RED HILL VALLEY PARKWAY INQUIRY

TRANSCRIPT OF PROCEEDINGS
HEARD BEFORE THE HONOURABLE J. WILTON-SIEGEL
held via Arbitration Place Virtual
on Friday, February 24, 2023 at 9:30 a.m.

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LIST OF EXHIBITS

Arbitration Place Virtual

--- Upon resuming on Friday, February 24, 2023 at 9:30 a.m.

MR. LEWIS: Good morning, Commissioner, Counsel, Mr. Hein. Today we have David Hein testifying in relation to a report he filed with the evidence to be led by counsel for the City, Mr. Chen, followed by cross-examination. Mr. Hein is the last witness. And if the court reporter could affirm Mr. Hein's evidence we can get started.

AFFIRMED: DAVID HEIN;

EXAMINATION BY MR. CHEN:

MR. CHEN: May I proceed?

JUSTICE WILTON-SIEGEL: Yes, please, Mr. Chen.

BY MR. CHEN:

Q. Before we get started, Mr. Hein, would you please confirm that you understand that as an expert witness you are to provide evidence that is fair, objective, and nonpartisan?

A. Confirmed, I affirm.

Q. Just speak up just a little bit.

A. Certainly. Confirmed.
Q. Thank you. And, Mr. Registrar, could we now please call up Mr. Hein's report which is M64775.
Mr. Hein, do you see that on the screen?
A. Yes, I do.
Q. You prepared this report for the inquiry?
A. That's correct.
Q. And the report contains your opinions?
A. That's correct.
Q. Mr. Commissioner, one housekeeping matter. I understand that there was a data entry error in one of the bar graphs in Mr. Hein's report. That is at image 9, if you could just bring that up.
That's the one, Mr. Hein?
A. That's correct.
Q. Figure 5, southbound lane 2. And so last night we circulated a document which is at HAM64785. So you'll see the original figure 5 at the top of that document and then the updated -- the slight variation in the

updated bar graph at the bottom.

Is that right, Mr. Hein?

A. That's correct.

JUSTICE WILTON-SIEGEL: And what's the difference?

THE WITNESS: The graph on the bottom has slightly higher or lower numbers. There's a transposition error in calculating the averages.

JUSTICE WILTON-SIEGEL: I see. Okay.

MR. CHEN: So Mr. Hein's report is Exhibit 222. I would ask that this document either be made the next exhibit, or my other suggestion would be to make it 222A, if that's possible.

MR. LEWIS: If it's possible it would probably be practical to make it 222A. I don't know if it is.

JUSTICE WILTON-SIEGEL: Possibility is I think more technical than legal. I have no objection. Can you do that, Mr. Registrar?

THE REGISTRAR: Exhibit 222A, noted.

EXHIBIT NO. 222A: Report of David Hein dated February 1, 2023.

BY MR. CHEN:

Q. Mr. Hein, let's start by going through your qualifications first. And his CV in the report starts at image 21 which, Mr. Commissioner, is A-1 appendix A page 1 if you're going by the report.

JUSTICE WILTON-SIEGEL: Thank you.

BY MR. CHEN:

Q. All right. Mr. Hein, does this CV accurately state your qualifications?

A. Yes, it does.

Q. So I just want to take you through some of it. It's obviously very long with all your experiences and I just want to highlight a couple of them. Let's start with your education. You obtained a bachelor of science from the University of Waterloo in 1984?

A. That's correct.

Q. You have a professional engineer designation in Ontario?

A. Correct.

Q. And now, I just want the turn the heading on this page, areas of expertise. I understand you have 38 years of design, evaluation, and management of transportation infrastructure experience?

A. Correct.

Q. And just what's in those three areas, design, evaluation and management? Where does friction management or friction measurement come into play?

A. It comes into play in all of them, all the areas.

Q. How so?

A. In terms of design aspects, it's designing road infrastructure to ensure that it's -- it has the proper smoothness, has the proper frictional properties, the aggregates that are associated with it. In the evaluation process, it's roads that are existing where we go and we evaluate the current condition that they are in and what we need to do to restore it to a higher level of service, in other words, taking something that's 60 out of 100 and making it closer to 100. And then this management aspect is we look at the entire network. So this is all

of the roads in a particular municipality or province or state, and we monitor their condition over a number of years to help make decisions and budgets for future restoration projects.

