together
21 all of the sites on one page, showing the impact
22 on the groundwater users, on the groundwater resource
23 and on the surface water resource and then shown
24 the rankings or the constraints all together on the
25 various sites, on how an engineered system would



1 impact the environment and they are there for a
2 comparison, one to the other.

3 Q. Having done this work and having
4 considered the potential impacts of an engineered
5 site development, did you refine your work further?

6 A. Mr. Chairman, our work with
7 the sites didn't end with engineering them and
8 seeing what would happen to the environment. We
9 went a step further, and the step further I gave
10 you in my introduction and that was to look at the
11 effect of a failed engineered system on the environ-
12 ment. When I say failed, this takes into account
13 the possibility that some of the mitigative measures
14 we are recommending for these sites, or conceptualizing
15 for the sites, that is a better term, they may not
16 work as well as predicted.

17 For example, it is possible that a
18 piece of equipment would break down and we are
19 not talking about everything plugging off and
20 leachate spilling all over the site, but the
21 possibility of a tile plugging or the possibility
22 of a pump failure, the possibility of a liner
23 being punctured somewhere in the system, the
24 possibility perhaps that we may have some side
25 slope discharges of leachate which may have to be



1 dealt with and this occurs at some sites.

2 So, we felt that in our opinion this
3 assessment we are going to discuss now represents
4 sort of the worst-case scenario that one would
5 expect at an engineered facility, and this is the
6 one that we have chosen to rank our sites on. I
7 should point out that in the event of these failures,
8 any failures when we talk of landfills, additional
9 contingencies are available to deal with these
10 problems.

11 If I could refer the Board to page
12 91 of the report -- at page 90 we start into the
13 table 3 assessment, which is the potential impacts
14 of a systems failure on water resources, and as we
15 have handled the rest of the cases, if we could
16 go to page 94, on page 94, as we did with the
17 other cases, we are looking at Site D, and the
18 potential impacts of systems failures on water
19 resources. Site D is a conventional landfill and
20 consequently we are looking here at the possibility
21 that there may be a tile plug within the system,
22 there may be some side slope discharges of leachate,
23 there may be a pump failure, that type of a scenario.
24 I should point out that in looking at Sites B and
25 C, we will see we have considered the impacts of



1 a puncture-type failure on the liner. However,
2 coming back to D, the impact on the groundwater
3 users in terms of quality and quantity is considered
4 and again the groundwater resources and the surface
5 water resources are considered with respect to the
6 same two parameters. So, this table is set up the
7 same way that table 2 was set up.

8 In terms of quality at this site,
9 on groundwater users, if the leachate collection
10 system fails, the potential for leachate to migrate
11 into groundwater flow system will be increased only
12 slightly, due to the fine-grained nature of the soils
13 and we give this an impact level of low to moderate
14 in our judgment.

15 Down-gradient well users are few
16 at this site, and that is another comment with
17 respect to that, we do take it into account. In terms of
18 the quantity, if the leachate collection system
19 fails, the water table could revert to its original
20 levels and we will get a rise of water levels within
21 the fill and so consequently in terms of quantity,
22 there is no impact any longer and we are now
23 starting -- we will revert to original conditions
24 and consequently groundwater recharge will reoccur,
25 and perhaps not the kind we would like to have occur.



1 In terms of the resource under
2 quality, if the leachate collection system fails, the
3 potential for leachate to migrate into groundwater
4 flow system will be increased only slightly due to
5 the fine-grained soils and that is the same type of
6 rating, low to moderate. In terms of quantity, the
7 groundwater table would revert to original levels
8 and the impact level would be nil.

9 In terms of the surface water resource,
10 quality; if the leachate collection system fails,
11 the leachate will mound up within the site, creating
12 the potential for seeps at the surface. This
13 condition could be corrected with interceptor
14 trenches . hence initially high, then becoming
15 low. If I could explain that. If this type of a
16 failure were to happen, it really refers more to
17 side slope discharges of leachate and they would
18 have to be picked up and handled appropriately but,
19 first of all, when they occur you have to identify
20 them and see them so you know some leachate will
21 hit your surface watercourse and so initially you have a
22 high impact and we correct the problem and go to
23 a low impact.

24 In terms of the description here,
25 the description here of referring to the whole



1 site filling and coming to surface with side slope
2 discharge of leachate is more a total failure
3 scenario which is very unlikely to happen and the
4 same problem, it would be remedied in the same manner.

5 In terms of the surface water resource quantity,
6 the failure of the system will not affect the
7 surface water quantities and therefore the effect
8 will remain about the same for the engineered site
9 and the impact level is low. In other words, the
10 slope is already there of the engineered system
11 and the site will not collapse or anything, so any
12 impact from slopes and shape of site and things like
13 that are not going to change the quantity if we
14 have a leachate collection system failure.

15 If we could look at Site F in the
16 same way, it is the same set up for the tables and
17 let's look at the groundwater users first. In terms
18 of quality and quantity, our comments are the same
19 as they were for the engineered system. Even here
20 if we have a failure, no one here need rely on
21 groundwater and we can hook them up to a municipal
22 system immediately and the impact level is nil.

23 In terms of the groundwater resource,
24 quality; if the leachate collection system fails,
25 leachate migration into the groundwater flow system



1 could increase, and this was our knowledge at the
2 2C level, but because of that poor quality, we give
3 it a low impact, not a nil impact but a low impact.

4 In terms of quantity, if the leachate
5 collection system fails, the water table will
6 revert to its original levels and therefore there
7 is no impact on quantity. On the surface water
8 resource, quality; if the leachate collection system
9 fails, leachate will mound up within the site
10 creating potential for seepage at the surface and
11 again we could think of side slope discharges as
12 well. This condition could be corrected with
13 interceptor trenches. However, initially medium,
14 then becoming low. Because of existing storm
15 drains, the impacts will be very local. Here we
16 have given it a moderate to low rating because
17 of two factors and one is lack of use of any surface
18 water resource in the area and, secondly, there are
19 already some quality problems and it's a natural
20 problem because the quality is not as good as in
21 some other areas.

22 In terms of quantity, the failure
23 of the system will not affect surface water quantities
24 and just like we said for Site D, the site won't
25 collapse, so whatever impact the landfill has had on the



1 surface water quantities, it will still exist at this
2 level under this consideration and so the impact
3 level is low.

4 I would now like to refer to page 90,
5 the summary of table 3. This was handled just a little
6 differently. Here we see the impacts, and I had
7 better start at the top, but we look across the
8 top and we say failed system and then at the right
9 of failed system we have the type of failure system
10 that would occur. With Sites A, D, E and F,
11 they are the type of system failure we would see
12 which would be something going wrong with the
13 leachate collection system and in the case of B and
14 C, there is that same potential, but we have added
15 another potential and that is a liner failure,
16 because these were considered with synthetic
17 membranes, so here we are considering the effect of
18 a liner failure and the other factors were
19 considered in a similar manner at these sites as
20 well, side slope discharges of leachate being
21 considered at all sites.

22 What we have done is we have now
23 summarized all of our judgments on the impact of
24 a failed system onto one table where we can compare
25 one site to the other.



1 Q. Mr. Sobanski, in undertaking
2 the ranking, what of all of this information did you
3 rely on?

4 A. The ranking of the sites is
5 described at pages 66 to 69. We have ranked the
6 sites in order of preference from our specialty
7 point of view, the water resources point of view,
8 and considering it on a worst-case scenario, which
9 is a systems failure. We have put forward to the
10 Board that we believe that any landfill site in this
11 area will have to be engineered, and to us in
12 assessing the ranking of these sites and how they
13 really compare from our perspective, we would look
14 at an engineered failure to rank them.

5B

15 We then looked at site to site to
16 see whether there are differences and what the
17 differences are as opposed to using some sort of
18 a summation method here and these are summarized
19 on pages 67 to 69 and on how we view the differences
20 between the sites.

21 Under the first point we say that
22 Site F is on the fringe of an urban development and
23 it has an installed municipal water supply system
24 down-gradient of the site, so that no residents need
25 be deprived of a potable water supply. Any leachate



what
about
rmd

1 that may escape the engineered system will enter
2 the deep groundwater flow system that contains non-
3 potable water. That was our first consideration.

4 Site D is situated on clayey till
5 that would have good natural attenuation capabilities,
6 but there are water supply users in this area and
7 there is a limited possibility that some contamination
8 of wells on this site could occur, or near the site,
9 and therefore D ranks lower than F from the aspect
10 of public health and safety.

11 So, at our first cut, given the
12 situation that we see, at Site F we don't have
13 to worry about users, and at Site D, even with an
14 engineered system, there is still some concern for
15 users.

16 Site E, the next consideration is
17 also located on a clayey till. However, the data
18 indicates that it overlies sand and gravel aquifers
19 from which most residents draw supplies. We felt
20 there was a greater potential at this site for
21 more widespread movement of contaminants in the
22 event of a failure. The site abuts a major stream
23 that is used for livestock watering and hence we
24 ranked this site below Site D. There are over-
25 burden aquifers in this area which are being used



1 extensively.

2 The fourth consideration was that
3 Site A is on a moderately permeable sandy till.
4 The attenuation characteristics would be poorer than
5 they are at D and E and from our descriptions of
6 sand zones, the hydrogeology of this site on the
7 western side appeared to be quite complex, or at
8 least potentially complex. The site was bounded
9 by man-made drainage works which could affect the
10 migration paths of contaminants and it was our
11 opinion that this site could involve a different
12 and complicated engineering task. Consequently we
13 rated this site below Site D.

14 Site B; the waste there would be
15 placed on the shale bedrock over about half of the
16 site and there are numerous groundwater users in
17 the area that use this aquifer zone and it is a sole
18 source aquifer. In our opinion a liner would have
19 to be installed and from the public health and
20 safety point of view, we would therefore rate this
21 below Site E, because of the possibilities of a
22 failure and the effects that could have on the
23 users in the area.

24 Sites B and C are similar. However,
25 on Site C, the whole site lies on rock and



1 consequently we rate it below Site B.

2 So, if we go to the little table on
3 page 67, we rank the candidate sites in our order
4 of preferences in the Stage 2C level of study as
5 Site F first, Site F being located in Burlington;
6 Site D second, it being located in Milton; Site E
7 third, also located in Milton; Site A fourth,
8 located in Oakville; Site B is ranked five, also
9 located in Oakville and finally, Site C, located in
10 Oakville near Sites A and B.

11 MR. LEDERER: Mr. Chairman, that
12 really concludes the evidence with respect to Stage
13 2C and this I think would probably be an appropriate
14 time to break for lunch.

15 THE CHAIRMAN: Very well. Until
16 2:15.

17 MR. LEDERER: Thank you, sir.

18
19 --- Luncheon Adjournment (12:45 p.m.)

20
21 --- Upon resuming at 2:15 p.m.

