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 0 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: 116

HELD AT: Oakville, Ontario

DATE: March 31, 1988

OFFICIAL REPORTERS
NETHERCUT & COMPANY LTD.
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BEFORE: H. H. Lancaster, Q.C. - Chairman

Dr. D.J. Kingham - Member

Nethercut & Co. Ltd.
Toronto, Ontario

Hearing conducted at The Oakville Granary Commercial Centre, 105 Robinson Street, Oakville, Ontario, on Thursday, March 31, 1988.

VOLUME 116

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

APPEARANCES (Cont'd):

C. Stevenson P. Hancock	for Framgard Holdings, Fosseri Investments Limited, Seriphos Investments Limited and Topic Investments
J.H. Olah	for the Halton Region Conservation Authority

* * * * * *

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Per: P. D. McQueen

Oakville, Ontario
March 31, 1988

--- Upon commencing at 9:32 a.m.

MR. LANCASTER: Thank you, please be seated. My sincere apologies.

MR. HODGSON: We are creeping up on the first anniversary, Mr. Chairman.

MR. LANCASTER: We are going to have a party.

MR. HODGSON: It sounds like a good idea.

MR. LANCASTER: We will be ready for one.

MR. HODGSON: I guess if it is our first of the year, it will be acceptable.

ANTHONY J. CRUTCHER, Resumed

JOHN M. PETRIE, Resumed

CROSS-EXAMINATION BY MR. HODGSON, Continued:

MR. HODGSON: Mr. Chairman, before I start, we have identified, over the evening, that we may have inadvertently erred in preparing Exhibit H-659.

I would like to ask Mr. Petrie, if you have a copy of Exhibit N-185, which is the Morrison, Beatty Phase 3 Report.

MR. PETRIE: A. I believe I do.

Q. Could you turn up in that report, Table E-1?

A. Can I just locate it? The Phase 3 Report?

Q. Table E-1. I am numbering the pages so as I can tell you which one it is on. It is in Appendix E, obviously.

A. Are you numbering the first page of the data as page 1?

Q. Yes, I am and on page 13, you will find some test results for OW-15. Do you see the results for OW-15?

A. Yes, I do.

Q. There are three results there for three piezometers, 15-9, 15-18 and 15-27.

A. Yes.

Q. Would you agree with me that the number that is presented on H-659 for the deepest piezometer, at the deepest level, is accurate, 19,300?

A. That is for the chloride level.

Q. Yes, and we seem to have inadvertently got the conductivity numbers confused with the chloride numbers, so I am going to give you

a blue pen that will colour co-ordinate and I am going to give you a little bottle of white-out and I wonder if you would doctor the evidence so that it becomes accurate rather than inaccurate.

A. I can correct the evidence.

Q. This is called fiddling with the data-base. If you would take the 4620 off, the 5730 off, and you need to take off the piezometer interval as well and put it back on in a different colour as well if you wouldn't mind. And also, regrettably, it would appear that the top number is inaccurate. In fact, it doesn't exist.

A. I gather you want me to correct the top of 5730?

Q. Yes,the 5730.

Then, perhaps if you could pass the white-out to your colleague, he could correct Exhibit M-437-D5, while you correct MB-59, Exhibit H-659.

A. Could you read me ...

Q. Yes, the first piezometer, the top piezometer, you need a blue pencil for the chloride, chloride that is less than 1,500.

The numbers should read 935 and if you wouldn't mind colouring in the piezometer as well, that would be useful.

A. The white-out is still a bit wet.

Q. Four, nine, nine for the second one.

DR. KINGHAM: While you are there, Mr. Petrie, can I ask you just to check the OW-17 numbers? I don't have any doubt that they are right, but I would like to be assured that they are right. You will find that over a couple of pages. Page 16, I guess.

MR. HODGSON: It would appear that the top one in OW-17-7, I have 555 in my copy of Exhibit N-185.

MR. PETRIE: I have 555 or 565.

MR. HODGSON: Q. If I could just -- Mr. Chairman, Dr. Kingham, if everyone would also pull out Exhibit E-214 and turn up page 61. E-214 is Ms Hewetson's thesis. Ms Hewetson also took some chloride readings in the Morrison, Beatty wells.

DR. KINGHAM: Where would you have us go on Exhibit E-214?

MR. HODGSON: On page 61. I believe it may be that the number is the same, but they are so close, perhaps we should correct them in MB-17, the top one can become 555, plus or minus 10 won't

matter will it, Mr. Petrie?

MR. PETRIE: It's your exhibit. If you would tell me what number you like on the exhibit.

MR. HODGSON: Q. If it is acceptable to the Board, I think we should have 555 on it, or do you think it worth changing?

MR. PETRIE: A. No, it's your exhibit, Mr. Hodgson.

Q. It's your evidence, Mr. Petrie.

MR. McQUAID: You presented this document. Mr. Chairman, Mr. Hodgson presented this document to the witness and said "Accept that the figures are correct." Now, he can't -- I suppose he can go through each one. What is it he wants done at this point?

MR. HODGSON: This is a silly argument, with respect, Mr. Chairman, but I asked the witness to accept it subject to check.

MR. PETRIE: And I accepted it.

MR. HODGSON: My preference is that it read 555, but I am in the hands of the Board.

MR. LANCASTER: It appears it should be 555 as far as we can tell at this point.

DR. KINGHAM: Would you please change it, Mr. Petrie, or Mr. Crutcher.

MR. HODGSON: Q. Then, Mr. Petrie, could I also ask you ...

MR. PETRIE: A. I am just correcting this exhibit. I have just corrected the chloride levels on Exhibit M-437-D5 for MB-15 to read the same as they are on Exhibit H-659.

Q. And then could I ask you, again going back to Exhibit H-659 and also if you could turn up the first page under Table E of Mr. Beatty's report, N-185. It would appear that we have from page 61 of Ms Hewetson, one dataset for MB-1 and that dataset is presented on Exhibit H-659 but there is a second dataset in Mr. Beatty's report.

It would appear that Ms Hewetson took her samples and reported her data and Mr. Beatty has reported his data. The second dataset on this first page of Appendix E of N-185, suggests that the upper piezometer, OW-18 could also read 1090 and I wonder if we should just have the second number put on for completeness. If the bottom piezometer could read 47,000 we could also have that on for completeness.

A. The top number would read 1090.

Q. The top number would read 1090 and the bottom piezometer would read 47,000.

Thank you. And then I think, Mr. Petrie, if I could ask you, for completeness, perhaps you could do this over the morning break. You will notice on page 61 of Exhibit E-214 that Ms Hewetson has sampled OW-2 AND OW-3 which are geographically quite closely related to OW-1. I wonder if you could, over the break this morning, project onto Exhibit H-659, OW-2 and OW-3 and put on the data that is reported on page 61 of E-214 and also from page 1 of Appendix E of N-185, would that be acceptable?

A. I am sorry, to project wells OW-2 and OW-3 onto that exhibit, being H-659, the chloride levels from both documents?

Q. From both documents if you wouldn't mind unless they overlap completely.

A. It will crowd the cross-section a little.

Q. I think if we are going to make use of this data we should have the complete dataset.

A. Certainly.

Q. You will notice in OW-2, at 21 metres below, I guess, ground surface we have

chlorides at 33,400.

A. That is as the number reads, yes.

Q. In OW-3 at 20 metres below ground surface, the chloride levels are 8,940.

A. Correct.

Q. I think that would be useful data to complete the dataset.

Now, Mr. Petrie, when we began on Monday, you were kind enough to put some numbers on Exhibit H-645.

Yesterday, at the end of the cross-examination, you put a line on M-437-D5, a horizontal blue line which went above the -- what I guess is the second piezometer in MB-1?

A. That is correct.

Q. Could you just read off, M-437-D5, the vertical elevation of that blue line that you have imposed on that document?

A. One hundred and twenty-six metres above sea-level.

Q. One hundred and twenty-six metres, would you mind putting on H-645, an indication of where we find 126 metres above sea level?

A. Approximately at this elevation.

Q. Would you mind also, this morning over the break, projecting onto that exhibit that same line?

A. Certainly.

Q. Unless you have a ruler there now. We have a ruler upstairs. I apologize for not bringing it down.

A. I have one.

Q. Perhaps you could do it now.

A. Any particular colour?

Q. Do you have a colour that isn't used on the exhibit?

A. I have an orange. It may not appear very different. Shall I project the line laterally?

Q. Yes, please.

A. To ground surface -- sorry, how far would you like me to project the line?

Q. If you wouldn't mind projecting it to ground surface, that would be satisfactory, thank you.

Could you write on that line in reasonably bold letters, the level you have got it

at?

A. I have written "126" adjacent to an orange line on Exhibit H-645.

Q. Then, would you write in brackets after "126" (MB-1-Piezometer 2) so that we know it co-ordinates with MB-1, Piezometer 2?

Now, Mr. Petrie, yesterday at the end of the proceedings, I put to you a bit of a hypothesis about that blue line. Could we go back to M-437-D5, please? A bit of a hypothesis about that blue line.

I would like to re-state that hypothesis for you and then ask you some questions about it. The hypothesis goes something as follows, that there are units of shale capable of containing within their matrix water with very high chlorides and that these units of shale are capable of retarding penetration of new water from above or of leachate from above, thereby deflecting flow horizontally such that an overwhelming percentage of water or leachate recharging the groundwater system is being deflected along the horizontal bedding planes of the overlying materials. Would you like me to read that again?

A. Yes, please.

Q. There is no test here. I am not going to ask you to pick out the three words in the middle and answer them.

There are units of shale -- there are, at Bayview, units of shale capable of containing within their matrix, water with very high chlorides and that these same units of shale are capable of retarding the penetration of new water from above or of leachate from above thereby deflecting flow horizontally such that an overwhelming percentage of water or leachate recharging the groundwater system is being deflected along the horizontal planes of the overlying materials.

Now, I want to ask you some questions. I am not asking you whether or not you agree with the hypothesis. I have no doubt there will be an opportunity to do that. I want to ask you a question framed in the hypothetical which is: If this is a useful hypothesis, then would you agree with me that it deserves to be tested in the most rigorous manner possible?

A. Yes.

Q. If it is to be a useful hypothesis, it should be able to explain most of the data in and around Bayview, Burlington and Site F?

A. Yes.

Q. If it is a useful hypothesis, features or facts that previously appeared anomalies could now be explained by the hypothesis?

A. They could.

Q. So, for example, since 1983, Gartner, Lee have been noting in the text of their annual monitoring reports that they have identified a leachate seep on the slope leading from the Burlington landfill to the Falcon Creek.

A. They have.

Q. Would you agree with me that when we address that leachate seep in the context of testing the hypothesis I have suggested, we must not only ask ourselves, as we did yesterday in the context of testing a different hypothesis, why are there not leachate seeps all over the slope, this is what we asked ourselves yesterday. But also, what does the single leachate seep, what is this single leachate seep doing functioning as it is on this slope?