Q. Thanks, Mr. Hein. I'm just going to ask you to slow down just a tad as we go on.

A. Understood.

Q. And now turning to your employment history, you've worked at a few places. TRO, John Emery Geotechnical Engineering Limited, and ARA?

A. That's correct.

Q. Just to summarize, is it correct that they all engineering consulting firms?

A. That's correct.

Q. And you specialize in pavement engineering?

A. That's correct.

Q. So let's just talk about TRO first. You were a pavement engineer from 1984 to 1985?

A. That's correct. I started out as a student working in two work terms

with the firm, who then hired me into this pavement specialty group when I graduated.

Q. And what does a pavement engineer do?

A. A pavement engineer does everything with respect to design, evaluation, and management of roads, runways, anything that you drive on basically.

Q. It was a relatively short period at TRO, but what type of work did you do there?

A. Being a new person, I typically did field-related work, monitoring construction quality, laboratory testing of materials, and basically evaluation type projects.

Q. And then your next experience was at John Emery or we've heard it being called as JEGEL, from 1986 to February 2000. Can you talk about that experience?

A. When we were at TRO three of us, John Emery, who is principal of JEGEL, left the company and a couple of us followed with him. So I was one of the initial founding partners of JEGEL, and the work we focused on was pavement engineering. It was a fairly specialty activity

that wasn't done by a lot of people at the time, and so we worked in all kinds of forensic projects with municipalities, with MTO, with other agencies across Canada and some overseas as well.

Q. With respect to municipalities, did you have any mandates related to rehabilitation?

A. Much of the work that we did was rehabilitation. Examples were projects related to city of Toronto where we brought in new technology, which at the time was new, microsurfacing, to Canada. And I was involved in writing specifications and monitoring the quality of the construction work that was being done.

Q. So when you say you brought it to Canada, did you actually use it?

A. Yes, yes, it was -- it came from the United States. It was the first time that it had been used, and we used it actually to rehabilitate or to fix a new hot in-place recycling project that was done poorly and so we needed to place a new surface on it. And so we were following -- John was a very innovative guy and liked to do new things and so we identified microsurfacing as a potential

solution to this problem.

Q. Where was the microsurfacing done?

A. It was done on Morningside Drive in the City of Toronto.

Q. You had mentioned doing innovative things. What about SMA?

A. SMA was -- my first encounter with SMA was as a part of a Canadian Japanese conference that took place every four years. And we were invited to Japan, and the Japanese showed us several new technologies they had, including hot in-place recycling, and we were introduced to stone mastic asphalt, which we then brought back to Canada. We were present there with one of the owners of a large construction company who saw the value of this, and we did the first test section of SMA in North America in Miller Avenue in Markham.

Q. Sorry, which avenue?

A. Miller Avenue. It's where Miller Paving is located, now Colas.

Q. I understand you worked with Ludomir Uzarowski at JEGEL?

A. Yes. Ludomir completed

his master's degree in the UK, in Nottingham, and found that we had the only Nottingham testing machine in Canada and literally walked in the door into my office looking for a job and we hired him.

Q. Thank you for that. Following JEGEL for about 20 years you worked at ARA, Applied Research Associates, correct?

A. That's correct.

Q. And at ARA you were a principle pavement engineer and also the VP of transportation in the infrastructure division?

A. That's correct. I was hired by gentleman that was working for ARA at the time named Dr. Jim Hall. Jim was the gentleman who did the first national cooperative highway research project on friction and the principal author of the friction guide that was eventually produced by AASHTO.

Q. And as a VP of transportation you led a team?

A. Yes. I lead a team of approximately 90 engineers and technicians in eight or nine offices in both Canada and the United States doing similar work. We were a specialty pavement engineering firm.