22 THE CHAIRMAN: Mr. Lederer?

23 MR. LEDERER: This is just in keeping
24 with our undertaking to attempt to keep the exhibit
25 list up-to-date. This list is up-to-date as of



1 yesterday evening and, in fact, you will see the date.
2 of June 8th is on it.

3 THE CHAIRMAN: Mr. Lederer.

4 MR. LEDERER: Thank you.

5 Q. Mr. Sobanski, could you
6 indicate, were you or was your firm instructed by
7 the Region of Halton to undertake work at what has
8 become known as the landfill technical phase of the
9 study?

10 MR. SOBANSKI: A. Yes, we were.

11 Q. I am just showing you, or
12 waving in front of you, if you like, two reports,
13 Exhibits H-39, or what has become known as H-39,
14 the Halton Region Landfill Technical Report, Site D -
15 Milton and H-40, the Halton Region Landfill Technical
16 Report, Site F - Burlington, and are you familiar
17 with those reports?

18 A. I am.

19 Q. Could you indicate who prepared
20 them and how they were prepared?

21 A. They were prepared by Trow
22 Hydrology Consultants staff under my supervision.

23 Q. Just to complete this, are you
24 also familiar with H-39-A and H-40-A?

25 A. Yes, I am.



1 Q. Would you indicate to the Board
2 what those exhibits are?

3 A. Those exhibits contain
4 appendices, the data base on which Volume 1 of the
5 report was prepared.

6 Q. Now, just to stop any
7 confusion, if you look at the front of these reports
8 you will see the two basic reports are referred to as
9 Volume 1 of 3 and the appendices are 2 of 3, and
10 Volume 3, as we will subsequently see, is the design
11 and operations report that Mr. Hiraishi will be
12 speaking to.

13 Now, can you indicate to the Board
14 please, what was the purpose of the studies?

15 A. The overall purpose of the
16 studies was first to define the hydrogeologic and
17 hydrologic setting of the Sites D and F with
18 respect to their suitability to serve as sanitary
19 landfill sites. The studies were based on require-
20 ments now of the Environmental Protection Act and
21 they were meant to address outstanding issues
22 relating to hydrogeology, leachate collection and
23 treatment, landfill site design, operations,
24 contingency measures and costs.

25 Q. Can you locate the two
remaining sites for us, both regionally and locally?



1 A. For the hydrogeologic study
2 for Site D, we define the regional part of the study
3 as being Sixteen Mile Creek on-- according to the
4 orientation of the other drawings-- the west side,
5 the Lower Baseline Road on the south side...

6 Q. The west side or the east side?

7 A. I am sorry, of course, the
8 east side, and the Lower Baseline Road on the south
9 side, Tremaine Road on the west side and Britannia
10 Road on the north side.

11 In terms of the regional area we
12 considered for Site F; on the north side we considered
13 the Niagara Escarpment, on the east side King Road,
14 on the south side Hamilton Harbour and on the west
15 side Waterdown Road.

16 Q. Mr. Sobanski, before you put
17 up the next exhibit.... Mr. Chairman, these drawings
18 are relatively comparable to drawing 1 in each of
19 the reports but they are not exactly the same and
20 they are a fairly good portrayal of where these
21 are located by reference to major roads and I think
22 it might be useful to exhibit this.

23 THE CHAIRMAN: They are in the reports
24 H-39 and H-40?

25 MR. LEDERER: I think we could do it



1 numerically. It would be H-39-1 and H-40-1 and that
2 would make it comparable to the drawing number and
3 you will see the drawings are actually in the back
4 of each of the reports in the plastic folders.

5 THE CHAIRMAN: Are they numbered?

6 MR. LEDERER: Yes.

7 THE CHAIRMAN: H-39-1 will be
8 for Site D in Milton.

9
10 --- EXHIBIT No. H-39-1: Map of Site D, Milton.

11 --- EXHIBIT No. H-40-1: Map of Site F,
12 Burlington.

13 MR. LEDERER: Q. All right, Mr.
14 Sobanski.

15 MR. SOBANSKI: A. In terms of the
16 local area, I believe we are all fairly familiar.
17 First of all, for Site D, this is drawing 5 in
18 H-39, for Site D, and the study area here is a
19 little difficult to describe because it lies mainly
20 in farm fields. On the east side we have Highway 25
21 and the First Line Road on the west side of the
22 property. The north side, I suppose, could be
23 described as being....

24 MR. LEDERER: While we have
25 interrupted the flow of Mr. Sobanski's answer, I
should indicate to you that in the largest part,



1 we have taken a copy of the drawing which you will
2 find in the back of the report and we have fastened it
3 to a piece of board and there doesn't seem to be much
4 point in exhibiting them, it will just be more
5 material.

6 THE CHAIRMAN: We have enough maps
7 and plans.

8 MR. LEDERER: And I hate to inform
9 you, but we will have many more before we finish.

10 THE CHAIRMAN: I would suspect that.

11 MR. SOBANSKI: The north property
12 boundary occurs about 600 metres south of Britannia
13 Road and there we extend about two farms south of
14 that and I am not sure how to describe the south
15 boundary, but this is essentially the candidate
16 site area for waste disposal as we have seen on the
17 other figures.

18 The local area for Site F is shown
19 on drawing 5 of the report and it is a much smaller
20 area and generally extends from the north end of the
21 Azova property down King Road, is bounded a couple
22 of hundred metres south by Highway 403 and then
23 includes roughly also the Burlington site out to
24 Falcon Creek. So, this is our local study area and
25 of course the concentrated work being done on the



1 candidate site itself.

2 MR. LEDERER: Q. Can you outline the
3 scope of the study you undertook and what were the
4 objectives specifically?

5 MR. SOBANSKI: A. We had four
6 principal objectives in this study and the first was
7 ① to assess the hydrogeological and hydrological
8 suitability of the sites or settings of the sites.

9 The second was to assess and
10 ② predict long-term effects on water resources as a
11 consequence of landfilling at Sites D and F; the
12 third was to identify measures to minimize adverse
13 ③ impacts to water resources at the sites and the fourth
14 ④ was to develop hydrogeologic criteria and
15 recommendations that would be incorporated into
16 the design and operating plans for both of the sites.

17 Q. As with the 2C studies, were
18 there reports available to you which had been
19 prepared previous to this work being undertaken?

20 A. Yes, there were.

21 Q. Could you identify for the Board
22 those reports, both with respect to Site D in H-39
23 and Site F in H-40?

24 A. Yes. Working first with
25 Site D, H-39, the references that we used are found



1 on page 3 of the report and our first reference was
2 Hydrology Consultants' work of 1985, which was the
3 environmental assessment of the landfill component
4 of Halton's solid waste management system, hydro-
5 geologic/hydrologic assessment and conceptual
6 design report on candidate Sites A, B, C, D, E and
7 F, Phase 2, Stage 2C, which we discussed just before
8 the break.

9 The second was Gartner, Lee
10 Associates Limited, 1985 and I refer to site
11 selection process, Phase 4A, technical appendix
12 PI-1-N, geologic/hydrogeologic and geotechnical
13 considerations, and this was prepared for the
14 Ontario Waste Management Corporation.

15 For Site F, report H-40, I would
16 refer the Board to pages 3 and 4 of the report
17 for Site F and the work we used here was firstly
18 work that we discussed before the break, Hydrology
19 Consultants, 1985, a report entitled Environmental
20 Assessment of the Landfill Component of Halton's
21 Solid Waste Management System, Hydrogeologic-
22 Hydrologic Assessment and Conceptual Design Report
23 on Candidate Sites A, B, C, D, E and F, Phase 2,
24 Stage 2C.

25 The second was by Hewetson, 1985,



1 An Investigation of the Groundwater Zone in Fractured
2 Shale at a Landfill, and this is an M.Sc. paper,
3 a Master of Science paper, from the University of
4 Waterloo.

5 No. 3 was Gartner, Lee & Associates
6 Limited, 1985, Burlington Landfill, 1985 monitoring
7 report for Halton Region.

8 The fourth was M.M. Dillon, 1984,
9 Burlington Landfill Site Application for Continued
10 Use, Volume 2.

11 The next reference is Conestoga
12 Rovers & Associates and Ecoplans Limited, 1984,
13 Landfill Capacity and Feasibility, NSP Property
14 and Adjacent Lands, City of Burlington, 1984 and
15 our sixth report was Acres Consulting Engineers,
16 1982, Solid Waste Management Strategy Study and
17 the seventh was Morrison Beatty Limited, 1981,
18 Phase 3, Hydrogeologic Investigation, National
19 Sewer Pipe Limited Landfill Site, and finally
20 reference eight is to Morrison Beatty also in
21 1980, Phase 2, Hydrogeologic Investigation,
22 National Sewer Pipe Limited Landfill Site.

23 Q. Could you indicate to the
24 Board, did you in fact make use of these studies
25 in conducting your own work?



1 A. Yes, we did. We reviewed and
2 commented on these reports and I am referring first
3 to H-39, the Site D study of Milton. We reviewed
4 the Gartner, Lee work for the general area and we
5 found that the study was done to provide a reconnaissance
6 field level of investigation for the site. They looked
7 at a broad area covering our areas D and E. They
8 did not do site-specific testing or instrumentation
9 on Site D, and so much of the assessment contained
10 in their report was based on inferred data.

11 Q. You may have said page 39?

12 A. I am sorry, page 9. I think
13 the 9 I referred to was H-39, the report number.

14 In terms of Exhibit H-40, Site F,
15 our conclusions with respect to other investigators
16 are summarized on page 7. The reports prepared
17 for Site F indicated that there was a divergency
18 of opinion among the investigators who had looked
19 at the site, and this regarded groundwater movement
20 in the shale and the extent of existing contamination
21 from neighbouring landfill sites.

22 They did, however, agree that the
23 natural groundwater quality is poor and at depths
24 of 15 metres in the shale, the background quality
25 does not meet current Ministry of the Environment



1 drinking water objectives.

2 The area down-gradient from the site
3 is serviced with a municipal water supply system
4 and they also seemed to agree on that.

5 Q. Could you indicate to the
6 Board then, as you undertook your own work, whether
7 there were any initial concerns that you thought at
8 that time you might have...

9 A. As I mentioned, at both
10 sites our study method was intended to resolve
11 outstanding issues relating to hydrogeology and to
12 establish -- it was necessary, we felt, to establish
13 the significance and characteristics of the important
14 hydrogeologic features in order to assess the
15 potential that the landfills had for impacting
16 the environment. At Site D, our concern was the
17 possibility of having sand zones within the glacial
18 till, so we were particular vigilant in the work
19 that followed to investigate this possibility,
20 because they could act as contaminant migration
21 routes.

22 You will recall, Mr. Chairman, at
23 the 2C level we had identified lenses, but with the
24 limited drilling program we weren't sure of their
25 nature at that time, so we wanted to follow up on



1 that aspect.