We need to answer that question; don't you agree?

A. Yes.

Q. Now, in testing this

hypothesis, do you agree with me that we must not only examine all the available data to see which data confirm and which disconfirm the hypothesis, but we should also examine that data itself and ask which is reliable data and which is unreliable data?

A. That is reasonable.

Q. Will you agree with me that a good hypothesis will not necessarily flounder because of a single piece of disconfirming data?

A. That is also true.

Q. So, for example, a datum may be unreliable.

A. A datum?

Q. A datum, data is the plural.

A. A single data point.

Q. It's the only piece of Latin I have left, but I have that.

A. I thought you meant an elevation datum.

Q. Datum may be unreliable, or it may be no more than an anomaly for which the hypothesis could account.

A. Is the hypothesis supposed to account for the anomaly?

Q. The anomaly, I suggest, is to

try to account for the anomaly.

A. Yes.

Q. We are dealing here with the flow of water and other substances through geological materials.

A. We are.

Q. And geological materials are not manufactured in facilities with careful quality control on the ingredients that go into them or the processes they undergo.

A. That is correct.

Q. Beds of shale in the Queenston formation were not manufactured at Stelco for stamping out front fenders of automobiles.

A. That is true.

Q. For standards of conformity we expect sheets of steel -- we should not expect in the geological materials laid down either at Site D or Site F.

A. Quite correct.

Q. If there was not this lack of uniformity and there were not the discontinuities, geology and hydrogeology would not be the difficult and demanding sciences they are.

A. Correct.

Q. You agree with my that hydrogeology is a science?

A. I do.

Q. And to really understand groundwater problems, the hydrogeologist needs a firm grounding in both geology and those other areas of study such as fluid mechanics that compose hydrogeology?

A. Correct.

Q. Now, would you agree with me, Mr. Petrie, that in looking at data, it would be appropriate to develop what I am going to suggest to you we call a confidence scale.

At one end of the confidence scale we put data that we distrust and wouldn't use for any purpose and at the other end of the confidence scale we put data in which we can place great confidence, do you agree that is an appropriate thing to do?

A. It is.

Q. So, we could then -- if we had a confidence scale for data, we could ask ourselves with any particular piece of data, "Where would I like to place this piece of data along the confidence scale?"

A. Quite true.

Q. In hydrogeology, would you agree with me that very few data fall into the 100 per cent end of the confidence scale?

A. I do.

Q. And a lot fall at the other end?

A. Correct.

Q. For example, you have reviewed the Hvorslev tests that were done both at Site D and Site F.

A. I have.

Q. In fact, as I recall, your evidence, I don't think I read this in the report, but I do recall you saying this two weeks ago. You reviewed the Hvorslev tests at Site F and you reviewed the Packer tests at Site F and it was your professional opinion to this Board, that this Board should place more confidence or that you personally place more confidence in the Packer tests than the Hvorslev tests.

A. I felt they were more representative, I do.

Q. In fact, would you agree with me that it is being your evidence that at Site D, the Hvorslev results are erroneously low and at Site F

they are erroneously high.

A. Could you repeat the question? I am not sure you have got it quite right.

Q. I am sorry, I am always getting confused about which way to go with those -8's and -7's that I confuse my question, so can I repeat it correctly?

A. Yes.

Q. At Site D, you have suggested that the Hvorslev tests give erroneously high readings for the upper unweathered till?

A. I don't believe I used the words "erroneously high." I said I did not place as much weight on them as Mr. Sobanski might, given the concern with the hydraulics of that unit, we wished some additional testing.

Q. In fact then, in complete fairness to both you and Mr. Sobanski, Mr. Sobanski didn't have the advantage of having your testing.

A. That is right.

Q. And you have Mr. Sobanski's Hvorslev results and your tri-axial test results.

A. I think that is correct.

Q. The tri-axial test results you had to ask yourself, here I have data on the

upper weathered, unweathered till at Site D. I have Hvorslev results and I have tri-axial results and I ask myself the question, in which am I going to place the most weight.

A. Correct.

Q. And you asked yourself that question?

A. I did.

Q. And you came up with an answer?

A. I did.

Q. At Site F, you looked at packer test results and Hvorslev test results and pumping test results.

A. Yes.

Q. And made some decisions as to where you wanted to put the weight as well, is that correct?

A. I did.

Q. And with respect to both Site D and Site F you could be right with respect to the Hvorslev tests at both sites, couldn't you?

A. I could.

Q. Or you could be wrong?

A. That is not unlikely.

Q. Or you could be right at one site and wrong at the other site.

A. You have suggested three possibilities, yes. You have covered the field.

Q. There are a lot of possibilities.

Would you agree with me, Mr. Petrie, that a major component of the task of a hydrogeologist is to put weight on the data which fall between the two extremes on the confidence scale? And, if I may qualify before you start your answer, at one end of the confidence scale we have got data which we should simply dismiss out of hand as worthless.

At the other end of the confidence scale you have got data that you can't dismiss, that you know is completely reliable, but as a hydrogeologist, would you agree with me that a major component of your task is to decide what weight to put on the data that falls in between those two points?

A. That is reasonable.

Q. Would you agree with me that if you use all the data without weighing it it is quite likely that you will come up with a picture

that is incoherent?

A. Yes.

Q. Now, it is difficult, is it not, for a hydrogeologist to put different weight on different data?

Let me rephrase that question, I am sorry. Let me restate the question completely. I got it all botched up, excuse me.

Would you agree with me that different hydrogeologists put different weight on the same data?

A. I can, yes.

Q. And that among the reasons why that might occur is that some hydrogeologists have more experience than others?

A. That could happen.

Q. One hydrogeologist in looking at data may have a different purpose than another hydrogeologist?

A. Correct.

Q. One hydrogeologist may have personally collected the data and know exactly what confidence he can place in the data because he personally collected the data?

A. Correct.

Q. And the other hydrogeologist, looking at the first hydrogeologist's evidence could always ask himself the question, "I didn't collect that data, I wonder if the guy knew what he was doing?"

A. That is one question he might ask.

Q. And also he might ask has the first hydrogeologist used the right test procedures.

A. That is another question he might ask.

Q. There is not much point in using the right test procedure, you want to use the test procedure that answers the question asked.

A. Presuming the first hydrogeologist asks the same question, yes.

Q. In addition to selecting the right test procedure, you want to make sure it was carried out properly?

A. Correct.

Q. And it is a test that reflects the parameter you are trying to measure.

A. Correct.

Q. And would you also agree with me that the level of confidence that you require in

your data before you feel you can make a prediction depends, at least in part, on the actual risk or consequences of being wrong.

A. In part.

Q. For example, if the hydrogeologists are wrong at Site D, and municipal water isn't put in to service the local citizens, it is possible, is it not, that someone could drink contaminated water from that landfill.

A. It is possible.

Q. Would you also agree with me that at Site F, that particular risk is much lower than at Site D?

A. I do.

Q. Would you agree with me then that the risk of being wrong at Site F is lower than the risk of being wrong at Site D?

A. The way you describe it, yes.

Q. Now, can we go back to chlorides for a minute, Mr. Petrie? At MB-1 in the bottom piezometer, we have chlorides which we now know today vary between 47,000 and 50,000. Can I just use the phrase around 50,000?

If that makes you uncomfortable, I will say around 47,000.

A. I am perfectly agreeable.

Q. At the lowest piezometer at MB-1 we have chlorides around 50,0000 parts per million.

Would you agree with me that what these chloride levels tell us is that the water moving through the rock around that piezometer is moving very slowly?

A. That is reasonable, yes.

Q. It is probably water that is older than, say, 50 years.

A. Correct.

Q. It may, in fact, be water that is older than thousands of years.

A. I would not like to speculate.

Q. In the thousands of years is within the range of what is possible isn't it?

A. It is.

Q. Would you also agree with me that in the upper zone at that piezometer, MB-1, particularly the first piezometer where we have levels around 1,100, chlorides are low and these indicate areas in which the groundwater regime is more active?

A. Yes.

Q. Would you also agree with me then that when we look at the higher chlorides, we know that we are dealing with a longer time scale, but we are not really sure what the time scale is?

A. Correct.

Q. Now, in looking at MB-1, we have, between the first piezometer and the third piezometer, what I am going to suggest to you is a transition zone between low chlorides and high chlorides.

A. Yes.

Q. We are not sure from looking at the data on Exhibit H-659 with regard to MB-1, just what the relationship is between those chloride levels in terms of the timescale that is involved.

A. That is fair.

Q. Would you agree with me that it would be helpful in getting a sense of that timescale to also look at the tritium data?

A. Yes.

Q. Now, can I just take you, for a minute, back to B-617. I like to think of what we are doing here, Mr. Petrie, is working with text and context.

Text is B-617, context, I think, is

the piece of geography that goes from King Road over to Falcon Creek.

Now, would you agree with me that the discussions that you have of tritium in B-617 are to be found at pages 47 and 108?

A. Forty-seven and 108, yes.

Q. So the discussions of tritium are divided and would you also agree with me that the tritium data available for review has been divided up by you on to two cross-sections, one on page 48 and one on page 109?

A. Yes.

Q. Would you agree with me that in your two discussions of tritium you have not made an attempt, for whatever reason, to relate the tritium data in the second discussion starting at page 107 with the tritium data in the first section at page 47?

A. My recollection ...

Q. Is it your recollection that you have discussed tritium data along the profile from HC-4 to HC-14 at the same time you discussed the tritium data along the profile that runs roughly through the middle of Bayview Park down to OW-18?

A. Looking at the top of page 110, I note a paragraph there that says the

interpretation is consistent with the tritium data provided by Trow discussed on page 47.

Q. Now, in addition to presenting the tritium data on two separate pages, would you also agree with me that you have not presented any tritium data for OW-1?

A. OW-1 being HC-1?

Q. No, OW-1 being MB-1. MB-1 is not shown on the cross section you refer to on page 109.

I think you will find if you go to page 68 of Ms Hewetson's thesis that you will find tritium data for OW-1 and also that if you check the tables in Ms Hewetson's thesis, you will find tritium data presented there as well.

I don't mean to make a big issue out of this, Mr. Petrie.

A. I am noting on page 28 of her thesis she has another figure of tritium and groundwater. For some reason, OW-1 is not recorded on one figure and it is on another.

Q. Would you agree with me that if we are going to work with tritium data that at least when we start working with the tritium data, it is better to have more rather than less?

A. Yes.

Q. Very, very expensive to acquire, is it not?

A. I don't have the cost at my fingertips, but given the data is available in the same document, it would have been appropriate to use it all, yes.

Q. Now, would you agree with me that in addition to these other points that you have not analyzed the tritium data and imposed on that data any sort of a quality check.

A. I did not -- sorry, could you repeat the statement.

Q. You have not analyzed the tritium data to impose on that data, any sort of quality check?

A. When we first reviewed the Hewetson thesis, I did have a concern with the tritium data. It now occurs to me there were two figures in this document which have provided the tritium data and I was referencing our remarks and our figure in our report from the first one. I had not noted there was a second one with slightly more data.