Q. Were you involved in friction measurement and pavement work in both Canada and the US then?

A. Yes, my group was the one that was responsible for the locked wheel testing equipment, collecting friction data.

Q. We'll come to your specific experience. Generally who are you typically hired by and for what in that experience?

A. Typically governmental organizations. So these would be federal government, Transport Canada, Federal Highway Administration. My group did -- I had the research group as a part of my purview as well, and so we did a lot of work for the US Federal government. We then worked for many of the U.S. states and Canadian provinces, and then municipalities across Canada, across United States. Also several projects overseas as well.

Q. Can you talk about your pavement preservation experience at ARA?

A. Pavement preservation is a name, almost a religion of keeping good roads good. And so this started in Michigan. It was a

national centre for pavement preservation. I was very actively involved with these groups in developing tools and guidelines for using them, and the national guide for municipal pavement infrastructure in Canada, I was the author of several of the research project including timely preventative maintenance and other thin surface restoration techniques. And so I had a very large focus on pavement preservation activities for a number of years.

Q. Would that involve questions like should you mill and overlay or should you do something anything else, that type of consideration?

A. Exactly the case. We developed many more techniques than we used to have. We used to just put a new layer of asphalt on top of the old one, but when we developed things like the milling machines and thinner, less expensive, higher quality interventions so that we could make roads last longer and by doing that, saved money.

Q. Can you bring up image 22. Just before this there's a heading called "Professional Affiliations," but here you

were involved with TAC, the Transportation Association of Canada?

A. Yes correct.

Q. What's TAC?

A. So TAC is a volunteer organization in Canada that brings together transportation professionals. Canada is one of the only countries in the world that doesn't have a national body, governmental body that's responsible for transportation. Transport Canada used to own all the airports in the country. In March of 2000 they were all divested to the private sector or to nonprofit groups.

So TAC is the only group that we have in Canada where provincial agencies, counterparts in municipalities, engineering professions like myself, get together to help advance the transportation knowledge in Canada. We write guides, we do training in aspects ranging from the environment to pavement engineering to materials to geometric design, a whole variety to -- workforce development, for example, as well. So it's our de facto national transportation group.

Q. And just the first bullet

there, it says past chair, pavement Standing Committee '86 to present. Can you tell us about that committee?

A. The pavement Standing Committee is one of the largest committees in TAC. We have more than 120 I think people who sit on that committee. I've been involved in it since I got out of school back in 1984. During the late 1990s I believe it was I was voted to be a member of the executive of that committee, so I would have been the secretary first, then the vice chair, then the chair, and then the past chair. So it was a four-year voluntary activity.

And I was responsible for the setting up of meetings, for chairing those meetings and helping develop research topics and things that we would like to do as a group. The TAC pavement design and asset management guide came from this committee as well. So we would -- as part of the executive I would steer it through the process of getting published.

Q. You recently received a distinguished service award?

A. Yes. Very surprised and very pleased. But very few people get that award

and it means a lot because you spend a lot of time doing volunteer work over the years and then you're recognized for it, so it's a nice thing to know.

Q. Congratulations.

A. Thank you.

Q. So we're already on the page, perfect. Pavement engineering, there's a heading there. Does that section include your pavement friction work?

A. Yes, it would.

Q. And so can we also bring up the next image, 23 as well. I just want to ask you about a couple of these. On A3, just the page to your right, the first and second bullet, so it talks about the 407.

A. Yes.

Q. Could you describe that experience.

A. The 407 highway, my involvement in it has gone back to the early 1990s. I was the pavement designer of record that selected the pavement types and materials. I followed after construction being retained by 407 ETR to help them with their pavement

management activities, condition rating systems, et cetera. Part of their requirement was that they have a -- in their concession ground lease agreement had a requirement for friction testing, and so we -- my company, since we owned the company, were also hired to do that testing and reporting to both the ETR and MTO.

And then eventually also advancing it further. When the national guide came out in 2009 EFI 407 wanted to develop a friction management plan, so I'm the author of that plan. And with guidance from Jim Hall, who I mentioned hired me earlier, developed that friction management plan with a group of people, with ETR and us as consultants. And then continued that further in doing collision analyses on an annual basis.