2 With respect to Site F, w
3 concerned about the potential for leachat
4 discharge between Site F and Hamilton Ha
5 a result of leachate infiltrating into the site.
6 At this stage of the process, the Ministry had
7 indicated that leachate infiltrating into the shale
8 should not surface between Site F and Hamilton
9 Harbour.

10 Q. All right. Now, if you could
11 pass the microphone over to Mr. Beechinor and we will
12 return to him.

13 Mr. Beechinor, what we are going to
14 do is review the study methodology undertaken with
15 respect to the two studies, but, before doing that,
16 what I would like you to do is indicate to the Board
17 whether or not in developing this methodology you
18 consulted with any other parties?

19 MR. BEECHINOR: A. Yes, we did. It was the intent
20 in the development of the field work program to develop
21 a program that was generally agreed to by the
22 Ministry of the Environment, by the Region of Halton
23 and by area municipalities and ourselves, Trow
24 Hydrology Consultants Limited.

25 For example, I have an overlay for



1 this and we consulted some of the area municipalities
2 as to what they felt were important aspects of
3 concerns with respect to our work program.

4 MR. LEDERER: You will find this
5 table at page 12 of the Site D study, H-39, and
6 a similar table at page 10 of the Site F study,
7 H-40.

8 Q. Perhaps you could review this
9 to us first, the Site D table?

10 MR. BEECHINOR: A. This is the
11 party comment matrix for Site D and on the top
12 horizontal axis we have the interested parties
13 with respect to Site D and the interested parties
14 were mainly the Town of Milton, at that time
15 represented by Morrison Beatty Limited, the Halton
16 Region Conservation Authority and the Ministry of
17 the Environment.

18 Down the left side are the various
19 comments and concerns. On the right side are our
20 responses or actions we undertook to deal with some
21 of these issues. For example, the Halton Region
22 Conservation Authority requested that measurements
23 of low flow in nearby streams be determined and our
24 action was to measure the low flow in the streams
25 during the summer of 1985. The Ministry of the



1 Environment requested that all our drilling be
2 conducted to bedrock, ground surface to bedrock,
3 and, as a result, all of our boreholes were advanced
4 to and into the bedrock.

5 The Town of Milton and the Ministry
6 of the Environment had concern with respect to the
7 possible presence of continuous sand and gravel
8 units in the overburden, and in order to assess this
9 possibility, we advanced nine drilling sites on the
10 property and continuously sampled the complete
11 overburden sequence from the ground surface to the
12 bedrock. This was done in order to evaluate potential
13 interconnections of shallow sand zones and, in addition,
14 we conducted pumping tests on the sand units, the
15 major sand units found in the overburden, and this
16 allowed us to establish the lateral continuity or
17 lateral aerial extent of these sand units and perhaps
18 that answers one of your questions from this morning.

19 The Ministry of the Environment were
20 also concerned about the impact of dewatering on
21 water supply wells in the vicinity of the site, as
22 Mr. Sobanski pointed out this morning. Because we
23 were removing water through the leachate collection
24 system, there can be an effect on water quantity
25 in adjacent water supply wells and so, to assess this



1 situation, we conducted two pumping tests on what
2 we considered potential water-bearing zones in
3 the overburden at Site F -- I am sorry, Site D.

4 We carried out a similar process
5 at Site F and this is on page 10 of the Site F
6 report. The structure of the party comment
7 matrix is the same, only the interested parties have
8 changed and here the interested parties are the City
9 of Burlington, represented by Conestoga-Rovers
10 & Associates Limited, the Ministry of the Environ-
11 ment and the Ministry of Natural Resources, and I
12 can run through a few of these as an example.

13 The Ministry of Natural Resources
14 wanted us to consider utilization of shale prior
15 to the landfill development and our response was
16 to conduct an assessment and assess the potential
17 ~~use of this shale resource and this was carried~~
18 out. Conestoga-Rovers indicated they felt there
19 was an insufficient number of wells for sampling
20 purposes in order to evaluate groundwater chemistry
21 and, given this request, we expanded our water-
22 sampling program and we made sure that wells
23 installed, for instance, at drilling site 8-85,
24 were constructed in a way that water samples could
25 be collected from them and evaluated. We also



1 expanded the water-sampling program from wells
2 between Site F and Lake Ontario to accommodate this
3 request.

4 Another request by Conestoga-Rovers
5 was to install one of our drilling sites near a
6 well that was previously installed by Morrison Beatty
7 Limited south of 403 to confirm previous chemical
8 results from that well location. We did so and
9 installed a number of wells at what we called
10 drilling site 9-85. Conestoga-Rovers requested that they
11 be allowed to put a site observer on site and
12 observe our logging procedure and our well
13 installation procedure. We allowed this, and for
14 most of the drilling activities and the well
15 installation activities, a representative of
16 Conestoga-Rovers was on site.

17 I might elaborate on this a little
18 bit. It was agreed at that time that at the end of
19 each day Trow's field representative or Trow's
20 geologist and Conestoga-Rovers field geologist or
21 technician would review the logging and the well
22 installation procedures that were done during the
23 course of the day and if there were any uncertainties
24 or discrepancies between the logs that Conestoga-
25 Rovers were preparing and ourselves, the two site



1 representatives from our organization and their
2 organization reviewed it and worked out any problems.
3 For instance, if either one of them were uncertain
4 about the depth of a particular well, they were
5 instructed to remeasure it and work out any of the
6 uncertainties, so the intent here was to eliminate
7 uncertainties from the data base.

8 Q. Mr. Beechinor, before you go on,
9 did you offer the same opportunity to the Town of
10 Milton with respect to Site D?

11 A. We did.

12 Q. What happened to that offer?

13 A. Well, to my knowledge, there
14 was no representative of the Town of Milton on site
15 during the drilling program.

16 Q. Thank you.

17 A. Both Conestoga-Rovers
18 and the Ministry of the Environment requested we
19 conduct pumping tests on permeable zones identified
20 in the shale. We accommodated this by doing pumping
21 tests at three locations on Site F. The Ministry
22 of the Environment requested that we assess the
23 potential for leachate to discharge between Site F
24 and Hamilton Harbour, and that is the main reason
25 why we at Site F conducted a more thorough regional

Conestoga-Rovers



1 study of the hydrogeology, and when I say regional
2 study we assessed the hydrogeological conditions
3 and the groundwater flow systems between Site F and
4 Hamilton Harbour as well as the site itself.

5 Q. With the consultation program
6 in place and these responses undertaken, can you
7 review with the Board the initial round of field work
8 undertaken with respect to these two sites?

9 A. Sure. I will start with Phase 1
10 at Site D and the work was initiated at Site D in
11 September, 1985. Six drillings sites were advanced
12 on Site D and observation wells or monitoring wells
13 were installed at each of the drilling sites.

14 At each drilling site a continuous soil sampler was
15 employed to sample the complete overburden sequence,
16 as I have already mentioned. This continuous sampler
17 allows us to collect a continuous undisturbed soil
18 sample for the entire distance drilled and at Site D
19 we generally drilled a distance of about 30 metres
20 from ground surface or 100 feet.

21 Now, in the field, a hydrogeologist
22 examined the soil samples and recorded such information
23 as soil moisture, soil colour, soil weathering and
24 soil texture. Of note, just to make this point
25 a little clearer perhaps, you will recall I showed



1 this borehole log yesterday and this is in
2 connection with the test drilling done during the
3 2C level of investigation. This is a borehole D7
4 from candidate Site D and you will note on the
5 righthand side you can see the locations where we
6 took our soil samples, essentially at intervals of
7 about every five feet, so there are gaps in the record,
8 gaps in the sequence where we didn't collect soil
9 samples because at the 2C level we were essentially
10 doing a reconnaissance level test drilling.
11 Once we got into this technical level or detailed
12 level of investigation, we employed the continuous
13 sampling procedure where we collected the entire
14 overburden sequence and now you will notice on the
15 righthand side where we record where we took samples,
16 it is complete and there are no gaps and this is
17 reflected actually in our logging. Our logging is
18 getting very much more refined and, for instance,
19 we can see -- and this is borehole BH 1-85 on Site D,
20 at a depth of between 12 metres and 13 metres below
21 ground surface and now we are able to identify even
22 thin sand units, in the case here of sand units
23 of three or four inches.

24 As in the 2C analysis, we installed
25 monitoring wells at the various drilling sites and



1 at each drilling site two or more boreholes were
2 drilled and subsequently instrumented with observation
3 wells or monitoring wells. For example, at drilling
4 site 1-85, four wells were installed, a shallow
5 standpipe to measure the water table as I discussed
6 yesterday at a depth of about 5 metres from ground
7 surface, a piezometer into the unweathered zone of
8 the till at that location to establish the groundwater
9 characteristics and the hydraulic conductivity of
10 that zone, a piezometer at a depth of 15.8 metres
11 below ground surface in a sand unit that was
12 encountered at that particular location and so at
13 15.8 metres we set a piezometer to establish for
14 instance the hydraulic conductivity of that sand
15 unit, as I mentioned yesterday, a measure of the ease
16 with which the fluids move through that particular
17 sand unit, and the piezometer allows us to collect
18 groundwater from that sand unit in order to establish
19 its groundwater chemistry and we are also able to
20 define the hydraulic head or the groundwater pressure
21 of that particular unit.

22 The fourth installation at that
23 drilling site was a piezometer installed at the
24 overburden/ bedrock contact or essentially
25 right into the bedrock at 29.8 metres. This is



1 generally the process that has gone on at each one
2 of the drilling sites, three, four, five or even
3 six sometimes, wells are installed at each drilling
4 site and the criteria for the number of boreholes
5 is really a field decision and we generally install
6 well screens of piezometers at zones of permeability,
7 for instance in a sand unit or a major fracture
8 unit at Site F for instance.

9 As I have already mentioned on all
10 the piezometers, water level recovery tests were
11 conducted to establish the hydraulic conductivity
12 of the units considered, geological units considered,
13 and this information is contained and summarized
14 in Appendix 12 of the Site D report, Volume 2,
15 the appendices.

16 Q. That would be Exhibit H-39-B?

17 A. Another test we conducted at
18 Site D was carried out in December of 1985 when a
19 pumping test was conducted on a fairly thick sand
20 unit found at drilling site 4-85. This later
21 became known as the lower granular unit and Mr.
22 Sobanski will be discussing this in some detail
23 later on. Just for a general understanding of
24 the pumping test, what we do here is install a
25 pumping well into the sand unit, pump water from it



1 for a period of let's say twenty-four hours and
2 observe what affects that pumping has on adjacent
3 observation wells, affects on groundwater levels
4 in adjacent observation wells, and this procedure
5 allows us to understand the continuity of the sand
6 units at depth. It also allows us to establish
7 the water-yielding characteristics of these sand
8 units and, as I mentioned, the continuity of them.
9 This information Mr. Sobanski will go into in more
10 detail in Section 6.2.3 and this information is
11 also evaluated in appendix D of the Volume 2, the
12 hydrogeological report.