We discussed this with Dr. Cherry at

one point in time and his impression of that discussion was that the tritium data was the most useful data in this report.

At that same discussion, as I recall it, and I am talking of a discussion two years ago, maybe even more, I remember that the complete chemistry data-base for the Hewetson document, he had it somewhere or could not find it. There was some concern on his part just where it was and how we could get hold of it because I was interested in obtaining the complete data base.

I also recall discussing that with Ms Hewetson and she recalls she was provided with a portion of the data-base for her work and that the complete data-base she had not been provided with.

Q. Well, at any rate, I don't want to make an issue out of this, I just want you to agree with me that if we have the tritium data from MB-1 we ought to at least consider whether or not it is reliable data and if it is reliable data we ought to make whatever use of it would be appropriate in the circumstances of the study we are engaged in.

A. I also note there is another point in WAT-5 recorded on page 68 of the thesis which is not available on the previous page I

referenced, being 28. That was an oversight on my part. I am in no disagreement with you.

Q. I have gone to a different point, Mr. Petrie. I accept it as an oversight, and it is not something we can't deal with. What I have asked you is, in presenting tritium data, first on page 48 in the cross-section and again, on page 109 on a cross-section, will you agree with me that you did not impose a quality check on that data before you used it?

A. With respect to the data on page 48, I believe we posed questions to Mr. Sobanski on the cross-section. He believed the data was reliable. In reading his document in Exhibit H-40 I did not note that the quality of that paper was questioned. As I indicated to you, I discussed with Dr. Cherry and he thought the tritium data had some value.

Q. That is the quality check you are imposing?

A. Correct.

Q. I wonder if we could just look at the tritium data and analyze it and ask ourselves what weight we should place on various components of that data and then when we have done that, carry on

relating that data to other aspects of the site.

I would like you to put up two cross-sections, if you would. I would like you to put the one behind up on the easel.

Now, I wonder, Mr. Chairman, if the first exhibit which is entitled "Tritium Data" from H-40 and E-214 could be marked as the next exhibit.

MR. LANCASTER: H-662.

---EXHIBIT NO. H-662: Tritium Data from H-40 and E-214

MR. HODGSON: Do you mind, could we mark the second exhibit as Exhibit H-663. Would you mind printing the numbers towards the top in large bold letters. People who are up here cross-examining have a lot of trouble remembering what exhibit they are going to and the quicker they can pick it up with their eyes, the easier it is.

---EXHIBIT NO. H-663: The most reliable tritium data from H-40 and E-214

Q. Thank you very much, Mr. Petrie. The second exhibit is entitled "The most reliable tritium data from H-40 and E-214.

Mr. Petrie, what I would like to do is I would like to work back and forth between Exhibit 662, 663 and 659 so that this Board could have your evidence as to the weight that you wish

this Board to understand that you want to assign to each piece of the tritium data at these two sites -- I am sorry, at this site.

Now, could we start with the data from the WAT wells? And you will note looking at the WAT data which is data that you have presented that we find in WAT-3, high tritium at the bottom of the hole and at WAT-4, relatively low tritium at the bottom of the hole.

MR. PETRIE: We do.

Q. And at WAT-5, would you agree with me that what we find at WAT-5 is a noisy dataset?

A. You mean the numbers are varied, yes the numbers are varied.

Q. Do they vary in a manner that suggests a pattern to you?

A. Depending on what the pattern is that one expects at this site. I don't have your expectation of a pattern.

Q. You must have some expectation when you address a dataset, don't you?

A. Yes, I do and it is this tritium data that highlighted for me the uncertainty in dealing with the fracture flow at this site, which

fractures were communicating water and which fractures were dead-end fractures which held all the water.

With that point in mind I did discuss this at some time a long time ago, with Dr. Cherry.

Q. I apologize, Mr. Petrie, for interrupting you in your flow, but Mr. Feenstra has just advised me again that page 68 appears to have a more complete set of tritium data than the page earlier in Ms Hewetson's report from which you took Figure C.3.2 at page 109 of your evidence.

A. That is correct. I indicated there was another point at WAT-5 and we have indicated that point under Exhibit H-662.

Q. Thank you.

Again, at WAT-7 would you agree with me that the pattern we see at WAT-7 isn't exactly the pattern one would predict for this area?

A. I don't know what your prediction is.

Q. Is it a pattern that you would predict?

A. I would not have predicted it. However, having the data before me and recognizing that I did question Dr. Cherry on this point some two

years ago or more, this highlighted the uncertainty of trying to define the hydraulics at this site.

Q. Now, do you recall, Mr. Petrie, that when Ms Hewetson, I assume it was Ms Hewetson, installed the piezometers in boreholes that someone had drilled for her at the locations WAT-3, WAT-5, WAT-4 and WAT-7 that she had some unfortunate problems in stabilizing her piezometers?

A. You mean with respect to hydraulic connection in the borehole?

Q. Yes.

A. I believe she references that in the document.

Q. Could I ask you to turn, sir, to Exhibit E-214, to the bottom of page 6?

The last paragraph reads:

"During the period of piezometer development and initial hydraulic testing..."

A. Yes, I have it.

Q. "During the period of piezometer development and initial hydraulic testing, the water levels in many of the piezometers in each multi-level device repeatedly equilibrated

to the same position."

What does that mean, Mr. Petrie?

A. I can suggest that, as I believe Ms Hewetson concluded, there is some degree of connection in the borehole.

Q. "This suggested hydraulic connection between the inside of the PVC casing and the individual sample intervals."

A. Correct.

Q. "The casing of each multi-level device was then filled with a thick bentonite slurry to seal leaks and prevent the influence of hydraulic 'short-circuiting'."

A. That is as it reads, yes.

Q. Now, as I understand what happened and I am going to ask you to confirm this, could you then turn to page 23? This would appear to be one of these unfortunate incidents that sometimes happen during the course of an investigation, scientific or otherwise, and that is that in putting in one's measuring devices to get one's data, things don't work out just the way you had planned.

A. That happens.

Q. Would you agree?

A. Yes.

Q. Looking at page 23, would you agree with me that what was happening here is that Ms Hewetson, first of all, had a borehole prepared of a suitable diameter.

A. She did.

Q. Then, she wished to install down that borehole, a two-and-one-half-inch in diameter plastic pipe.

A. I don't have the dimensions in front of me.

Q. Will you accept?

A. Yes.

Q. The dimensions don't really matter for the purposes of discussion. It was a plastic pipe. It wasn't enormous in size.

Inside that plastic pipe, she had a whole series of very small piezometer pipes -- I believe they were as small as three-eighths, or one-half inch.

Probably three-eighths OD, yes.

Q. The construction of this device was such that each one of her piezometers extended down through the plastic pipe that encased

it. Shall we call the casing the plastic casing?

A. Within that casing, yes.

Q. Each piezometer extended down through the casing and since each piezometer was to test a different interval, each piezometer ended by making a little left turn or right turn and developed a hydraulic connection to the outside of the case through a hole.

A. Correct.

Q. Yes, so that it wouldn't matter very much what was inside the casing, because there wouldn't be hydraulic connection to the piezometer from inside the casing because the piezometer was connected to the outside of the casing.

A. Correct.

Q. It was, in fact, designed for what was going on outside the casing. Ms Hewetson didn't go to Site F to investigate what was going on inside the casing.

A. Yes.

Q. In order to seal off the borehole between each interval that she wanted to test, she had an expandable packer; correct?

A. Correct.

Q. This was material that was on the outside of the casing at various intervals between the piezometers.

A. Correct.

Q. It would follow, would it not, that because the whole instrument had to be installed down the hole the packer material could not be the diameter of the hole when it went down the hole, or it wouldn't go down the hole.

A. That is correct.

Q. So, what had to happen was that the packer material had to somehow grow once it got into the hole.

A. Correct.

Q. And the way in which the packer material was to grow in these holes was it was going to grow because it was going to get wet.

A. Correct.

Q. And the way it was going to get wet was that Ms Hewetson poured water -- Ms Hewetson or someone else, someone on Ms Hewetson's behalf, poured water, will you agree, down the casing? That wouldn't contaminate the piezometers, would it? But because there were holes in the casing at each packer interval, water that was

poured down the casing could go through those little holes into the swelling packer material and swell the packers up.

A. That is the intention of that device.

Q. And seal off the borehole between each interval.

A. At each packer location, yes.

Q. Will you agree with me that unfortunately what happened, and these were new devices that were being tested by the University of Waterloo?

A. Yes.

Q. They weren't interested in putting a landfill at Site F, they were interested in doing some research for their own purposes?

A. On the hydraulics of groundwater contamination, down-gradient from the existing landfill.

Q. They had invented this new device and they were really test-flying it at Site F?

A. At Site F, yes.

Q. In fact, they wrote it up later, did they not, correct?

A. Yes.

Q. What happened, unfortunately, is that when they put the water, they filled up the centre casing with water so that water would leak out through the holes at the packer intervals and swell the packers.

A. Correct.

Q. But what happened, is that they subsequently realized, or very quickly realized that their piezometers all had the same reading and that told them that the water they had put down the casing to swell the packers, had leaked into the borehole and in effect, they had a hydraulic connection between the inside and the outside of the two-and-a-half-inch casing.

A. Or that the elbows at which the piezometer pipe was connected to the casing had leaked, yes.

Q. Because they had -- because the packers had swelled, but because the water from the packers had leaked into the case or somehow water had got outside that two-and-a-half-inch circle, what they then did was that they put a bentonite slurry down the hole, down the casing rather.

A. It is my reading of the sentence you just read before is that there was some

sort of connection within the vertical casing string. It was my interpretation of that sentence that the elbows may have been the question, the elbows being the base of the piezometer pipe which intersects with the casing. By introducing a bentonite slurry down that casing, they sealed wherever the leaks were.

Q. Can we go to the bottom of six and read the last sentence? It says:

"This suggested hydraulic connection between the inside of the PVC casing and the individual sample intervals."

That means the inside of the casing and the outside of the casing between each packer.

A. Or the inside of the casing and the piezometer pipe.

Q. It doesn't read "or inside and the piezometer pipe." It reads:

"This suggested hydraulic connection between the inside of the PVC casing and the individual sample intervals."

So, the second part of the sentence, I suggest to you, is talking about something outside the PVC casing since the first part of the sentence is talking about something inside the PVC casing.

A. The individual sample

intervals refer to the piezometer pipe and the portion outside the casing.

Q. In any case, it doesn't matter, does it, Mr. Petrie, because what happened is that the water that was put down the PVC casing to swell the packers was water from the City of Burlington, do you agree with that?

A. I cannot agree with it, I do not know.

Q. Would you agree with me that if it was water from the City of Burlington, it was water that was tritiated water?

A. Most likely, yes.

Q. Most likely. If tritiated water was put down that PVC casing and leaked out into those intervals, then if someone later decided to do a tritium test, they would be testing water on the outside of the PVC casing that had also been contaminated with water from the inside of the PVC casing.