Friction testing was done every two years and collision analysis was done using the friction data from the previous years to the most recent data to evaluate potential areas where we would look to potentially improve the roadway in terms of friction.

Q. I'm just going to ask that you try to slow down just a little bit more.

Thank you.

Then a couple of bullets below your 407 experience there are a number of pavement surface friction testing mandates for I see the Huntsville and Owen Sound district, Region of Durham, Region of York, Highway 407 east phase 1, Windsor Essex, Highway 407 east phase 2.

Can you talk about if there are similar areas between that work in terms of the equipment that you used and so on.

A. In the earlier days when I was at JEGEL the testing was typically done using a British pendulum. You've heard about this already, but it's a small device developed in the UK that's used like a pendulum. Or fulcrum to measure friction so Durham region, for example, being older would have been with a British pendulum.

There was some other work using a device called a flow meter, a different method of measuring friction. And the majority of these, including Region of York and the public private partnership projects, the 407 east, Windsor Essex parkway, for example, all of those were done with the locked wheel trailer, ASTM

brake force trailer.

Q. Did you try the grip tester for any of those --

A. Yes. So our experience with 407 ETR, we were bringing the friction tester into Canada on an every two-year basis to do testing projects. It requires crossing the border, paperwork and things like that, and so while we are required to test using that device specifically on 407 and all of the other ones you see here, we wanted to have something that was more of a continuous basis, something that was less expensive than a brake force trailer.

And so we had a supplier Canada of the grip tester, and so we purchased one for ETR and we used it in between to go and test in years we didn't have the brake force trailer present. And we did an evaluation program to see how well that device would correlate with the locked wheel tester. Unfortunately that wasn't certainly the best, but at least it gave us some more detailed numbers that we could look relatively if the friction was staying the same or was changing with time.

Q. We'll likely get into

this later, but you said that -- I think you said the correlation between the grip tester and the locked wheel did not go well?

A. Yes.

Q. And maybe in just one or two sentences what do you mean by that?

A. We tested it at various speeds, we tested at various conditions, and we found that the one-to-one correlation between the equipment was not very suitable. It was very low. It was a correlation coefficient if I recall .3, .4, something like that.

Q. So outside of the 407 experience, do you have other experience with the grip test?

A. My other experience -- direct experience was in -- my company sold equipment and technology and training to the Dominican Republic, and so what that included, as well as pavement strength testing equipment, was a grip tester, which is what they wanted. And so I go back a ways with Tradewind Scientific and Len and I went down and taught the Dominicans how the use the equipment.

Q. Len as in Len Taylor,

right?

A. Len Taylor, that's correct, from Tradewind.

Q. You seem to know everyone who has testified on friction matters.

A. It's a small group.

Q. So turning to the forensics and litigation heading which is at image 30. And I'm going to take you again to your 407 experience. It's further down on the page where it says detailed evaluation, legal action including arbitration experience, for significant early age asphalt concrete cracking. So I'm not interested in the legal action part but more about the cracking and rehabilitation that was done there.

A. In 2007 fall into the spring of 2008 we started noticing some very strange looking cracking on the east section of 407 ETR's asphalt. Cracking appeared -- it just was almost a random pattern. And so we were very concerned that this was going to affect the performance of our pavement and so we did a field evaluation, took cores, did extensive laboratory testing, and were not able to figure out exactly

what the problem was; it basically passed all of our tests.

Our concern was that we were going to -- we didn't want the cracks propagating from the surface into the lower layers, damaging those lower layers, and so the highway was going to be widened within a year or two and so we used microsurfacing on top of that cracking to determine if we were going to get an extension of life. We built a 500-metre test section. What we found from that cracking was that it immediately within one winter cracked through the surface of the microsurfacing. So it stuck to the pavement, but ultimately it was not really the solution for our we call it top down cracking.

Q. And now moving further down to image 35, which is page 15, and just for context, this is in the airport pavement design evaluation and management section of your CV. And just kind of in the middle of the page there's a reference to the Canadian Forces and the use of the skidabrader. Can you tell us about that experience.