13 Another task carried out at the sites
14 involved the monitoring of groundwater levels
15 in all the observation wells and monitoring wells
16 installed at the site. This was done twice a month
17 for a period of eight months and perhaps I could just
18 show some of that information.

19 This is a groundwater hydrograph
20 from Site D for wells installed at drilling site
21 5-85 and the water levels from three different
22 wells are recorded here -- monitoring well 3,
23 which is a standpipe, a piezometer at 2 and 3,
24 which represent deeper piezometers. On the left
25 axis are the groundwater elevations and



1 on the horizontal axis are the time period we were
2 monitoring the groundwater levels in these wells.
3 What we see for the period of September, 1985 to
4 April of 1986, we see the fluctuations of groundwater
5 levels associated with the geologic units that are
6 screened, either piezometers or standpipes. It was
7 the data for April, 1986, the water level data that
8 was used in our hydrogeological assessment of this
9 site and Site F.

10 Another task carried out at Site D
11 included....

12 Q. Just to complete that, Mr.
13 Beechinor, you will find the results of that work
14 at Appendix 8?

15 A. Yes, and in Appendix 5 is
16 the groundwater data actually used in the final
17 analysis.

18 Another task carried out at Site D
19 was sampling groundwater from the wells installed
20 at drilling sites 1, 5 and 6. This information
21 is contained in Appendix 11, I believe. Surface
22 water samples were collected from locations both
23 upstream and downstream of the proposed landfill
24 site in order to establish the background surface
25 water quality.



1 Q. Again, would I be right in
2 saying that the observation wells are found on drawing 5
3 and the surface sample areas are on drawing 4?

4 A. That's right.

5 Q. Can you indicate to the Board,
6 did you conduct the same series of tests with
7 respect to Site F?

8 A. Yes, we did.

9 Q. Did you as well do some
10 additional tests on Site F?

11 A. We did.

12 Q. Could you review the additional
13 test done in the Phase 1 aspect at Site F?

14 A. In the Phase 1 program the
15 general scope and type of analysis were very similar
16 to the work done on Site D, but because we were
17 dealing with a somewhat different sort of geologic
18 condition, there were some special analyses that
19 set the study methods apart between the two sites
20 and if I can just identify what those are in the
21 case of Site F. These are additional methods
22 employed at Site F and all the methods I discussed
23 at Site D were conducted in a similar manner.

24 On Site F, there were eight drilling
25 sites advanced on Site F and, in addition, in order



1 to understand the hydrgeology between Site F and
2 Lake Ontario, we installed five drilling sites,
3 denoted HC 9-85 and HC 13-85 between the
4 site and Hamilton Harbour and, like Site D, all
5 drilling was done to a depth of about 30 metres.
6 I will also mention that similar to Site D a
7 continuous soil sampler was used to sample the
8 complete overburden sequence and a continuous core
9 sampler collected the complete bedrock sequence to
10 a depth of 30 metres. Again we have a complete
11 sequence or rock sample from the bedrock like at the
12 overburden.

13 One different test conducted at
14 Site F was something called a packer injection test.
15 When a borehole is advanced into the rock
16 at some locations we were able to identify
17 significant water inflow into the borehole and so
18 consequently we wanted to define the permeability
19 of that unit of the rock that was providing water
20 into the borehole and so we conducted packer
21 injection tests at locations HC 3, HC 4 and HC 6.
22 The test involved sealing off the section of the
23 borehole by inflating packers and injecting water
24 into the fracture zone of interest. The volume of
25 water moving into the formation versus time and



1 pressure is indicative of the permeability of that
2 packed-off section.

3 The other major difference in terms
4 of work program involved the test pits dug on Site F.
5 There were a number of test pits dug on Site F to
6 investigate the weatherability and ripability of
7 the soil to ascertain whether it could be actually
8 employed as cover material, and that points out the major
9 differences between the two major programs for the
10 Phase 1 program.

11 Q. Was there a Phase 2 field work
12 program?

13 A. There was.

14 Q. Can you refer the Board back
15 to table 1, party comment matrix for Site D, and
16 indicate to the Board with reference to that on
17 what basis or what it was that motivated the under-
18 taking of this second phase?

19 A. Without going into this party
20 comment matrix again, as a result of the input of
21 these interested parties, such as the Town of Milton
22 and others, we devised a Phase 2 program field
23 investigation which commenced in February of 1986.

24 Q. That is referred to in the
25 fourth paragraph under the responses or actions of



1 Hydrology Consultants?

2 A. Yes.

3 Q. Could you indicate to the Board
4 the substance of this Phase 2 program?

5 A. Very well. It involved the
6 drilling of additional boreholes and the installation
7 of additional monitoring wells on sites denoted
8 HC 1-86, HC 2-86 and HC 3-86, in order to better
9 define the stratigraphy and areas of interest to the
10 Town of Milton. We conducted a second pumping test....

11 Q. Again I am sorry, but to make
12 the record complete, the location of the additional
13 holes will also be found on drawing 5?

14 A. That is right.

15 Q. Thank you.

16 A. In addition a second pumping
17 test was conducted on another granular unit found
18 on the site at location 2-85 and this, in our
19 interpretation, is denoted as the upper granular
20 unit and Mr. Sobanski will comment on this further.

21 Another test carried out at Site D
22 was the installation of a piezometer nest to do
23 an evaluation of the distribution of tritium. Mr.
24 Sobanski will be going through this in some detail
25 later when he presents the data on this, but just to



1 provide the Board with an overview of why we did this,
2 I will bring it up now. Tritium is a radioactive
3 isotope of hydrogen and this information was used to
4 estimate the depth of penetration of recent waters
5 into the soil profile. This allows us to calculate
6 the rate of infiltration of precipitation into the
7 subsurface. Prior to 1952, the natural tritium
8 content of the precipitation in the atmosphere was
9 estimated to be between five and 20 tritium units.
10 Beginning in 1952, the above-ground testing of
11 thermonuclear bombs resulted in an increase in
12 the tritium activity in the atmosphere. Prior to
13 1952 we have a background or natural tritium level
14 in the atmosphere and after 1952, because of thermo-
15 nuclear testing in the atmosphere, we have an
16 elevated tritium level in the atmosphere.

17 Now, this is useful because we can
18 distinguish in the sub-surface pre-1952, or low
19 level tritium groundwater, from high level tritium
20 groundwater which has infiltrated from ground surface
21 from precipitation since 1952. By identifying the
22 depth to this interface, the pre and post-1952
23 waters, we can calculate the groundwater velocity
24 in the vertical direction with some certainty, and as
25 I pointed out, Mr. Sobanski, when he introduces the



1 data, I think it will become much clearer to the Board
2 on how this actually works. That is primarily the
3 work program conducted for Phase 2 at Site D.

4 Q. What about at Site F?

5 A. At Site F we conducted a
6 Phase 2 program in February, 1986. There were
7 essentially three reasons why we conducted the
8 additional program at Site F. No. 1, there was a
9 need to understand groundwater flow systems just
10 south of Highway 403 and to do so we installed at
11 three new drilling sites, denoted HC 14-86, HC 15-86
12 and HC 16-86, also shown on figure 5 of the Site F
13 report, and we installed monitoring wells at these
14 locations to establish groundwater conditions south
15 of Highway 403.

16 Another reason for doing the Phase 2
17 program, and it's in connection with drilling site
18 15-85 which is shown on drawing 5 and it's also
19 positioned south of the current Burlington regional
20 landfill, and the reason we installed a well location
21 or drilling site there is because Gartner Lee
22 at that time was conducting a plume delineation
23 study of the existing landfill to find the extent
24 of contamination from the existing landfill and we
25 felt it would be of assistance to that study process



1 to install another drilling site south of the existing
2 landfill to see if we could define or pick up any
3 contamination in the groundwater system at that
4 location south of the existing landfill.

5 The third reason for carrying out the
6 Phase 2 program at Site F was to establish or quantify
7 the continuity and the water-bearing characteristics
8 of fracture zones found within the shale. Three
9 pumping tests were carried out on Site F for this
10 purpose and they are denoted PW-1, PW-2 and PW-3,
11 and I believe they are shown either on drawing 2
12 or drawing 5 of the Site F report.

13 DR.KINGHAM: They are on drawing 5,
14 but you said a moment ago to delineate a plume south
15 of the existing landfill, and were you talking about
16 the landfill to the west or to the former one?

17 MR. BEECHINOR: The one to the west
18 and Gartner, Lee was conducting through the
19 installation of a number of monitors and concurrently
20 with our work they were trying to ascertain the
21 extent of contamination from the existing landfill.
22 So to assist them and to assist our understanding
23 of how a landfill performs in this geologic setting,
24 we installed a drilling site down-gradient of the
25 existing landfill site to see whether or not



1 contaminants from this landfill had migrated to this
2 point here.

3 DR.KINGHAM: That would be HC 15 to
4 which you referred before?

5 MR. BEECHINOR: That is right.

6 Mr. Sobanski points out to me that
7 they were constructed with stainless steel casings
8 and stainless steel is essentially state-of-the-
9 art for determining whether or not -- when we do an
10 evaluation of organic components, stainless steel
11 wells are sometimes necessary to ensure that we are
12 not getting any effects from the actual well
13 construction and affecting the natural chemistry, and
14 sometimes stainless steel wells are employed for
15 this purpose.

16 As I pointed out, we conducted the
17 three pumping tests during the course of the Phase
18 2 analysis and the pumping tests allowed us to
19 consider or assess the water-yielding characteristics
20 of fracture zones within the shale and allowed us
21 to understand the lateral extent of fracture zones
22 within the shale, and allowed us to assess the
23 feasibility of installing a purge well contingency
24 system at this site and when we get to that area of
25 the report, Mr. Sobanski will discuss why we



1 consider contingency systems at landfill sites.

2 MR.LEDERER: Q. Did you undertake
3 any laboratory analysis on soils at the site?

4 A. Yes, we did. I will start
5 with Site D. As I showed yesterday for the 2C level
6 soil analysis, similar soil tests were done for
7 this technical level and selected soil samples
8 were selected and subjected to sieve and hydrometer
9 analysis at the Trow Geotechnical Laboratories. We
10 also defined the amount of calcite and dolomite as a per
11 cent of the soil, and this is useful information
12 in that there is significant attenuation in
13 geologic strata where the pH of the units are six
14 or higher and the buffering capacity of the
15 geologic setting is controlled by the presence of this
16 carbonate material, calcite and dolomite, and so
17 we established the content of this carbonate
18 material in both the overburden -- in Site D
19 just in the overburden. We also examined the
20 clay for its minerology because there are various
21 types of clay and depending on the types of clay,
22 they can have differing attenuation capabilities
23 and we assessed the clay minerology at Site D.