A. That may have been, yes.

Q. If that happened, the result would be that the tritium results wouldn't be reliable, would they?

A. That could be an

interpretation, yes. I had that concern when I reviewed the data. That is partly why I recall discussing it with Dr. Cherry.

The second thing I note is that there were more than one sample taken from the sample intervals. Page 31 records the data. Some installations sampled in '84, for instance, nine months after some of the earlier ones report the same sort of levels.

At one, WAT-7 number 5, I note does record a decrease.

Q. Now, supposing, Mr. Petrie, that regrettably in the installation of multi-level piezometers tritiated water got into the sampling intervals and suppose that some, or all, of the sampling intervals were very, very tight materials. Very tight materials would mean materials through which water flows very slowly.

Would you agree with me that it would take an enormous amount of bailing and developing of those wells to satisfy yourself that you had removed all the tritiated water and anything that might have been contaminated by the tritiated waters so that you could get a fair representative sample of the groundwater at that interval for tritium testing?

A. That is fair.

Q. Then, would you agree with me that since we have the clear evidence from Ms Hewetson that a hydraulic connection was made between the inside and the outside of her sampling apparatus that we have to put a very big question mark over the tritium data that is recorded in Exhibit E-214?

A. Again, I have that concern as I mentioned. I did discuss it with Dr. Cherry and he intimated to me that he felt that the tritium data was most useful.

Q. Well, I don't have Dr. Cherry here to cross-examine.

A. No, you do not.

Q. Mr. Petrie, will you accept from me that if I had him here to cross-examine I would ask him the same questions as I am asking you?

A. I think that is fair.

Q. I am going to ask questions and I want to have your evidence for this Board. Do you not agree with me, based upon the information that Ms Hewetson reported in her thesis as to the unfortunate occurrence of the contamination of her WAT wells during the installation of her piezometers,

that her tritium data has to be questioned very, very severely.

A. It has to be questioned, and indeed I did.

Q. Would you not also agree with me then that when we put a big question mark over each one of the tritium results and in each one of the WAT piezometers, because we are only talking about the WAT piezometers, she also took tritium data from Mr. Beatty's waterwells and Mr. Beatty didn't use the same kind of device, so we are not addressing the same concern to that data.

A. I understand.

Q. Would you agree with me that if we put a big question mark beside the tritium data in the WAT wells that the minimum we would have to do is we would have to look at each piece of data and we would have to correlate it with other data and ask ourselves how could this -- is the data that I am getting from WAT-5 consistent with the pattern I am seeing elsewhere, because if it is consistent with the pattern I am seeing elsewhere would you agree with me that that would suggest that the data was more rather than less reliable?

A. If it was consistent with the

pattern of other data you would derive some measure of comfort from it, yes.

Q. If it was totally inconsistent with the pattern of data from somewhere else, would you agree with me that you would derive some measure of discomfort from it?

A. Yes. With that in mind, we reviewed the hydraulic head data in the system and the hydraulic head data being the water level profiles developed by Ms Hewetson and provided. We reproduced them in our report and we have noted erratic profiles within the data head. To me, that erratic behaviour was consistent with the tritium data and I believe Ms Hewetson made some conclusions to the fact that she also felt the flow system was very complex.

That is my opinion, that the flow system at this site is complex and the tritium profile is consistent with a complex flow pattern.

Q. Well, that is fine, Mr. Petrie, but would you agree with me that it would also be an appropriate test procedure testing the reliability of this particular data inherent to the tritium data we would get in other wells?

A. Yes.

Q. Would you also agree with me that where we have chloride data and tritium data, it would be useful to correlate the two to see whether or not there is any relationship between the chloride data and the tritium data?

A. That would be a useful exercise.

Q. Would you agree with me that if we went about the exercise of correlating tritium data and chloride data and we discovered a fairly high level of confidence, a fairly high level or correlation between low tritium and high chloride that that would give us some confidence in both data, the chloride data and the tritium data?

A. It would give you some confidence. The inconsistencies might raise some cause for concern, they do in my mind.

Q. Would you also agree with me that if we have chloride data which confirms tritium data elsewhere in the area, that gives us one pattern of results and we have a totally erratic pattern of results in some four WAT piezometers and no chloride data to compare it to, that we would be better advised as hydrogeologists to put weight on the tritium data we had from the wells where we had

chloride data to cross-check it, than we would be to put weight on the WAT wells where we don't have chloride data to cross-check it and we know that something went wrong in the testing procedure at the beginning of the experience.

A. I would not dismiss the other data out of hand, no.

Q. Would you answer my question?

A. I thought that was your question.

Q. You would not dismiss the other data out of hand. What other data would you not dismiss out of hand?

A. You are referring to the correlation between tritium and chloride. Where the picture does not fit you are asking me to agree that the tritium data is not consistent. I am not agreeing with that.

Q. But you wouldn't dismiss the other out of hand?

A. I would not dismiss it. I believe that we are speaking at cross-purposes.

Q. What wouldn't you dismiss out of hand, I would like to know?

A. I thought that you were

implying that the tritium data and chloride data being inconsistent, I should believe the tritium data were erroneous. I was saying I would not dismiss the tritium data out of hand. Perhaps I misunderstood your question.

Q. Well, let me go back and see if I can reframe my question and I apologize. It was probably too complex. Let me break it down into pieces so we aren't talking at cross-purposes.

I was suggesting that on the one hand it may turn out that we have got tritium data that correlates fairly closely with chloride data. I am hypothesizing that if we had such data, tritium data, correlated with chloride data and that tritium data gave us a pattern and that pattern was not consistent with the tritium data we got from WAT wells and it turned out that the WAT wells were wells in which we had no chloride data to cross-check against the tritium data and we knew that something had gone wrong in the way in which the data were collected in the WAT wells that what you, as a hydrogeologist, a responsible hydrogeologist should do, is place very little weight on the tritium data from the WAT wells and put the weight on the tritium data from elsewhere because you know that data from elsewhere is more

reliable.

A. If you are basing an interpretation based on chloride and tritium data alone I might do that, yes.

Q. Don't for a minute, during this week and next, think that I am asking you to do an interpretation based on one piece of data, two pieces of data, five pieces of data, or even five kinds of data. We are not, I am going to suggest, interpret anything at Site F unless we interpret all the data and see how it hangs together. Do you agree that is an appropriate procedure?

A. The question spoke to tritium.

Q. It did and you will recall that this chloride data isn't presented in your report, is it?

A. It is also not presented in the report we were critiquing, H-40, there is not a detailed discussion of the chloride data available.

Q. Now, Mr. Petrie, I put a hypothesis to you that there may be some correlation between tritium data and chloride data.

A. You did.

Q. I want to focus everybody's attention on the tritium data and the chloride data.

As it happens we have correlated the two on Exhibit H-662, and we have also correlated them in another manner. I am going to give you a document, Mr. Petrie. What we have prepared, Mr. Petrie, is a scatter plot. Are you familiar with that kind of a procedure?

A. Yes, I am.

Q. Could we just go borehole by borehole, Mr. Petrie?

A. Yes.

Q. And look at how the data correlates. First in MB-1, we find hung up at the top of the system, chlorides of around 1,100 in MB-1, look at Exhibit H-662?

A. Yes, I see that.

Q. Maybe I will move closer then I won't have to work between two exhibits I can't read from back here.

A. At MB-1, we find in the upper piezometer, high tritium, 51?

A. Yes.

Q. And low chloride.

A. We find chlorides of 1,190, yes.

Q. And the high tritium suggests

water that is newer than 1952?

A. Correct.

Q. And the low chloride suggests that the flow zone there is at least more active than it is at the bottom of the borehole?

A. Correct.

Q. At the bottom of the borehole we find chlorides of between 47,000 and 50,000?

A. Correct.

Q. And tritium at one.

A. Correct.

Q. That suggests water older than 1952.

A. It does.

Q. It doesn't tell us how much older than 1952?

A. It does not.

Q. The chloride suggests it might be considerably older than 1952.

A. Yes.

Q. At MB-11, we find at the top of the hole, fairly recent water, tritium of 45?

A. Yes.

Q. And chlorides relative to this site relatively low at 731?

A. Yes.

Q. Then in the middle piezometer at that borehole we find tritium at one?

A. Yes.

Q. That would suggest water older than 1952?

A. Correct.

Q. At the bottom of the hole we find tritium of -- sorry, we find chlorides of 3,000. We have modest but not low chlorides at 3,000?

A. Yes.

Q. Again, very low tritium?

A. Yes, very low, three is a number that borders on the plus or minus with respect to 1952.

Q. In Ms Hewetson's thesis at page 31, the results that are reported by her are reported with a plus or minus two on them, suggesting that the testing procedure has a certain range of fallibility.

A. Yes.

Q. Plus two would make it five in that borehole?

A. Yes.

Q. Minus two would make it one?

A. Indeed, it would.

Q. We are so close, would you not agree it would be fair to say that what we have in borehole MB-11 at the bottom, is water that is likely older than 1952?

A. Possibly, yes.

Q. It is likely, is it not, with chlorides of 3,000?

A. You are asking me the data with respect to tritium and I said it was possible.

Q. I would like you to look at the tritium and the chloride together and ask yourself whether or not the two suggest to you that the water is older than 1952.

A. The chloride suggests old water. If we have some fracture connection to that depth, it could be a mixture of old and newer waters.

Q. Now, at MB-12, we find a level three and again on Ms Hewetson's -- if that is Ms Hewetson's data, and it is, that would be plus or minus two.

A. If it is for the '83 sampling, yes.

Q. So, that tritium result could be a one or a five?

A. It could.

Q. That would suggest it might be around 1952, or it might be older?

A. It might be around 1952 or it might be older.

Q. Here we have higher chlorides than we had at the bottom of MB-11?

A. Correct.

Q. So we seem to be seeing a fairly close correlation, when we see these chlorides we don't find high tritiums associated with them?

A. For the wells we have just questioned, yes.

Q. Then at the bottom of MB-12, we find an anomaly, would you not agree?

A. High tritium and high chlorides.

Q. Yes. That appears to be a piece of data that is a little difficult to explain.

A. I am not sure what your explanation for it would be. Mine would be that it could be some sort of fracture connection between which old and new waters have mixed in a complex flow system.

Q. That is one possible

interpretation of the data.

A. That is my ...

Q. Another possible interpretation is that the tritium result is inaccurate.

A. That's another one that is possible.

Q. It is unlikely the chloride one is wrong.

A. Yes.

Q. Tritium testing is a very tricky procedure.

A. It is an elaborate procedure.

Q. It is a difficult procedure.

A. I am looking at the reported accuracies. Are you referring just to the analytical procedures?

Q. No, I am referring to the whole business of going out to Site F, boring a hole, putting a piezometer down it, developing the interval screen, the interval you want to test, extracting the water, taking it to a laboratory and getting a result.