A. The skidabrader is a device built by company called Humble Equipment

Louisiana. It is a unique device developed to remove rubber from surfaces of roadways or surfaces of pavements -- airport pavements. And so when aircraft land on a runway the wheels are spinning and they leave some rubber from it on the pavement surface, and the national -- we heard of this equipment and suggested to the national defence folks that this might be the be suitable for use in rubber removal contracts. And so we brought it into Canada from the U.S. It was not and still not available any place outside the U.S. So we brought it into TRO's steel shop at the pavement surface and to remove that rubber material.

I also had the opportunity to use it for surface texturization, I will say, on Guelph line in the region of Halton where there was a tight curve and there was some accidents occurring where vehicles were going into this house actually. And so we tried to use -- we thought the skidabrader might be suitable for use so we tried it. It was the summer. Didn't work too well because the steel shot got stuck in the asphalt. So we waited until colder temperatures and we treated the surface using the skidabrader.

Very little experience had been had with using it on roadways at this point in time, and it made it coarser but it also damaged the asphalt surface so we didn't it was particularly suitable for that kind of a treatment.

Q. And so you talked about the skidabrader. What experience do you have with shot blasting?

A. Shot blasting is -- skidabrader, you might call it shot blasting but it really sent because it's using steel balls. Shot blasting is usually using sand or other gritty aggregates like silicon carbide, and so you are blowing it out. The skidabrader used a circular device the steel balls to surface, so they are a little bit different than each other.

Q. The question was what experience do you have with --

A. We did shot blasting for the rubber removal on Pearson airport, on the concrete and asphalt pavements there as well. There's also soda blasting. There's other things you can throw at the pavement surface and none of them were very effective.

One other I might add is

BlasTrac. It's a device that's used to abrade the surface of the pavement. And so sometimes it's used to improve macrotexture and I've used that on 407 ETR as well.

Q. Right, yeah, the BlasTrac has come up in the course of the inquiry.

A. Okay.

Q. And not surprising, you have a section on technical courses, workshops, webinars and training, so you've clearly spent significant time teaching. Does that include teaching with respect to pavement friction and pavement preservation, that type of stuff?

A. Absolutely. So all of the evaluation courses, all of the design courses I have a module in pavement surface friction testing and evaluation of data.

MR. CHEN: Mr. Commissioner, that is all I intended to ask with respect to his CV, and I'll now just go through the questions that Mr. Hein was asked to comment but of course focusing on the main points of his report.

Can we go to image 4, Mr. Registrar.

BY MR. CHEN:

Q. So first question you looked at was commenting on the applicability of the MTO's FN30 at 90 kilometres per hour with a ribbed tire to the threshold to the RHVP. And so you've set out Dr. Flintsch, and we know that Dr. Flintsch doesn't offer an opinion with respect to MTO's use of that, the FN30, although he notes it as being some -- having some frictional value. And so you have been asked to comment about that. So can you elaborate on your opinion?

A. It's my opinion that the MTO's FN30 is an investigatory level that numbers above this are considered to be acceptable, but as you get to approaching 30 it is an investigatory level where you may want to start looking at other elements like collisions, for example, to determine if the pavement surface friction has any contribution to potential accidents.

Q. In this section you've listed a couple of reasons for your conclusion as to why it's an acceptable friction value to use. So paragraph 9 first you talk about your career and what you've seen in terms of the use of FN30 as an investigatory level. Can you elaborate on that?

A. Pretty much all the testing that we've ever done in the province of Ontario has used FN30 as being an investigatory level. MTO is a little bit unique in that they use that same number regardless of the speed that is being used. So the majority, and you've heard this before, is that the majority of users follow the ASTM E274 standard where the testing is conducted at 65 kilometres per hour, 40 miles per hour. And MTO is one that does the testing at any particular speed, whatever the posted speed is, that's their process. It's safer for the testing equipment, but it's also more conservative also than what you would do at the 65 kilometres per hour speed.

Q. You also make reference to other highways, and one of the things you say is that it's important to compare Ontario highways with similar characteristics. What do you mean by that?