24 Two other soil tests conducted
25 included the following, and the rationale for this



1 is this, two common factors used to assess the
2 leachate retardation capacity of the overburden
3 are its cation exchange capacity and its organic
4 carbon content. When you get to those sections
5 of the report and the data, Mr. Sobanski can discuss
6 the significance of this analysis in detail, but
7 the cation exchange capacity reflects the ability
8 of geologic materials to absorb contaminants and it
9 is important for us to quantify that in the manner
10 we can and the results of this information are
11 discussed in Section 8.4 and are recorded in Appendix
12 3 of the hydrogeologic report for Site D.

13 The organic carbon content of the
14 overburden reflects the quantity of organic material
15 present in the material. The presence of organic
16 carbon can retard the migration of organic
17 substances, and this information and this analysis
18 was conducted by Zenon Environmental Inc. in
19 Burlington and these results are discussed in
20 Section 8.4 of the hydrogeological report and the
21 data is reported in Appendix 3 of the hydrogeologic
22 report.

23 At Site F we pretty much covered
24 the same sort of soil analysis; grain size
25 distribution curves which were prepared and we assessed



1 the calcite/dolomite content of the overburden and
2 the shale and we conducted clay minerology analysis
3 of the overburden and the cation exchange capacity
4 of the shale and the overburden was determined and
5 the organic carbon content of the bedrock was
6 determined.

7 Q. Did you undertake any
8 laboratory analysis on water or groundwater at this
9 level of study?

10 A. We did. With respect to Site D,
11 and this relates back to the tritium work, eight
12 groundwater samples were collected and sent to the
13 University of Miami for an analysis of enriched
14 tritium and to establish background chemistry of
15 the various geologic units on the site, ten water
16 samples were collected and tested for general
17 chemistry parameters including pH, hardness,
18 alkalinity, calcium, magnesium, potassium,
19 conductivity, iron, chloride, phenols, sulfite
20 and dissolved organic carbon. These results are
21 reported in Appendix 11 of the hydrogeologic
22 report for Site D.

23 At Site F, eight groundwater samples
24 were collected from wells HC 5 and HC 8-85 and were
25 also sent to the University of Miami in order to be



1 evaluated for enriched tritium. To establish the
2 background surface water and the groundwater quality
3 at Site F and between Site F and Lake Ontario, five
4 surface water and thirty groundwater samples were
5 tested for general chemical parameters, as discussed
6 before and, in addition, as I previously mentioned
7 before, at the request of Conestoga-Rovers &
8 Associates Limited, observation wells installed at
9 drilling site 9 were tested for chemical parameters
10 to confirm earlier results.

11 Q. Did you do any work at this
12 level of study to identify ground users in the area
13 of these sites?

14 A. Groundwater users?

15 Q. Yes.

16 A. Yes. At Site D in September
17 of 1985 we conducted a walk-and-talk survey of
18 local residents in the vicinity of Site D and this
19 was simply a survey of local residents who went
20 out and knocked on doors and we asked them for
21 information such as how deep is your well, what
22 type of well is it, are you having problems with
23 your quantity or quality of water and any other
24 useful information we thought could help us under-
25 stand the water or groundwater usage in the vicinity



1 of Site D. The survey area and the locations of the
2 groundwater users we encountered are shown on
3 drawing 2 of the hydrogeological report and, in all,
4 69 residents in the vicinity of Site D were inter-
5 viewed.

6 DR. KINGHAM: What is "vicinity"?

7 MR. BEECHINOR: I can find the
8 vicinity on drawing 2 of the Site D report.

9 MR. LEDERER: Q. Before you describe
10 anything, can you give the Board the heading of
11 that drawing?

12 A. The heading of the drawing
13 is for Site D in Milton, Location of Exploratory
14 Boreholes, and that is the holes we located on
15 the site and the location of water supply wells
16 and our study area was quite large. It extended in the
17 east from Sixteen Mile Creek to Tremaine Road and
18 even on past Tremaine Road to Bell School Line,
19 in the south to the vicinity of Lower Baseline Road
20 and, in the north, north of Britannia Road and the
21 information given on this blow-up figure -- for
22 instance, the water supply wells, the types of
23 wells, was it a drilled well completed in the over-
24 burden, was it a drilled well completed in bedrock,
25 was it a dug or bored well completed in the over-



1 burden, was it a dug or bored well completed in the
2 bedrock, and in some cases when we talked to local
3 residents, they were uncertain whether or not -- what
4 the position of their wells were and on some occasions
5 we were able to open up a well and do our own
6 measurements and determine where these wells were
7 finished. There are locations of abandoned wells we found,
8 there are locations where they use cisterns for
9 their water supply and various information sources
10 are there. When we denote a small hc, that means
11 someone from our office actually talked to that
12 resident about the water supply well and when a
13 small gl is used, that is information that was being
14 developed generally around the same period by the
15 Ontario Waste Management Corporation, by Gartner
16 Lee & Associates, and the other source of information
17 is the Ministry's waterwell records.

18 DR. KINGHAM: I wanted to be sure
19 we could understand because you said you did a
20 walk-and-talk survey of about 69 residents in the
21 vicinity, and the vicinity stretches as far as
22 two or two and a half miles or something like that.

23 MR. BEECHINOR: I don't know the
24 distances offhand, but probably in that area.

25 MR. LEDERER: Q. Just one thing you



1 said, you said Mr. Beechinor spoke to -- is it you
2 spoke to the 69 residences or you located 69 residences
3 who were groundwater users?

4 MR. BEECHINOR: A. Sixty-nine
5 residents were interviewed.

6 Q. Can we turn at the same time
7 to page 25 of Exhibit H-40 and to page 23 of H-39. On
8 those pages we have the beginnings of Section 2.6
9 and in the case of H-40, Site F, it's called
10 Hydrogeologic and Geologic Relationships, whereas
11 in the Site D, H-39....

12 A. Before I get into that, I would
13 like to identify for the Board that we did the same
14 sort of walk-and-talk survey of Site F and I don't
15 want to leave you with the impression that we didn't
16 do that as well. There is a similar map for Site F....

17 Q. I am trying to get to a break,
18 Mr. Chairman.

19 MS. CRONK: Nice try!

20 MR. LEDERER: I thought you had
21 done that. I apologise.

22 MR. HODGSON: You are getting tired.

23 MR. BEECHINOR: I had better review
24 this one as well. This is the drawing for Site F
25 in Burlington, the location of exploratory boreholes



1 and the location of water supply wells in the vicinity
2 of Site F, and our study area was regional in the sense
3 that it extended from Mountain Brow Road to Lake
4 Ontario and on the east side from just east of King
5 Road to Waterdown Road on the west, and again we
6 interviewed local residents to ascertain whether or
7 not they were utilizing the groundwater in any way
8 for their domestic needs. You will find there is
9 use of groundwater in this vicinity, which is up-
10 gradient of the landfill, and except for a very
11 limited amount of groundwater use south of Site F,
12 the area relies on municipal services for a water
13 supply. One difficulty we had in this identification
14 of wells south of 403 is the fact that it is
15 completely serviced and there are some remnant wells
16 that were being used prior to the servicing and an
17 area resident assisted us in locating a number of
18 these wells and if there is any use at all, they
19 are being used to, say, water someone's garden or
20 something like that, but in general everyone has a
21 municipal link-up to the municipal water system.
22 There is some reported use of groundwater in this
23 vicinity, and we will go into that later in our
24 analyses, and this seems to be an area that for
25 some reason is not on the municipal system, but



1 the municipal system is there, but there is simply
2 a groundwater well there, but the -- it is being used
3 for a water supply but the -- the municipal water
4 supply system is there, but it is not connected
5 to the house, but we will go into that in some
6 detail.

7 Q. I am afraid to ask a question.
8 Can we go on now?

9 THE CHAIRMAN: Would this be a good
10 time to take a break?

11 MR. LEDERER: I have about two more
12 questions which would probably take about ten minutes,
13 but that gets us to the end of the study methodology
14 and we will be ready to get into the results of
15 the Site D work, if that would be better.

16 THE CHAIRMAN: All right.

17 MR. LEDERER: Thanks for the
18 consideration.

19 Q. Could you turn now, as I asked
20 you, to page 23 of Exhibit H-39 and page 25 of
21 Exhibit H-40. Again, as I said a few moments ago,
22 we have there the beginnings of Section 2.6 in the
23 two studies, but the titles are only slightly
24 different, Hydrogeologic and Geologic Relationships
25 in H-40 and Hydrogeologic Relations in H-39 and



1 is there any difference?

2 MR. BEECHINOR: A. No.

3 Q. Can you review with the Board
4 the analysis you undertook under that heading?

5 A. All right. I will start with
6 Site D. What we are talking about here is the study
7 process involved with pulling all the data together
8 and assessing all the information to come up with
9 our interpretations, hydrogeologic interpretations
10 of the site, and to assess the potential for
11 contaminant migration beneath the sites.

12 On Site D we prepared three regional
13 and four local geologic or stratigraphic cross-
14 sections and these are shown as drawings 11 --
15 6 through 11 in the hydrogeologic report, and I
16 won't pull them out right now, but when we get into
17 interpretation we will pull those drawings out.
18 The vertical gradients were calculated on both sites
19 to determine the recharge and discharge settings
20 encountered. Drawing 17 for Site D defines the
21 direction of groundwater movement in the upper till
22 and drawings 15, 16 and 18 all for Site D, define
23 the direction of groundwater movement in the granular
24 units and the overburden/bedrock contact..
25 Section 7 of the hydrogeologic report assesses and



1 interprets the chemical results of the samples
2 collected from the various geologic units and
3 Section 8 in some depth goes into the assessment
4 for potential contaminant migration through the
5 various geologic units in Site D.

6 Sections 9 and 10 in the hydrogeological
7 report for Site D, for instance, discusses measures
8 to control the degradation of off-site water
9 resources and Section 11 of the report develops a
10 program for the monitoring of contaminant movement
11 in order to identify problems before they actually
12 occur or in time to do something about it.

13 A similar process was carried out
14 for Site F, and I can review it very quickly. Drawings
15 6 through 10 I believe show the two regional and
16 five local geologic cross-sections for the site and
17 regional study area. Drawings 14 and 16 define
18 the direction of groundwater movement in the over-
19 burden or shallower shale unit. Drawings 13 and 15
20 determine the groundwater movement or show or
21 delineate the groundwater movement in the deeper
22 shale units. Section 7 of the Site F report is
23 the interpretation of the groundwater chemistry.
24 Section 8 of the report is the assessment of
25 potential contaminant migration through the various



1 geological units at Site F.