A. Comparing that to the chloride I would agree. It has the potential for more error

than chloride analysis.

Q. If you are going to hang your hat on one of the two, you would rather hang your hat on the chloride rather than the tritium assuming you want to hang your hat in the air.

A. The chloride data I might find easier to accept.

Q. Let us leave HC-5 and come back to it. When we go down HC-8-85, we find an interesting relationship right up in the overburden. We find untritiated water.

A. Right.

Q. And high chlorides.

A. Correct.

Q. Down a little further, we find even less tritium and even more chlorides

A. Correct.

Q. And when we go down the borehole we find even less tritium and even more chloride.

A. I am not sure which piezometer we are on.

Q. I am at the third one, it is 0.17 and 9850.

A. Correct.

Q. When we get to the bottom of that hole we have very high chlorides and very low readings of tritium.

A. With respect to the pattern you are trying to indicate, the tritium has gone up a bit.

Q. I am not trying to indicate a pattern, I am trying to see the pattern the data indicated.

A. I thought you were trying to indicate that the tritium values went down, 0.12 went to 0.17 and it was consistent with the chlorides going up.

Q. When we go down to a tritium of 0.18 and 0.17 and 0.21, would you agree that they might vary within a hundredth of a part per billion?

A. No, we are reading with tritium units. It is 1×10^{18} -- I don't have a word for that.

Q. Atomic physics or whatever area we are into now.

A. When you are dealing with tritium values of one or less, they are all of the same magnitude.

Q. With respect to MB-13, we find

fairly high levels of chloride above 5,000 at the second piezometer?

A. Presumably, this is the second one, but I am not sure which piezometer.

Q. MB-13.

A. Less than 5,000, are you reviewing this one?

Q. I am sorry.

A. The number there reads 3,000.

Q. The chlorides are 3,110, the tritium is zero.

A. Yes.

Q. And we get to the bottom there are chlorides of 12,000 and tritium of three.

A. Correct.

Q. We are back to Ms Hewetson's data, so that is plus or minus two.

A. If it is 1983, yes.

Q. As a hydrogeologist, just looking at the data from MB-13, if you have got zero tritium up above and 3,000 chlorides, would that suggest to you that the water where there is 12,000 chlorides at the bottom of the hole, is older than 1952 rather than younger than 1952?

A. I am sorry, are you indicating

that water flows from here to here?

Q. No, I am asking you to correlate four pieces of data two tritium readings and two chloride readings and one other piece of data, I guess. I am asking you to look at the relationship between those readings and the surface of the earth where the rain falls. I am asking you, as a hydrogeologist, what is your best opinion for this Board as to the youth or age of the water at the bottom piezometer in MB-13.

A. It is older than 1952. The value of three, recognizing there is a plus or minus associated with that. You cannot be certain if it is older or younger than 1952 based on the tritium numbers.

Q. Don't you think it is more likely it is older than younger, given the chloride levels?

A. Again, I will repeat to you what I said earlier. You are dealing with a complex fracture flow pattern. You could expect to have mixing of older and younger waters. I do not see that as an inconsistency.

Q. If we are dealing with a complex flow pattern, we can expect to see a mixing

of older and younger waters.

A. Yes.

Q. We could also be, would you not agree, dealing with a complex flow pattern in which we don't find that kind of mixing.

A. That is not impossible. I said it is not impossible. You could have a mixing of old and old waters.

Q. Let us look at MB-16. Given everything we have seen up-to-date, I suggest to you that MB-16 is what any scientist would call an anomaly because we find there high tritium readings all the way down the borehole.

A. We do.

Q. And we find extremely low chlorides at the top, modest chlorides at the middle and only levels of 3,180 at the bottom.

A. Relative to other portions of the site, we have tritium levels that correlate to chloride levels in the thousands. For example, in MB-1, you have tritium occurrences and you have a number of 1,190 for the chlorides. Those numbers are not dramatically different for the chlorides and we have tritium occurrences.

Q. And it suggests, does it not,

that we could place more reliance, we can place some confidence in thinking that the water at the bottom of MB-16 is younger than 1952.

A. We could.

Q. A lot more reliance than we could place on thinking the water at the bottom of MB-13 is younger than 1952.

A. We could, yes.

Q. Let us go to MB-17 and there we find reasonably low chlorides, 4,370 near the bottom and low tritium?

A. Yes.

Q. And higher chlorides and the same tritium further down?

A. We do.

Q. Suggesting a sluggish flow system and very old water.

A. Most probably.

Q. At MB-18, we also find a pattern that we have seen before. We find low chlorides in water that would appear to be younger than 1952?

A. Correct.

Q. Then, if I take you to the scatter diagram, which I handed out, can -- just

looking at the scatter diagram you can see that chlorides for all of these -- all that is plotted on this document, I didn't hear the number, Mr. Chairman.

MR. LANCASTER: H-664.

---EXHIBIT NO. H:-664: Scatter Diagram, Site F - Tritium vs. Chloride

MR. HODGSON: Q. The tritium data plotted on H-664 is only tritium data for which we also have chloride data. You will notice that on the Y axis, we have plotted the chloride data and on the X axis -- I am sorry, on the Y axis we have got chlorides and on the X axis there is tritium, then each dot represents a finding in a borehole that incorporates both a tritium level and a chloride level.

Do you see that?

A. As I understand this figure, yes.

Q. Do you agree with me, in just looking along the Y axis that where we find chlorides above about 2,500, we find, for the most part tritium units down around the 1952 range? With one exception.

A. By the 1952 range?

Q. Around two-and-a-half, isn't

it two point something?

A. Two point three is the number referenced in the Trow document, around, yes.

Q. Looking along the X axis where we find very high tritium, we find very low chlorides in every instance but one and that one is MB-12 at the bottom of Piezometer 3.

A. There is another indication of HC-5-1.

Q. That's not a high tritium, that's a low tritium. I am talking about the high tritium now. Where we find high tritium, we find low chlorides except at MB-12.

A. Yes.

Q. Going back to the Y axis and HC-5, we didn't discuss HC-5-85.

A. Correct.

Q. Let us talk about how that one correlates. HC-5-85, we find young water at the top and low chlorides?

A. Correct.

Q. Young water at the next piezometer and low chlorides?

A. Correct.

Q. Young water in the third

piezometer and low chlorides.

A. Correct.

Q. And at the bottom of the hole we find high chlorides, 11,600?

A. Correct.

Q. We find a relatively low tritium reading but it is a tritium reading above three or above 2.3.

A. Two point three is the number, yes, it is.

Q. Would you agree with me just looking at the data plotted on Exhibit H-664 that that reading at the bottom of HC-5 is anomalous?

A. That reading, the 6.4 was generated by Trow as part of Exhibit H-40. They undertook that sampling for the express purpose of determining the age of these waters.

When that result was provided, we had a concern and I believe we questioned Mr. Sobanski in cross-examination. He felt his tritium data were reasonable. I have critiqued the data that I have before me, being the tritium data and I note an inconsistent relationship respecting tritium and chlorides.

As I indicated earlier, it is not

inconceivable in my mind that that reflects some sort of mixing between older waters and younger waters. It suggests to me that the hydraulics of those sites are complex.

Q. Mr. Petrie, I too repose enormous confidence in Mr. Sobanski, but I suggest to you that you haven't accepted his interpretation of the hydrostratigraphy at Site F.

A. His ...?

Q. Just please, I would like a short answer and we can come back to it.

MR. McQUAID: He may not be able to answer shortly. The witness is entitled to answer the question as best he needs to.

I would ask you to indicate to Mr. Hodgson that this is not just what Mr. Hodgson wants to come out of it, it is what the witness is entitled, through courtesy and the rules, to explain his answer. That is the way he has to take it. He may not get the exact answer he wants. He can't cut him off, and he can't say "You just have to answer shortly".

MR. LANCASTER: As I understood it, you hadn't completed your question.

MR. HODGSON: I had completed my

question, Mr. Chairman, but I would like to repeat my question and I ask the Board, I ask the witness, to give me an answer and then a qualification and I am happy to have it in that order.

Q. The question, really the pith of the question was this, Mr. Petrie.

I said, I too repose a lot of confidence in Mr. Sobanski because you place confidence in his tritium results, but I ask you, you don't accept unquestionably, everything that Mr. Sobanski suggests at Site F, do you?

A. No, I do not.

Q. Thank you.

So that means you question the data he presents.

A. I critiqued the document, yes.

Q. So that means you have to question this data that he presents?

A. You mean this data of the tritium at HC-5?

Q. Yes.

A. I do.

Q. What we have on H-664 is 24 plotted up relationships between tritium levels and chloride levels in 24 piezometers in and around Site

F?

A. We have.

Q. Two of them are anomalous, I suggest to you. HC-5-1 and MB-12-3.

A. You have indicated the two do not fit the pattern you are suggesting.

Q. Yes. Let us start at the top and work down. Would you agree with me that it would not be appropriate to hang the whole theory about Site F on one piece of anomalous information?

A. If it were shown to be anomalous, yes.

Q. Do you believe -- do you agree with me that the result at HC-5-1 is anomalous?

A. As presented in the manner on H-664, it does give me cause for concern. However, Mr. Sobanski did provide the data. As I recall, there was quite some discussion on that point. The discussion focussed around if tritium was evident at that location, is it not consistent with the hydraulics of the site as he understood it. Again, I am recalling that he discussed it at some length in-chief and in cross-examination, that that value was consistent with the hydraulics of the site as he understood it. That value being 4.6 specifically,

but a number indicating younger than 1952 water. That was his information as he provided portions of it in his report and in cross-examination.

We were critiquing that information to see if we could agree or not as the case may be. The hydrostratigraphy or the hydraulics of the site as presented in Exhibit H-40.

Q. I want to come back to the whole subject of his hydrostratigraphy and your hydrostratigraphy, but now I would like to focus on H-664.

Would you agree with me that we have on H-664, plotted two pieces of anomalous data, and it would be appropriate with respect to both of them to put a question mark beside it?

A. It could be. I indicated to you that when you present it in this manner, it does give me cause to rethink.

Q. Would you agree with me that if you have gone through your database and you have either erased some data because you don't want to use it or you put a question mark beside some data that it would be useful then to examine the data that is left to see what kind of pattern you have got and relate it to the pattern that you have when you have

all the data.

A. Yes.

Q. Would you now look at Exhibit H-663 and you will notice that what is missing from H-663 is all the tritium data from all the WAT wells, the tritium data from the bottom of MB-12-3 and the tritium data from the bottom of HC-5-1.

A. It appears to be that way, yes.

Q. Looking at the data we have on Exhibit H-663, would you agree with me that what has been removed from H-663 is the data on which we can fairly -- the tritium data on which we can fairly put a question mark?

A. I am just trying to check back for myself.

Q. Please take your time.

A. We have eliminated the WAT wells, deleted the value from the bottom of MB-12, that I see. You have deleted the value from the bottom of HC-5-85 and I see again a WAT well. Yes, I see what you have done between the two exhibits.

Q. Now, would you agree with me that it is at least a useful -- let me go back and ask you -- would you agree with me that it is at

least a useful exercise having put a question mark on some of the tritium data in and around Site F to do what we have done on Exhibit H-663, which is to look at the tritium data that doesn't have a question mark beside it.

A. Yes, I do agree that is a useful exercise.

Q. When we look at the tritium data on Exhibit H-663, would you agree with me that with one outstanding exception, there appears to be a pattern of higher tritium at the top of the boreholes and lower tritium at the bottom?

A. There appears to be that pattern, yes.

Q. There is an outstanding exception and that is MB-16?

A. Yes.

Q. Do you recall what MB-16 did during a pumping test known as PW-1?

A. Not specifically. I would have to refer back to the text.

Q. I am sorry?

A. I would have to refer back to the text.

Q. Would you take it, because we

will come back to the pumping test, that in MB-16 in the bottom two piezometers, there was a response during the pumping test at PW-1?

A. I recall there being a degree of hydraulic connection, yes.

Q. We will come back and correlate that data, but that is an interesting correlation, do you not agree?

A. Yes.

Q. Low tritium in MB-16 and a response during a pumping test -- sorry, high tritium in MB-16 and response during a pumping test.

A. Yes.

Q. I am sorry, I erred in one of my questions. I said there was one outstanding anomalous piece of data and that was MB-16. I was incorrect. I suggested to you that on that figure, there are two outstanding anomalous pieces of information, both of which have to be explained.

One is MB-16 and the other one is what is going on at HC-8. Because at HC-8 there is low tritium from top to bottom.

A. Correct.

Q. And top is up in the overburden?

A. Correct. I recall Mr. Sobanski's evidence in that regard where he felt the upward gradients that he measured at that site may be an explanation for the absence of tritium.

Q. Now, I don't want to go back in detail to what you have proposed on page 156, that being your box of 30 metres deep of shale, but would you agree with me that if we plotted onto H-663, a segment of shale, 30 metres deep, that the data on H-663 alone would not support an interpretation that this area is receiving recharge at the rate of 100 millimetres per annum?

A. There were two numbers on the page 156, that if I could refer to it ...

Q. You are quite correct. It is the top number you want to refer to, Example A.

A. No, there are two depths indicated, 15 metres and 30 metres.

Q. I asked with respect to 30 metres. What does the 30-metre depth tell you? If we put 30 metres, how deep is 30 metres, can you just indicate for the Board in rough terms where 30 metres would fall?

A. In this sort of vicinity.

Q. Maybe we should have you draw

that. Here is a green pen. Here is a ruler, obviously, it is not a straight line, but we are interpreting from a fairly variable earth surface.

A. You would like the 30-metre depth?

A. I would like the 15 on too, because you have mentioned it. Maybe the 15 could go on in a different colour.

MR. HODGSON: Mr. Chairman, my colleagues note that it is time for a break, we started on time. Could we take a break and the witness could ...

MR. LANCASTER: It is time for a break and we didn't start on time.

MR. HODGSON: It would be acceptable for the witness to plot this on the cross-section during the break.

MR. LANCASTER: As long as he gets time for a break too.

MR. HODGSON: I would like to have that as well.

--- Recess

MR. LANCASTER: Please be seated.

MR. HODGSON: Q. Before we continue, Mr. Petrie, at the break I asked you to put on the

free-flow zone of 15 metres or 30 metres. Am I right that -- did you not intend your free-flow zone to be in the shale?

MR. PETRIE: A. I never called it a free-flow zone. You just asked me to indicate a line 15 metres and 30 metres in depth. I did that, below ground level.

Q. Would you agree with me that if we are going to talk about the zone of active groundwater flow necessary to carry away the water, that you are hypothesizing could be carried away on page 156 of B-617, that what we are talking about is 30 metres of shale and not 30 metres below ground level.

A. I am sorry, I should have clarified that before I put the line on.

Q. Perhaps after when we break at lunch time, I want you to interpret on this diagram your 15-metre zone and your 30-metre zone corresponding with what it is you are suggesting to this Board on page 156 in B-617; is that fair?

A. I would require the bedrock elevations to be put on the exhibit.

Q. I am advised that the overburden bedrock interface is on each piezometer

and to simplify it, since we are really talking about Site F, why don't you key it to the following piezometers, HC-4 ...

A. Can I make a note of that?

Q. Sure. Why don't you just put a tick on the figure.

A. I could do that.

Q. Would you agree with me that the piezometers are actually bored into the rock that may or may not some day carry garbage from Site F. HC-4-85, HC-3-85, I will skip HC-7, because it is away over on King Road, HC-6-85, HC-5-85, HC-8-85 and if we are going to carry the water away down-gradient, the down-gradient well that we do not agree is most reasonable, HC-14-85.

So, can we have the zone keyed to that?

A. Would you like me to do it now?

Q. No. Now, Mr. Petrie, when we finished up yesterday, we were talking about paradichlorobenzene. Could you put the figure for paradichlorobenzene up in front of the tritium data figure that you are now staring at, looking at, I am sorry, looking toward, it is the big, big cross-

section behind.

Now, would you agree with me, Mr. Petrie, that looking at Exhibit H-663, which is labelled the most reliable tritium data, and looking at Exhibit H-661, that H-663 helps us to understand the distribution of PDCB in H-661?

A. It does.

Q. Would you agree with me that during your evidence, you indicated to the Board that you thought that two contaminants could usefully be used to monitor the Bayview Landfill Site and those two contaminants were chlorobenzene and paradichlorobenzene?

A. Yes.

Q. It is written in the text.

I want to show you a figure for chlorobenzene. Perhaps we could put it up where the paradichlorobenzene is and we could put paradichlorobenzene -- would you mind, Mr. Chairman, if we put paradichlorobenzene on your bookcase behind your chair?

MR. LANCASTER: Not at all.

MR. HODGSON: Just so there can be a reference to it while we proceed.

Q. Now, Mr. Petrie, I just want

to make sure -- perhaps we should move the exhibits in front of this so that everyone can read the code at the bottom.

Now, Mr. Petrie, I would like you to accept this exhibit again, subject to check. It is an attempt to put the results of monitoring for chlorobenzene in and around the Bayview Landfill Site, on a cross-section, so that they can be seen as a pattern, if they have a pattern, and they can tell us a story if they have a story.

A. Yes.

MR. HODGSON: Could we mark this, Mr. Chairman, please?

MR. LANCASTER: H-665, I believe it is.

---EXHIBIT NO. H-665: Cross-section showing chlorobenzene.

MR. HODGSON: Q. Could we, Mr. Petrie, start with an obvious possible conclusion and then take the conclusion as a hypothesis and work with it to see how much reliance we can place on it?

Would you accept that MB-15 is a borehole in the waste at the Bayview Landfill Site?

MR. PETRIE: A. I don't believe it is in the waste.

Q. I thought we agreed yesterday

-- isn't that where you have it on your page 119?

A. I thought we agreed yesterday that the borehole record for that did not indicate waste. I would like to check -- my recollection ...

Q. Sorry, no I don't need it in that fine a detail. Let's go back to page 19. MB-15 is at the south end of the Bayview Landfill Site.

A. It is.

Q. And actually, Mr. Feenstra has pulled the borehole log for me and it reads from 1.5 metres to 9.1 metres refuse, wood, cloth, plastic with grey silt fill, odorous.

A. I am sorry, we looked at it yesterday, was it MB-1?

Q. We looked at MB-1 yesterday. I am sorry, I don't mean to confuse you and I know we have a lot of data to deal with.

A. I was confused.

Q. That is why the cross-sections are here to see if we can get data in a way that we can all look at it and think about it in a way that we won't be confused.

So, MB-15 is drilled through garbage at the south end of the Bayview Landfill Site and

MB-1, you told us yesterday, is drilled at the toe of the site not through any garbage?

A. Correct.

Q. If you were going to expect to find chlorobenzene at this site you would expect to find them at least in those boreholes?

A. It is not unreasonable to find it close to the landfill, yes.

Q. In fact, we find the highest level recorded on H-665 in MB-1 in the top piezometer?

A. We do.

Q. That is exactly where we found the highest level of paradichlorobenzene?

A. That is, as I recall.

Q. It is right up above the Chairman.

A. That is 1.5, yes.

Q. And the second highest level of paradichlorobenzene just looking up at Exhibit H-661, is found in MB-11 in the top piezometer?

A. Correct.

Q. Would you agree, looking at MB-11 in the top piezometer on H-665 that we find, not the second highest reading, but a high reading

for chlorobenzene?

A. Relative to some of the other numbers, it is high, yes.

Q. We find one other reading, two other readings higher, 4.6 in WAT-3 at the top and we find a 3.4 in WAT-6 at the bottom. They are comparable to the finding in MB-11 at the top.

A. Correct.

Q. Just accepting for the moment that this is a kind of snapshot, would you agree with me that the first conclusion one might draw from looking at the actual found examples of chlorobenzene above the background level, that what is identified at the Bayview Landfill Site, is a leachate plume?

A. One could conclude that, yes.

Q. There is a kind of teardrop shape to the findings, is there not?

A. Correct. Some of the numbers are very low as well.

Q. Now, do you agree with me, Mr. Petrie, that we should look at this database and examine it for reliability as we did with the tritium database?

A. That would be most useful, yes.

Q. Could we then start with MB-15? What we find in MB-15 is in the bottom piezometer where we have chlorides of 19,300, we have a level of paradichlorobenzene that is 1/100th above background and we have a level of chlorobenzene at 2.4.

A. Correct.

Q. Would you agree with me that based upon the chloride reading in that well we should at least put a question mark beside that 2.4?

A. I recognize the 2.4 data is reported and you are also referring to MB-15, a well that was drilled through the waste. It does support some concern for that number.

Q. Would you put a question mark beside that number 2.4?

Why don't you use a green pen so as we can point it out quickly? Now, in MB-12, we find a level of 0.58 in a low piezometer.

A. You are referring to chlorobenzene?

Q. Yes.

A. Yes.

Q. Excuse me for a moment.

Just cross-referencing page 5 of

Exhibit H-658, which was the volatile organic fingerprint for the Burlington Landfill Site.

A. If you could give me a second to locate it -- sorry, which page?

Q. Page 5. We have -- I think I asked you yesterday on page 5 ...

A. Yes, I have it.

Q. ... to write in that chlorobenzene had a log Koc of 2.5.

A. I wrote it in.

Q. So, it puts it sort of in the middle of the log Koc values on that page.

A. Correct.

Q. It puts it away ahead of chlorobenzene

A. Correct.

Q. What we would predict, just from the log Koc value is that dichlorobenzene is a less mobile contaminant than chlorobenzene.

A. Yes.

Q. Therefore, if we find dichlorobenzene and we know chlorobenzene is in the leachate, we would expect chlorobenzene to have gone further and be at higher concentrations?