2 Section 9 of the Site F report
3 discusses measures to control the degradation of
4 off-site water resources. Section 11 I believe is
5 a program to monitor contaminant movement.

6 Now, two special investigations were
7 done at Site F and they largely reflect the study needs and
8 concerns of the various interested parties. One
9 was with computer model studies to assess and under-
10 stand the groundwater flow system between Site F
11 and Lake Ontario, as was carried out, and Section 4.4
12 of the hydrogeological report for Site F, there
13 we discuss the impact of the loss of a shale
14 resource at Site F as a consequent of landfilling
15 at this site.

16 Q. Finally, as to the review of
17 study methodology, could you indicate to the Board
18 if you used any other sources of data and, if so,
19 where would we find them listed?

20 A. We used other sources of informa-
21 tion and these are referenced for Site D in Section 12
22 of Volume 1 of the hydrogeological report and for
23 Site F in Volume 1 -- Section 13 of the Volume 1
24 hydrogeological report for Site F. The sources
25 include personal contact with various government



1 agencies to collect information on waterwell
2 records, to collect geological, local geologic
3 understanding from academic sources, to collect
4 data on climatic information, we viewed air photos
5 to understand in a broad sense the terrain of both
6 sites and we collected information, long-term
7 information on stream flow characteristics in water-
8 courses near the two sites.

9 MR. LEDERER: Mr. Chairman, that
10 concludes a review of the methodology and we will
11 now move to the substance of the analysis and this
12 would be an appropriate time to break.

13 THE CHAIRMAN: Very well.

14
15 --- Recess

16
17 MR. LEDERER: There are a lot of
18 questions I would like to ask in a real hurry!
19 I hesitate to start this without Milton, because
20 this is Site D.

21 THE CHAIRMAN: Mr. Estrin isn't here.

22 MR. LEDERER: It appears that
23 Mr. Estrin was warned we were going to start.

24 THE CHAIRMAN: Here we are.

25 MR. ESTRIN: Sorry.



1 MR. LEDERER: Now, as I indicated
2 before the break, I have now a lengthy series of
3 questions on the Site D study, H-39.

4 Q. Mr. Sobanski, if you would
5 turn to page 26 of that report and if you would now
6 please review with the Board your findings with
7 respect to the physiography and topography of the area
8 around that proposed site?

9 MR. SOBANSKI: A. The Chapman
10 and Putnam map of physiography of Southern Ontario
11 classified the Site D area as being located
12 on the Peel Plain. Their description indicates
13 that the area is characterized by a thin layer
14 of lacustrine clay sediments overlying the Halton
15 till. We did not find the lacustrine clay
16 sequence in our borings. However, that is the
17 general description of the physiographic unit.

18 We did find, of course, the till.
19 The topography of the site is somewhat uninteresting.
20 It is essentially flat and has very low relief with
21 a mean elevation of about 184 metres above mean
22 sea level. It is gently undulating to rolling.
23 There are imperfect soil drainage conditions
24 present and this reflects the low permeability of the
25 materials that are on-site and also the site's flat



1 terrain.

2 Q. Could you now indicate to the
3 Board what you have learned about the regional
4 geology surrounding the site, first of all in the
5 bedrock and, secondly, the overburden?

6 A. I would refer the Board in
7 their notes to drawings 2, 6, 7 and 12, which we
8 will put up on the hard boards here.

9 The drawings that we are going to
10 look at show an interpretation of the regional
11 distribution of the overburden sediments at the
12 site and also the configuration of the bedrock.
13 The cross-sections were prepared from our borehole
14 logs and from the Ontario Ministry of the Environment
15 waterwell records. As well we employed works by
16 Gartner Lee, where appropriate, and Morrison
17 Beatty, where appropriate.

18 The figure we are looking at is
19 the regional area and we are going to look at
20 geologic cross-sections in several directions
21 through Site D. The first section A-A runs
22 from the northwest corner of Site E and starting
23 at Gartner, Lee's well called 84-1 (4N) and it
24 then traverses the site, the study area, and ends
25 up at the southwest corner, or southeast corner



1 rather of Site D at Gartner Lee borehole GL 84-4 (IN).

2 This gives us a regional perspective and the first
3 thing we will handle is the bedrock and on this
4 diagram on the left we have the elevation in metres
5 above mean sea level of both the ground surface and
6 the various geologic units found within the boreholes.

7 Across the bottom axis, the X axis, we have the
8 distance in kilometres and starting at this end
9 of the section we have zero and at the far end of
10 the section is 5.8 kilometres and with the gaps included
11 the area covers a distance of about 5.1/2 kilometres.

12 The important aspect to notice about
13 the regional appearance of the rock, which is the
14 Queenston shale, the red Queenston shale, is the
15 occurrence of a bedrock depression that occurs in
16 the general area of Britannia Road and Tremaine
17 Road and, in our initial discussions on the 2C
18 study, we mention that we felt we had this bedrock
19 depression with granular units in it, and here we
20 can see the reason for part of that interpretation,
21 the depression in the rock. It then rises in the
22 Britannia Road area at GL 84-5 (IN) located here
23 at the railway tracks at Britannia Road, and then
24 it lies relatively flatly across the rest of the
25 section with a shallow, perhaps a shallow minor



1 depression occurring on Site D, starting from the
2 vicinity of HC 1-85 and running roughly to HC 5-85.
3 We can see here the rock starts to rise again as
4 we approach the southwest portion of the site.

5 Looking at the next sections....

6 Q. If you could be certain to
7 identify which of the drawings you are referring to
8 so the record will be clear and so the Board will
9 know what you are talking about?

10 A. Yes, thank you, Mr. Lederer.

11 The first drawing we discussed in
12 terms of the bedrock cross-section is drawing No. 6
13 of the Site D report, H-39.

14 It's also called the regional
15 stratigraphic cross-section A-A.

16 THE CHAIRMAN: That is probably
17 more meaningful than the number.

18 MR.SOBANSKI: The next figure we
19 are going to examine in conjunction with drawing
20 No. 2, which was the location of exploratory
21 boreholes and water supply wells, is going to be
22 regional stratigraphic cross-section B-B and C-C
23 and these are found in drawing 7 of the H-39 report.

24 Dealing first here in the reverse
25 order to that in which they appear, let's look at



1 Section B-B, which extends essentially along the
2 First Line Road starting in the north at roughly
3 Gartner, Lee No. 12 and extending southward down
4 the First Line Road to approximately the junction
5 of Lower Baseline Road and First Line Road. This
6 section incorporates essentially the waterwells
7 we found and have records for in some cases as well
8 as interspersed with borehole data from the site and its
9 periphery.

10 Looking at Site D, we can see here
11 the bedrock depression referred to as we are closing
12 in on the site a little bit more, and the bedrock
13 depression in the rock is showing up on Section B-B.
14 It extends roughly from Gartner, Lee 12 in the
15 north and it then declines and reaches a low value
16 at about HC 1-85 and it then starts to rise again
17 and in the vicinity of Morrison Beatty MB(IN)-OW.2
18 we are then near a plateau.

19 Another small depression within
20 the bedrock surface is found to the south as we
21 approach the Lower Baseline Road, and that is found
22 near the location of domestic well 3 HC. So
23 while in this direction the bedrock surface or
24 the depression on Site D did not appear to be
25 too great, we can see now from this section that it is



1 deeper than we first thought. We are dealing here
2 with a depth of about close to 30 metres; about
3 30 metres in depth at HC 1-85. HC 1-85 is
4 located at the northwest corner of Site D.

5 We then want to examine Section C-C,
6 which runs down Highway 25 and it starts at a
7 domestic well called 56 or labelled 56 HC and it
8 progresses from there to a point approximately at
9 the Lower Baseline Road and Highway 25. On this
10 section we can see that the bedrock surface is
11 somewhat undulating with a small bedrock depression
12 occurring in the vicinity of Gartner Lee 84-4 (IN)
13 and a domestic well called 32 HC. So, there are
14 some little loops and depressions within the bedrock
15 surface.

16 I would now like to go to drawing
17 12 of the report, and these will be coming up again
18 as we discuss the overburden. In this map we have
19 taken known well records where we now have a well
20 record from the Ministry of the Environment, and we
21 have used the elevations the Ministry of the Environment
22 has picked on these wells and we have then
23 subtracted from that the depth to the bedrock and
24 come up with a series of points on the map which
25 indicate the elevation of the bedrock at these various



1 wells. For example, if we look at the southwest
2 corner of Site D, domestic well 12 HC has an
3 elevation of 172.8 and this is the elevation of the
4 bedrock based on the Ministry's interpretation of
5 the topographic elevation at that point less the
6 thickness of the overburden.

7 We prepared the same type of
8 information where we had better control and we have
9 actual topographic information on our own landfill
10 on the Site D area and we have it here in a bit more
11 detail and so we are mixing some regional data with
12 some local data where we have some better control
13 and it still gives a pretty good indication of what
14 we are looking at.

15 We can see to the north of the site
16 and in the vicinity of a well called 65 HC that
17 the bedrock elevation there is in the order of 185
18 metres. As we come south along First Line Road,
19 the elevation of the bedrock starts to drop and we
20 start at about 185 metres and by the time we hit
21 Britannia Road and the First Line Road, we are at
22 about 170 metres and at the site, the northwest
23 corner of the site, it is about 155 metres and then
24 the rock starts to rise again. So, from the northerly
25 point where we started at 65 HC, to the northern edge



1 of the site, we drop about 30 metres. We then come
2 back up again and the rise up the incline now is
3 not quite as steep in that we are dealing with
4 about a 170 metre contour to the south of the site,
5 running from the southwest corner of the site down
6 to Lower Baseline Road, elevations slightly in
7 excess of 170 metres, and so now the rock has dropped
8 into the depression by about 30 metres and it comes
9 back about 15 to 17 metres.

10 It is obvious from this diagram
11 the bedrock trend depression we are talking about
12 in our discussions at the site, and it shows up
13 as this low area, and those look like contours in a
14 few cases, and we feel the depression on our Site D
15 may be related to the depression that is seen on the
16 south end of Site E.

17 Coming back to the regional
18 stratigraphic cross-sections again, we are now
19 back to cross-section A-A, drawing 6 of the
20 report, which again extends from Site E in the
21 northwest corner of Site E down to the southeast
22 corner of Site B -- I am sorry, D. On this map
23 we have mapped the granular units that occur within
24 the glacial till. At this level of detail, we are
25 not distinguishing the till sheets yet and we have



1 in fact two till sheets in this area and they are
2 basically an upper clayey till unit and a lower
3 sand unit. The sections of sandy material that you
4 see, the granular units, generally occur within the
5 lower till and so we have an upper till that is
6 relatively devoid of these features and we have a
7 lower sandy till that contains within it these
8 granular units.