A. You may expect that, yes.

Q. So the first piece of interesting information we have looking at H-665 is that that is supported by the data that is presented in H-665. It does seem to appear that chlorobenzene has gone further than paradichlorobenzene assuming that the readings are accurate.

A. It does appear that way.

Q. Looking at MB-12, however, we find that in the piezometer that we find a trace quantity of chlorobenzene, we also find a level of 8,420 parts per million of chloride.

A. If you can read that correctly. I have trouble finding it, yes.

Q. Just to be completely fair, this was the well in which we had a tritium reading which we found to be anomalous, is that not right?

A. I am not sure we had...

Q. The tritium readings are on the floor beside you. Perhaps you can get the full tritium readings out and leave them.

We had a tritium reading at the bottom of MB-12 of 46.

A. You interpret that as being anomalous as I recall, yes.

Q. I think you agreed with me it

was anomalous.

A. I agreed it was questionable.

Q. What is the difference between "questionable" and "anomalous"?

I don't need an answer to that. "Questionable" is satisfactory with me.

So, we have a high chloride reading that doesn't correlate -- I am sorry, we have a high tritium reading that doesn't correlate with a high chloride reading, resulting in an anomalous tritium result at the bottom of MB-12.

At the same time, we have got a very low finding for chlorobenzene at that same piezometer.

Would you agree with me that since the tritium doesn't correlate with the high chloride that the high reading for chlorobenzene doesn't correlate either?

A. No, I would not agree.

Q. All right, what is your evidence?

A. I have indicated before that if you are dealing with a fractured flow system in which you are not even sure where the fractures are or the relative water quality between the fractures

in the matrix, one could expect to see some degree of mixing of water in the well.

If we were just to focus specifically on three data points, it does not support the hypothesis you are suggesting, I agree.

Q. Which hypothesis am I suggesting?

A. You are indicating that the chloride levels provide -- your word was active flow or something to that effect, and high chloride levels do not. Therefore, if you have young water, and high chlorides, the young water, the age of the water from the tritium is in error. I think that was your hypothesis. It is not mine.

Q. I am really asking you, you know, let us go back to where we started this morning. We have got a continuum, in which we have more confident data at one end and less confident data at the other. Now, we are taking a dividing line in the middle between more confident and less confident.

At which end of the confidence continuum do you want to put the finding for chlorobenzene at the bottom of MB-12, given the level of the reading which is low and given the high

chlorides in that hole?

A. I would tend to put it towards the low end of the confidence scale.

Q. Looking at the results in the WAT wells for chlorobenzene, they are beside you, we see -- sorry, chlorobenzene on H-665. I know it is difficult, Mr. Petrie, and all I can tell you is that we are nearly finished. We have got 20 minutes to go.

Now, here would you not agree that we see a peculiar thing. We see variable readings in WAT-3 with the highest at the top, the second highest at the bottom and the lowest reading in the middle.

A. That is what we see at WAT-3.

Q. Since the leachate had to get to WAT-3, if it did get to WAT-3 from the Bayview Landfill Site, the Bayview Landfill Site is not only up-gradient, but at a higher elevation.

A. It is.

Q. The first thing one would at least sort of expect intuitively is that you would find higher readings at the top than the bottom.

A. Depending on your intuitive understanding of the flow system.

Q. What do you think you would

expect to find -- approach this data with no pre-conceptions at all, wouldn't you agree with me, you would expect to find higher readings nearer the landfill than further away from the landfill?

A. Yes.

Q. You would expect that nearer the landfill and further away from the landfill, a lot of things could happen to contaminants, couldn't it?

A. They could.

Q. They could be attenuated in any number of ways that you and I could go through?

A. Yes.

Q. So, do you not agree with me that that 3.4 at the bottom raises a question about the accuracy of the data from that test hole?

A. It leads one to think of that.

Q. It leads one to wonder, whether or not given the similarity of the three readings that there is still some leakage between those levels in that borehole doesn't it?

A. The boreholes, the WAT installations as I understand it, were plugged using a bentonite slurry. I do not recall that I know the date of that plugging or sealing relative to the date

of sampling.

The packers have been inflated, I am not sure if there is still cross-connection, if that is what you are referring to.

Q. Let us just look at the two other WAT wells. In WAT-4, WAT-4 is closer to the landfill than WAT-5.

A. It is.

Q. In the plan view on page 19 of your report and also as located on H-665.

A. Yes, I am in agreement with that.

Q. The levels in WAT-4 are lower than the levels in WAT-5?

A. They are.

Q. The levels in WAT-4 are all very similar to one another.

A. They are.

Q. And quite different to the levels in WAT-3?

A. Numerically there is a difference, yes.

Q. In WAT-5 again, all the levels are similar to one another, are they not?

A. Essentially, yes.

Q. And the levels at the bottom are, for all intents and purposes, the same as the levels at the top?

A. For all intents and purposes, yes.

Q. Suggesting one of two things, one of several things, perhaps.

One possibility is that when chlorobenzene moves through the surface of the earth it maintains the same strength until it gets to the bottom of WAT-5 no matter what and that there is no attenuation going on because would you agree with me, that whatever got to the bottom of WAT-5 took a lot longer route to get there than whatever got to the top of WAT-5?

A. Most probably.

Q. Now, what we have then, would you not agree of the three WAT wells, are in each well, looking at each well alone, similar readings, quite dissimilar readings between the wells.

A. Numerically, they are not dramatically different. They are all low numbers.

Q. Do you remember that the WAT wells were solvent welded couplings?

A. I do.

Q. Of unclean pipe.

A. That is as has been presented to this Board, yes.

Q. That many intervals leaked immediately following installation.

A. Correct.

Q. And that Burlington water was introduced into the centre core to swell the packers and that water leaked into the formation.

A. I am not sure it said in the text what sort of water it was.

Q. And the Morrison, Beatty wells are also solvent welded couplings?

A. Correct.

Q. Of unclean pipe.

A. That is my understanding.

Q. And the deeper ones were drilled with a mud rotary drilling method, what do you call it?

A. I don't recall the drilling method.

Q. A mud rotary method means that you are pumping mud down into the borehole as you drill and it slurries up the side of the borehole and it carries all the chips and stuff out with it?

A. Correct.

Q. That mud is something that the driller prepares especially for the job?

A. He purchases the dry mud and mixes it with water.

Q. It is not just mud, is it, it has got other things in it to lubricate the drill and make the whole process work nicely?

A. I am not sure that a lubricant is added to drilling mud, no.

Q. Do you know what is added to a drilling mud?

A. Water. The drilling mud is a sodium bentonite clay.

Q. Does the driller ever reuse his mud?

A. Not that I am aware of. You could have gallons of it around once he has mixed it up.

Q. At any rate, you would agree with me that the Morrison, Beatty wells weren't installed for the purpose of testing for trace organics?

A. They were installed, as I understand it, to investigate the hydrogeology of

contaminants down-gradient from the landfill. I am not sure at the time of the investigation, trace organics was the focus of the investigation.

Q. It was the focus of Ms Hewetson's investigation.

A. It was, indeed.

Q. Unfortunately, the materials were not as reliable as, for example, stainless steel.

A. That is the opinion at this stage, yes.

Q. It is possible also, is it not, that both chlorobenzene and paradichlorobenzene could be contaminants that come from the well installations themselves?

A. They could be.

Q. So, aren't we left then looking at H-665, Mr. Petrie, with one of two conclusions? One conclusion is that there is no problem at all monitoring a landfill site in and around Site F because H-665 demonstrates that you can monitor a well and when you monitor it, you get a beautiful leachate plume of chlorobenzene?

A. I didn't agree it was a beautiful leachate plume, Mr. Hodgson.

Q. You agree that is one possible interpretation of the data presented on H-665?

A. I indicated to you that the values were low and if I can refer back to a portion of my text, I think I concluded in our portion on organic data that the data was sporadic. You don't find a contaminant plume on the site.

Q. You don't accept these data, is that what you are telling me?

A. No, that is not what I am telling you.

Q. What are you telling me?

A. I am telling you the data are sporadic, the levels are very low and I do not believe you can define a contaminant plume at the site.

Q. At this site, meaning the Bayview site?

A. Oh, correct, yes. I also believe Mr. Sobanski was of that same opinion. I do not recall he expressed it per se in the text, but in order to provide him with a measure of what that data meant, Trow installed a stainless steel well at this site in which to provide for them a good measure of what the volatile organic compounds in the

groundwater down-gradient were. That installation was HC-9. In my review of that data, I beg your pardon, if I could back up a little bit.

I believe Trow concluded that the data demonstrated to them, that there was no plume at that point, HC-9 being down-gradient of Highway 403.

In my review of that installation I was not concerned with the methodology, or the equipment used to construct the well, but I noted that the well that they sampled, and I can't find the reference in the text, was one that I noted was completed at the base of the till.

My conclusions are still that the data is sporadic. There is a trace level and that the data from HC-9, that is the stainless steel installation down-gradient, cannot be used to confirm, or cannot be used to indicate the presence or absence of contaminants at the site.

Q. I am sorry, Mr. Petrie, but perhaps you could confirm, HC-15, it is HC-15, and not HC-9?

A. I beg your pardon?

Q. That was constructed with stainless steel?

A. HC-15, yes. HC-9 was a PVC

installation.

Q. Could you also confirm, to make it more complicated for everyone, that there are four piezometers at HC-15 and only the three shallowest piezometers are stainless steel? The deepest piezometer is, in fact, a PVC piezometer?

A. No, I don't recall that, but I can take it as indicated.

Q. Thank you. So, you don't then think that H-665 gives us a picture of a leachate plume?

A. I have indicated that I said it could not be used to define a contaminant plume. It gave an indication to me of sporadic trace level contamination. I recognize that chlorobenzene has some occurrences within the leachate as monitored. It also has some very low levels within the leachate as monitored.

Q. Can I just -- you keep using the word "sporadic." Do you mean by "sporadic" "variable"?

A. And I also used the words "trace levels" at very low levels. We are dealing with concentrations that are one microgram per litre. I do not like to be definitive and say that describes

a contaminant plume unless obviously, I have some higher contaminants within that mass that I feel more confident is the bulk of the plume.

One microgram per litre level would then be describing the leading edge. I do not believe I concluded anywhere in our exhibit that we have defined a contaminant plume. I did believe that compound could be usefully monitored on which one may draw conclusions regarding the presence of contaminants.

Q. Thank you. I think I have asked you whether or not one possible interpretation of H-665 is that it defines a contaminant plume and I don't think I have got a direct answer to my question but I do think that you have told me that you don't think that what we see here does confine a contaminant plume. Have I got that right?

A. That is correct. To answer your question, it can give a useful indication of the presence of contamination.

Q. If one conclusion is it could define a contaminant plume, but the answer is it doesn't then the alternative is that what we have got in H-665 confirms that contaminants aren't getting to depth south of the Bayview Landfill Site.

A. At the locations monitored, correct.

Q. And that then confirms, does it not, something that you and I were discussing at the end of yesterday, which is that it would appear that the contaminants that go out the bottom of Bayview, assuming that some do, don't go to depth. If they go somewhere they must go laterally and emerge on surface in a vicinity south of the Bayview Landfill Site.

A. You make two statements there. In reviewing the data provided by Trow with respect to the hydraulics of the site, we concluded that one, their hydraulic characterization, I could not agree with their hydraulic characterization.

I took the data that they provided and concluded that the dominant flow direction closer to the surface was probably lateral. You indicated that therefore implied discharge to the surface.

Q. You don't agree that it implies discharge to the surface?

A. There may be discharge to the surface, but I thought ...

Q. No, I asked the question if we don't think that the contaminants at depth in H-665

are landfill-derived, then don't we come to this conclusion, looking at H-655 and H-661, that contaminants that leak out the bottom of the Bayview Landfill Site move to a shallow depth beneath that landfill site and then they appear to move, they must move horizontally and emerge on the surface of the earth not very far south of the Bayview Landfill Site?

A. Horizontally I agree with, emerging on the surface of the earth, I am not so sure.

Q. If they are not emerging on the surface of the earth, perhaps you could tell the Board what they do.

A. They could move laterally.

Q. You mean laterally west and east?

A. With respect to the alignment of your cross-section, they can continue to move further down in that direction.

Q. On H-665, could you show us which way you mean.

Down on the cross-section, you are saying they continue to move towards 403?

A. Yes, they could.

Q. But in order for them to move towards 403, they would have to have a flow path, would they not?

A. Correct.

Q. Now, Mr. Petrie, yesterday we were talking about an exhibit -- sorry, we were talking about H-656; and if I could take you back to H-656, it is this possible distance of leachate migration for various exfiltration rates.

A. If I could just get my copy of that. Yes, I have it.

Q. You will recall that we discussed the methodology by which we derived this and what we were looking for was a determination, taking the hypothesis that there is 100 millimetres of recharge, how much rock matrix, how much leachate would be available to fill what quantity of rock matrix for what distance?

A. Correct.

Q. Now, it would be also possible, would it not, to work backwards in this way: Looking at H-665, and accepting as a hypothesis because I understand you don't accept it, that H-665 defines a leachate plume, the rough dimensions of that leachate plume would be approximately 300 metres

down-gradient of the landfill site.

A. Using your numbers from this cross-section and your definition of a leachate plume, yes.

Q. And about 35 metres deep?

A. There was an occurrence at 400 metres. I am just noting on the scale here. And 35 metres deep seems consistent with the numbers you have provided, yes.

Q. So that we could work out, could we not, if we took the volume of rock 300 metres long by 35 metres deep, we could work out using various porosities, the volume of leachate that would be needed to fill that volume of rock?

A. You could.

Q. Working backward from the volume of leachate necessary to fill that rock and the volume of leachate necessary to fill the rock under the Bayview Landfill Site as well, since its presumption is it goes down then laterally, would you agree with me that working backwards we could determine an infiltration rate necessary to create at least this kind of hypothetical, and I understand it is a hypothetical leachate plume.

A. You mean exfiltration rate,

yes.

Q. Now, happily that calculation has been done for us. It is called "Back Calculation of Exfiltration Rate from Bayview Landfill Based on Assumption that Chlorobenzene is Landfill-Derived."

Not to spend too much time, Mr. Petrie, working frontwards with a porosity of 0.1, the volume of the leachate plume, the volume of water necessary to fill that matrix of rocks would be 29,705 cubic metres.

A. Two, nine, seven, zero, five metres, cubed. You are looking at a plume length of 300 metres and I noted on that figure it was 400.

Q. Since it is a hypothetical plume, could we have a hypothetical plume length of 300 metres?

A. Three hundred metres.

Q. It becomes a hypothetical calculation in a number of respects. So just working backwards, first of all, if we use various porosities we have got various amounts of quantities of rock matrix to stuff with water.

A. In which water can flow, yes.

Q. And then, using the same

porosities and working backwards, we can calculate the amount of recharge necessary to fill that rock matrix.

A. You can.

Q. Would you agree with me that there is not much point in looking at a porosity of 0.1, is there, because we don't believe that this is plug flow in this area? You don't believe it is plug flow.

A. I believe there is a lot of fracture flow. I am not dismissing plug flow.

Q. Would you agree with me then that just on the hypothesis that H-665 defines a leachate plume, that with a porosity as high as 0.01 you would only need 18 millimetres of recharge out the bottom of the Bayview Landfill Site to fill that whole matrix of rock with pure raw leachate at full strength?

A. Given the numbers you have indicated, that seemingly is correct, yes.

Q. Would you agree with me that on H-665, the one thing we don't find in the block of rock that we are looking at is pure, raw leachate at full strength?

A. I have indicated that the

leachate is of quite variable concentration. There are some high numbers. I have noted 299 being the leachate in MB-14. For chlorobenzene, you also have concentrations of less than 0.2. I don't know what you mean by "full strength."

Q. The thing about this calculation is that we can focus not just on trace organics, but everything in the leachate would have to get there as well.

A. That is correct. You were referring to Exhibit H-665.

Q. I know I am referring to H-665 and also H-661 because we have those before us.

The reality of this calculation is that when we correlate this calculation with your calculation on page 156 of Exhibit 617, what it tells us is that the data that we have do not suggest a recharge to the system higher than at least 18 millimetres per annum.

A. Based exclusively on the data before me, that is reasonable.

Q. If it should turn out that the porosity is too high and the porosity is 0.001, 1.8 millimetres of recharge to the system would be enough to fill every space of rock in this area with pure,

raw leachate.

A. Given the numbers you have quoted, yes.

Q. If we went to a porosity of 0.00002, we would only need less than one millimetre of recharge to the system.

A. Correct.

Q. You would agree with me that this gives us some ability to correlate data from the plume delineation studies that have been undertaken in connection with the Bayview Landfill Site and your recharge calculations on page 156?

A. I am sorry, your question was it gives you some measure...?

Q. Some ability to correlate the results of your recharge calculations on page 156 with the results of the plume delineation studies that have been undertaken in connection with the Bayview Landfill Site.

A. They do.

Q. Would you agree with me that on the whole the data appears not to support your conclusions about recharge?

A. Yes, I would.

MR. HODGSON: How did I do?

DR. KINGHAM: You are two minutes early.

MR. HODGSON: Mr. Chairman, on Monday at 9:30, we are going to roll up our sleeves and get dirty in the data. As I said in the beginning, we are going to start looking at rock.

DR. KINGHAM: Does that mean you want us to wear jeans and rubber boots?

MR. HODGSON: It seems right. I am not going to ask the Board to lug any of these boxes around, at least until the hearing is over.

DR. KINGHAM: There is something we would like to request of this witness. I am not sure how to do it.

In the course of this cross-examination and in the course of your main evidence in fact, we have had -- and in other cross-examinations, we have had numbers for exfiltration ranging from millimetres per unit area to boxcars per year. That is very difficult for us to compare with a variety of numbers. I think with Mr. Hodgson, you have been using millions of gallons per year from time to time, and sometimes you have used cubic metres per annum. I think Mr. Sobanski used cubic metres as well.

The short of it is that we have got a lot of different units. I think it might be helpful if you could summarize for us, at your convenience, on a chart, your evidence about leachate exfiltration and pick a unit.

I would suggest perhaps gallons per day might be one that everyone would feel comfortable with where you would have, for example, Site F, your calculation of leachate exfiltration in gallons per day for a six-metre mound ranging to what it was, 1.9 with an upward gradient which you gave in the course of your examination.

Similarly, you have numbers as well, I believe, for Site D, your assumption of exfiltration. I recall that we had numbers from Mr. Sobanski and here I don't know how to deal with this quite. Would it be a difficult thing for you to put as well, your understanding of exfiltration from the Halton evidence and the Milton evidence, or is that not a straightforward thing to do, in the same units and with the same range of numbers? That is from things working to things not working. Is that too difficult a task?

MR. PETRIE: I am running it through in my mind.

At least for Site F with the Trow data, they provided flow rates but there were no dimensions over which those areas, the areas for which those flow rates were calculated. So, in order to take my millimetres per annum, I need an area. I cannot do it with some of the Trow data.

DR. KINGHAM: Can you assume the same area that everyone has assumed in terms of the dimensions of the sites, sort of 1,000 metres by 500 metres?

MR. PETRIE: I was referring to Trow's water balance that they have done for Site F.

DR. KINGHAM: What brought this particularly to my attention, Mr. Petrie, is that I recall in cross-examination at one point there was some reference to the Trow data about exfiltration without a landfill in terms of, again, I think it was millimetres per annum.

In that case, it would have been infiltration and then there was exfiltration with a landfill that went to something like 22.5. I just thought it might be useful for us in considering the two sites, the range of what is really something like six values of exfiltrations of leachate with systems working and systems not working as depending on the

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evidence. I don't quite know how to get that before us for our use.

MR. HODGSON: I actually think with respect to Site F that we are not all that -- it is not all that difficult. I believe I am right that the infiltration that Dr. Rowe gave of one millimetre and the range that Mr. Sobanski gave of two-point-something to twenty-two-point-something, and this witness's range of infiltration as going all the way up to 100. Those are all related back to the area of the landfill.

I think they are all comparing the same thing. I don't think there is any discontinuity there. It may be that it would be appropriate for you to pick the kind of units that you find the easiest to relate to and we can relate everything back to them, but I think in the end, they are all related back to millimetres per annum and that relates to the area of the landfill.

DR. KINGHAM: I thought they were as well and we, of course, the Board could have done the calculation, but there would be no way of testing it was done correctly. While this witness is here and while he is under these first rounds of cross-examination at least any numbers proposed as being

the proper multiplication of millimetres per annum into say, gallons per day, would at least be something that other counsel, yourself included, could question and be satisfied with the accuracy.

MR. HODGSON: Perhaps we could have a chart that has got a range in millimetres and then a conversion factor for cubic metres and then to satisfy our missing friend, boxcars, truckloads, I can't remember what they were.

DR. KINGHAM: That probably would be useful.

MR. PETRIE: Tank trucks.

DR. KINGHAM: It became obvious in the course of the evidence that one man's tank truck is different from a woman's boxcar. We would just like to know, be able to compare like numbers at the end of the day.

MR. HODGSON: Mr. Feenstra indicated he thought it would be easy to do and in fact he has got his computer here.

Perhaps -- would it be reasonable if we prepared the document and we will put it to the witness and get it into evidence that way. We will also give it to the witness well in advance of putting it to him so that -- we will obviously accept

his input. I think probably given the position he is operating in at the moment, he would like some other activity to engage in this weekend, rather than prepare this exhibit.

DR. KINGHAM: I think you have solved my problem.

MR. LANCASTER: The back exhibit is H-666.

---EXHIBIT NO. H-666: Chart

--- Adjournment at 12:19 p.m.

CERTIFIED CORRECT:

P.D. McQueen

(Page 28150 Follows)