9 At our own site at HC 2-85, we can
10 see the two granular units and they are in the lower
11 unit and one is a thicker unit in the order of a
12 couple of metres thick and then we have a sliver of
13 material below it, but you can see from our
14 stratigraphic correlation done on this scale, that
15 we feel already at this stage in seeing how they
16 are laid out, even though they may be just little
17 slivers, there seems to be continuity to some of
18 these units at various elevations and we seem to be
19 able to take little stringers of sand and extend
20 them over quite extensive areas of the site.

21 The other thing I would like to
22 point out is that within the bedrock depression on
23 Site E we do have more extensive granular units,
24 one associated with the top of the bedrock. If
25 we come back to Site D on this cross-section, which



1 runs from HC 1-85 at a distance of about 3.8 kilo-
2 metres along the section down to the edge of our
3 site at Gartner Lee 84-4 (IN), we don't have any
4 extensive granular units on top of the bedrock.
5 We have one at HC 1-85, which is described as a
6 granular unit and our description of this in the
7 logs is that it is a gravelly till at that point
8 as opposed to a sand and gravel, but being that it
9 is coarser, we have identified it on here as a
10 potential granular unit.

11 So, again on the site we can see
12 these two sandy zones which are showing up and again
13 less extensive and thinner than on Site E.

14 Q. Now, Mr. Sobanski, can we narrow
15 this down a bit and can you indicate to the Board,
16 please, what you concluded about the local
17 geology at this site, again from the perspective
18 of bedrock and secondly the overburden?

19 A. The bedrock at the site
20 consists of the reddish shales of the Queenston
21 formation. The bedrock contains a narrow bedrock
22 depression on our site, but it does not contain
23 a granular unit. There is a discontinuous gravelly
24 till unit occurring on site. The overburden thickness
25 in the area ranges from about 12 to 29 metres.



1 The deepest overburden is over the bedrock depression
2 and it thins from the north to the south from this
3 depression.

4 Q. What about the overburden?
5 Do you not have cross-sections with respect....

6 A. Now you would like to discuss
7 the local overburden?

8 Q. That's right.

9 A. Page 30.

10 MR.LEDERER: This is figure 1 which
11 you will find on page 30 of the report.

12 MR.SOBANSKI: Based on our drilling
13 programs, the three of them undertaken on this
14 site, we developed the following summary of the
15 local geology. First of all, the bedrock, and I
16 should explain this drawing first, but it's broken
17 into three linear sections and the first identifies
18 the overburden sequence which extends to a depth
19 of 24 metres on average and the second describes
20 the bedrock which extends probably hundreds of feet
21 to the Precambrian or Cambrian formation. The
22 overburden in the next drawing, for everyone's
23 information, is broken into two basic units, the
24 upper till unit, which occurs to an average depth
25 of about 8 metres, and the lower till unit which



6B

*Upper clay
till**Lower
1
2 granular
units*

1 occurs to the top of the shale.

2 Within the overburden we found
3 six units which were noteworthy, and I had better
4 count these. The gravelly till has a limited lateral
5 extent and it is shown here without a thickness
6 and was encountered only in a well or so and above
7 that unit we have the lower till. This is a sandy
8 silt to silty sand till which has some minor
9 clay faces within it and this till has a wide lateral
10 extent, it extends over the whole site.

11 Within that lower till unit we have
12 two granular units and the lower granular unit is
13 about 2 metres thick and it consists essentially of
14 silt. We interpret this unit to have a wide
15 lateral extent.

16 The upper granular unit is about a
17 metre thick and it consists of sand and gravel and
18 we have interpreted this unit to have limited
19 lateral extent.

20 Finally -- not finally, but we have
21 a thin bed of silt that is noteworthy and this appears
22 as a silty unit that is fairly thin, only about
23 10 centimetres or so, and it shows up in most of
24 the borehole logs, so it's a marker horizon that
25 occurs between the two glacial till units. We then



1 have the upper till which is a clayey silt till and
2 this we have broken into two units which we will
3 discuss in terms of their hydrostratigraphic
4 importance in a bit and the upper 4 metres or so is
5 weathered and the lower 4 metres of that unit is
6 a massive unweathered till, and these units, of
7 course, have wide lateral extent and form the Peel
8 Plain and extend over the whole area. You can see
9 from my earlier description on the region, we did
10 not identify the clayey unit described as being
11 diagnostic of this area in terms of physiography.

12 DR.KINGHAM: To refresh our memory,
13 when you are talking about site construction, you
14 are talking about excavation down to about 5 metres?

15 MR.SOBANSKI: About 4.1/2 metres
16 and the excavation would be taking place....

17 DR. KINGHAM: Through the
18 weathered surface into the unweathered.

19 MR. SOBANSKI: Yes.

20 MR.LEDERER: One cautionary note,
21 the design to this point is the conceptual design
22 at the Stage 2C level of study, and when we get to
23 the design and operations report, as with all other
24 parts of our work, that work will be refined and
25 there may or may not be changes, but there certainly



1 were changes in the design and whether that impacts
2 on that answer, I am not certain.

3 DR.KINGHAM: I want to understand
4 at this stage where in that profile the thinking
5 was about the bottom of the site?

6 MR. SOBANSKI: At the conceptual
7 level and not taking into account the final contours,
8 the original concept was about a 4.1/2 metre
9 excavation.

10 MR. LEDERER: My concern is to
11 keep remembering where we are in the course of
12 the process and not to be mixing too much of
13 the information from one level to the other.

14 Q. Mr. Sobanski, having then
15 established the geology of the site, can we move
16 to page 40 of the report, and can you indicate to
17 the Board, please, what is meant by the term or
18 could you define the term hydrostratigraphy?

19 A. Simply put, I would define
20 it as the relationship between groundwater and
21 geology.

22 Q. Can you indicate to the Board
23 what a hydrostratigraphic unit is?

24 A. I would define a hydrostratigraphic
25 unit, again in simple terms, it's a geologic unit that



1 we are not going to define in terms of its age or
2 in terms of its origin, but rather the way that
3 groundwater will behave in that medium. For example,
4 when we talk of the upper till, in terms of age,
5 it's the same age, it is deposited by the ice sheet.
6 However, the weathered surface will behave
7 differently than the massive portion of that unit
8 and this will, as we discuss, comprise in fact
9 two hydrostratigraphic units.

10 Q. Can you indicate to the Board
11 what hydrostratigraphic units you identified at
12 Site D? I believe Mr. Beechinor is now going to put
13 up figure 2, which you will find on page 41 of
14 Exhibit H-39.

15 Mr. Sobanski, just before you do that,
16 if I could ask you this question and you may already
17 have answered it. Are you able to explain to the
18 Board how hydrostratigraphic units relate to
19 geological units?

20 A. I believe I have covered that.
21 What we are saying is we are not so interested in
22 the age of the materials, we are more interested
23 in how water is going to behave within it. We
24 could have, for example, several glacial till sheets
25 at a site and if they had similar hydraulic



1 properties in terms of porosity and permeability,
2 they could form one hydrostratigraphic unit, despite
3 the fact that we may have several till sheets.
4 If we were to put a sand lens within that unit,
5 that sand lens would probably still behave as though
6 it were part of that hydrostratigraphic unit.
7 It would be isolated within the geologic medium,
8 the surrounding finer-grained materials, and
9 effectively would not have an influence on ground-
10 water. However, if that unit were to be continuous,
11 we have now suddenly gone from one hydrostratigraphic
12 unit to three, because we would have the upper unit
13 behaving in one manner in all likelihood and the
14 sand unit having a lot of continuity, behaving in
15 another manner, and I can be almost sure that the
16 till unit below that would now behave in a different
17 manner than it would have if it had just been one
18 lump.

19 Q. Can you review figure 2 with
20 us and identify for us the hydrostratigraphic
21 units you found at Site D?

22 A. We identified six major
23 hydrostratigraphic units. Geologists work from
24 the oldest to the youngest, so we will start at
25 the bottom of the hole and work up. They are first



1 the shale bedrock, secondly the lower till behaves
2 as a hydrostratigraphic unit and thirdly the lower
3 granular unit because of its lateral continuity is
4 an important hydrostratigraphic unit, the upper
5 granular is another hydrostratigraphic unit and
6 that is four, and finally we identified, and I hope
7 I mentioned the shale as being one, but finally we
8 break the upper till into two hydrostratigraphic
9 units because they do have different hydraulic
10 properties, significantly different hydraulic
11 properties, at least conceptually and we can talk
12 about that in more detail too.

13 Now, if we look now at some of the
14 characteristics of these zones, the weathered shale
15 is estimated to have a hydraulic conductivity of about
16 10^{-5} centimetres per second, and this is a moderate
17 permeability for hydraulic conductivity.

18 DR. KINGHAM: You use the phrases interchangeably,
19 hydraulic conductivity, permeability, groundwater
20 migration and is there any difference or can we
21 just take any of the terms?

22 MR. SOBANSKI: When I speak of it,
23 take it that I am intermixing terms, because there
24 are specific meanings to hydraulic conductivity and
25 permeability and intrinsic permeability and several



1 other types of permeability, but here the proper
2 term should be hydraulic conductivity when we
3 talk about it. Occasionally I will refer to
4 permeability.

5 DR. KINGHAM: We don't have to
6 worry about it?

7 MR. SOBANSKI: I am talking hydraulic
8 conductivity.

9 DR. KINGHAM: And the speed of ground-
10 water migration is the hydraulic conductivity?

11 MR. SOBANSKI: No. Hydraulic conductivity is
12 the ease with which water moves through the soil
13 and maybe I should just make this point, Dr. Kingham.
14 This is one of the scientific things which sometimes
15 defies explanation when we talk about some of these
16 factors.

17 In hydrogeology, we have quite a
18 few different units we talk about, but when we
19 talk about hydraulic conductivity, and now we are
20 talking about Darcy's Law but it is related
21 to a factor that is a property of the porous medium
22 through which it is flowing and it is expressed
23 in centimetres per second, which is a velocity.

24 Now, what it is is it's a velocity
25 expressed over a unit area. If we want to talk --



1 hydraulic conductivity is expressed as a velocity
2 over a unit area. If we want to talk about the
3 relationship with the velocity of groundwater, we
4 will take hydraulic conductivity, and I will use
5 the letter K or Kd and we will divide that by
6 the effective porosity of the rock and hydraulic
7 conductivity takes into account the rock too. Don't
8 ask me why he did it this way, but he did. He
9 is considering it as a unit area of material.
10 If we want to get to velocity through that medium,
11 we would divide it by the porosity. So, if we have
12 a hydraulic conductivity, for argument's sake of
13 10^{-2} centimetres per second, and this would be
14 indicative of a sandy unit, the porosity of that
15 unit would be about 30 per cent and we would divide
16 it roughly be 0.3 or the true velocity would be
17 about 3×10^{-2} or about three times higher.

18 When I say hydraulic conductivity,
19 it is a scientific measure of the ease of which
20 fluids flow through the rock, but it isn't the
21 velocity, the velocity requires the introduction of
22 the porosity factor and the two aren't inter-
23 changeable to that extent.

24 DR.KINGHAM: When you and your
25 colleagues talk about groundwater migration, you



1 will then be talking about the movement of contaminants,
2 leachate, whatever and that will take account of
3 the porosity.

4 MR. SOBANSKI: Yes, it will.

5 MR. LEDERER: Q. If we could review
6 with the Board the hydraulic conductivity values
7 that you identified with respect to each of these
8 hydrostratigraphic units?

9 A. For the ^①bedrock we identified a

10 hydraulic conductivity in the order of 10^{-5}
11 centimetres per second. You will recall from Dr.

bedrock
 10^{-5}

12 Cherry's figure that was put up yesterday, that
13 that would be a moderate hydraulic conductivity.

14 The lower till unit we have it shown at the side here ^②

lower till
 2×10^{-6}

15 at 2×10^{-6} centimetres per second and so it has
16 a lower hydraulic conductivity than the shale by
17 an order of about five times lower.

18 The hydraulic conductivity of ^③
19 the granular units, and we can see the importance

20 they will assume because suddenly within this unit
21 of 10^{-6} or nearly 10^{-6} permeability material, we

③ lower
gran
 3×10^{-4}

22 now have the lower granular unit with a hydraulic

23 conductivity of 3×10^{-4} centimetres per second

24 and the upper granular unit, the sand and gravel, ^④

④ upper

25 has a hydraulic conductivity of 8×10^{-3} centimetres



1 per second, which is nearly 10^{-2} centimetres per second and we
2 are now coming to the high hydraulic conductivity
3 range when you get up to 10^{-2} centimetres per
4 second.

5 The upper till, we have two values
6 for upper till and one is a value of 8×10^{-8}
7 centimetres per second for the massive unfractured
8 portion of the till, and this is a hydraulic
9 conductivity of nearly 10^{-7} and finally at the top
10 in the weathered zone we have assigned a hydraulic
11 conductivity of 1×10^{-5} centimetres per second.

12 It is difficult to measure this
13 weathered hydraulic conductivity. Some time in
14 the past, thousands of years ago and following
15 glaciation, Ontario was cursed, I guess would be
16 the word, with what investigators feel was a very
17 dry period and consequently while this area now
18 has a water table level that might be a metre
19 below the ground surface, at one time it was much
20 deeper and we apparently had very dry conditions
21 in the province and we produced a weathered profile
22 that is about 4 to 5 metres deep and it was produced
23 in other ways as well. Not only did we have a dry
24 period, but we originally had a forest on this area
25 and its deeper root systems also helped create this



1 weathered deeper profile. So, within this upper
2 unit we feel that it has a higher hydraulic
3 conductivity and there are other factors to consider
4 in the very shallow zones, things like root tubes
5 and worm tubes can provide us with paths of higher
6 hydraulic conductivity and we can't measure this
7 very well in the field in these types of units,
8 this is a clayey till, and when we put a borehole
9 into a clayey till we tend to smear any fractures
10 found within that unit and hence we decrease the
11 hydraulic conductivity we would like to measure
12 with our observation wells.

13 Now work by Cherry and others has
14 indicated that the increase in hydraulic
15 conductivity of tills due to this weathering and
16 fine fracturing within this unit could be in the
17 order of one to three orders of magnitude or ten times
18 to one thousand times greater than the massive
19 unit. So in this case we have assigned a
20 hydraulic conductivity value of 10^{-5} to the
21 weathered unit, which is two orders of magnitude
22 greater than we measured within the massive unit.

23 Q. Mr. Sobanski, before we leave
24 this matter of hydraulic conductivity, you have now
25 identified values for the Board and can you indicate



1 | what it is you do to them to calculate them?

2 | A. These values are calculated
3 | from the tests that Mr. Beechinor described and
4 | these are falling head or slug tests carried out
5 | in individual piezometers where we withdraw water
6 | from a piezometer or inject water into a
7 | piezometer and we measure the time versus water
8 | bleed-off rate and this can then be put into the
9 | Hvorslev equation that he mentioned, I believe,
10 | and from that we can calculate hydraulic
11 | conductivity.

12 | The second method we used at this
13 | site was to actually run pumping tests on these
14 | individual units where we installed water wells,
15 | essentially water wells, as domestic well
16 | supplies, and installed an observation well network
17 | around them and then we pumped them for a period of
18 | time and in one case -- in the case of the lower
19 | unit for a twenty-four hour period and in the case
20 | of the upper unit, for forty-nine hours, and
21 | observed what the effects were in the observation
22 | wells to see whether or not there was continuity
23 | between these zones and to see if there was a
24 | decrease in the hydraulic head in the observation
25 | wells. These were the two methods used at this



1 site to determine the value of the hydraulic
2 conductivity.

3 Q. Can you indicate to the Board,
4 and this may seem a bit simplistic, but I want to
5 be clear, but can you indicate to the Board if this
6 is important and for what purpose would you use
7 it in conducting the kind of study you have under-
8 taken with respect to these two sites?

9 A. The hydraulic conductivity?
10 It is essential we determine these things. It
11 affects groundwater velocity, it affects groundwater
12 flow directions and it affects how much groundwater
13 will move in the subsurface in the various units.
14 So, it is a very important factor.

15 Q. Could you indicate to the Board
16 what is meant by the term porosity?

17 A. Porosity in simple terms is
18 the amount of void space within a geologic unit
19 and any geologic unit will comprise two things,
20 and not all geologic units, but most geologic units
21 will comprise two things, one being the actual rock
22 particles and the other will be the actual void
23 spaces or holes within the unit.

24 In terms of a sand and gravel it is
25 fairly easy to visualize, it's the open holes between



1 the grains, whereas in a limestone unit or in a
2 shale unit, it may take the form-- it takes two forms,
3 it takes the form of the intergranular pore spaces,
4 as we have discussed, and it takes the form of
5 fractures which can add to the porosity.

6 Another term that will be coming
7 up in this will be effective porosity. This one's
8 a little harder to explain. It is an estimate in
9 many cases from literature of the porosity that
10 will have the most important effect on groundwater
11 movement if we look at it from the point of view
12 of velocity. In terms of a sand and gravel unit,
13 the effective porosity we would talk about, or
14 this could be a glacial till, but it would be in
15 terms of the network of the interconnected granular
16 pore spaces through which the water moves. So,
17 this is really about equal to the total porosity of
18 the medium and that is the effective porosity.
19 If we look at a piece of rock, a core of rock, and
20 this is a limestone which can be altered in some way
21 through slow processes of groundwater movement
22 over ions, but within this piece of rock, and we
23 will have to visualize this, but we have a vug or
24 a void within the rock. All around that we have a
25 network of very fine porosity within the rock matrix,



1 and most rocks have some porosity. I made one
2 exception when I think of salt, because salt bothers
3 me a little bit as to how much porosity it actually
4 has and I don't have it on the top of my head, but
5 obviously groundwater doesn't move through many
6 salt deposits or they would not be there, they would
7 dissolve away, so the effective porosity in salt
8 must be extremely low.

9 If we were to move water through this
10 porous medium here, the effective porosity are these
11 tiny little voids as opposed to the big vug because
12 the water won't be able to move through that vug,
13 it must go through these tiny pores, go into the vug
14 and then go out through tiny pores and the effect
15 of porosity we are talking about would really be
16 the matrix porosity of that rock, even though this
17 hole could compose perhaps 25 per cent of the rock.
18 The effective porosity of this rock isn't the 25
19 per cent determined by that void, it's the little
20 inter-connected pore spaces that become the
21 effective porosity.

22 DR. KINGHAM: While we are having
23 this lesson, perhaps you can flip back the page
24 and complete it by telling us what the range of
25 porosities are for us to consider since I notice



1 you have it in the denominator of your equation,
2 it will obviously have an effect?

3 MR.SOBANSKI: Indeed it does, but
4 if I can go through the next one, just the next
5 one because there is one more important effective
6 porosity and then we will come back to that, if you
7 don't mind.

8 Here is a piece of shale and it has
9 a crack in it. Now, two things here will control
10 the movement of groundwater in this zone and one
11 is this fine porosity which occurs between the
12 shale plates and which is very high, it could run
13 40 or perhaps even 50 per cent by volume of void
14 space within these kind of units, within clays and
15 shales. However, here the common factor we consider
16 is what is the worst-case situation and this will
17 be moving some fluids, but because of the low
18 permeability onhydraulic conductivity of these units,
19 the velocity through these units is very low, just
20 about as we talked about in the vug situation.

21 Now, what we have here is a crack and
22 with respect to the total rock mass, it has a
23 relatively small effective porosity in terms of how
24 much would move across there and these numbers become
25 very low and in some cases we talk about effective



1 porosities as low as 10^{-5} . In our case we don't
2 feel they are that low, but we have these values
3 in our calculations as low as 10^{-3} for a fractured
4 medium.

5 So indeed, Dr. Kingham, when you
6 come back to this equation, the lower the value we
7 have on the bottom of the equation, the higher
8 the velocity we have. So, the velocity is equal
9 to the hydraulic conductivity times the gradient we
10 are going to impose upon it or, in other words, a
11 flat gradient, and if there is no driving force, there
12 is no movement and so that is now a factor and "I"
13 is the gradient and we will divide this by the
14 effective porosity. So the range of values we will
15 look at here run from about 0.3, which aren't
16 necessarily low velocities because we have to come
17 back to how much permeability or hydraulic
18 conductivity we have, and they will run down to
19 about 10^{-3} in terms of the lower end of the effective
20 porosity. So this type of value or this type of
21 an analysis gives you a higher velocity even though
22 your hydraulic conductivity could be fairly low.

23 Can I be more helpful to the Board
24 perhaps?

25 MRS. TANNER: Can you tell me what



1 a vug is? We are learning lots of new words for
2 Scrabble.

3 MR. SOBANSKI: It's a hole in
4 solid rock.

5 MRS. TANNER: That has no egress?

6 MR.SOBANSKI: That's right. For
7 instance, when we talk about the general description
8 of the shale on Site F, we talk about there being
9 some vugs and I believe where we have -- there is a
10 piece of shale that originally had a piece of
11 calcium sulphate incorporated within it and this is
12 gypsum and as the water slowly percolates through
13 this rock through the ions, this material is fairly
14 soluble compared to the surrounding rock and it
15 leaches out and you are left with a hole in the rock.

16 MR.LEDERER: I should tell you that
17 vug, by my recollection, is a six point word and it's
18 not worth very much.

19 I think this is probably the right
20 time to end.

21 THE CHAIRMAN: Very well. 9:30.

22 --- Adjournment (4:50 p.m.)

23 CERTIFIED CORRECT

24

25


C.F. Nethercut, C.V.R.