A. Ultimately a lot people used investigatory numbers around 30, and so in order to be able to compare apples and apples you have to recognize that MTO does it at the posted speed in all cases. So adjustments would have to

be made either to MTO's numbers or other agency numbers to ensure that we've got them comparing properly to each other.

Q. And when you say other agencies, if we can also bring up image 5. There's table 1 which shows different levels of friction for various transportation agencies in the U.S. What's the purpose of this table?

A. This table is to give examples of what other agencies use. I've just changed it to be metric, so we used 65 kilometres instead of 40 miles per hour. You can see that different states do different things. Some of them use the same numbers for different levels of road, being interstates or primary or secondary roads. You can see some of them are using the same numbers for all of them, for example, Washington state, and that all of the numbers are kind of around the 30 range, so between the mid 20s and low 30s.

Q. And if the RHVP and -- was -- or what kind of road, if we were to look at the different columns here, would the RHVP fall into?

A. In Canada particularly we

do not use the same designations for road classes. It's different in Quebec or Ontario and others. I did some research on that in the past. In this particular case I would consider the RHVP to be similar to 400 series highway that we have in Ontario which would be considered an interstate highway in the U.S.

Q. So if you were to compare the FN30 we would be looking at the figures or the numbers in the interstate column?

A. That's correct.

Q. You also do a speed adjustment, you know, you just talked about the 65 kilometres per hour as being the usual standard. But of course the MTO does it at the posted speed and so you undertake a conversion?

A. That's correct. A conversion is necessary to bring the values that we have in say FN90 in Ontario to be down to equivalent to 65. That's 25 points difference between the two.

And MTO has history of using approximately two FN points for each 10 kilometre difference in speed. By applying that to the 25K difference in speed between those numbers you

would end up with a 5 FN point difference. So to convert the values you see in that table using that 5 point conversion you would end up with FN values ranging somewhere between 23 and 36 out of that table.

Q. And I think you identify them in paragraph 12 of your report, ranges from FN23 to 36 and that the MTO's FN30 criteria is roughly in the middle of that interstate range?

A. Correct.

Q. So now moving ahead to question 2, which starts at image 6. Here you are addressing Dr. Flintsch's characterization of the friction testing results on the Red Hill. And in his report, he's used the words relatively low and I understand in your report you disagree with that. Why do you disagree?

A. I disagree because the values in Ontario are 30 or above would be considered to be completely acceptable. So I wouldn't consider them to be relatively low because they would be acceptable and action is not needed to be taken at this time related to friction.

Q. As part of your review I

take it you looked at the available friction results on the Red Hill from 2007 to 2019?

A. That is correct.

Q. And that of course included the Tradewind friction results?

A. That is correct.

Q. Just for context, do you know why Tradewind was asked to undertake friction measurements?

A. Not -- I wouldn't -- no, not really. I understand from reading testimony of others that Golder asked MTO initially to -- if they could do the testing. They indicated that they were too busy. They weren't -- they try to help out when they can, but they were too busy at the time, and they suggested that Golder contact me because MTO knows that we do the 407 ETR and other testing using the locked wheel trailer. And I didn't hear from -- I never was asked by Golder or anyone else to provide the locked wheel trailer. So maybe because we are competitors potentially, but I know Ludomir quite well so I'm surprised he wouldn't have asked me.

Q. So in any event, if you had conducted the testing what testing equipment

would you have used?

A. I would not have used the grip tester for sure. I would have used the locked wheel tester. It's only device that we have only device that we have reference for, all the MTO testing that's been done in the past.

Q. So when you say reference for, what do you mean?

A. Reference in terms of a absolute value at which point in time an investigation may be warranted. So they have the history in Ontario. They were the only agency doing that type of testing for the longest time.

Q. So moving on to the friction results obtained by Tradewind, I would like to -- Mr. Registrar, to pull up GOL1113, images 17 and 18. GOL1113, images 17 and 18.

Obviously very small figures on your screen now. These are the Red Hill grip tester friction numbers. Do you see these figures?

A. Yes, I do.

Q. So if you had these results in late 2013 what steps, if any, would you take as a consultant?

A. Well, first of all I said I wouldn't have used the grip tester, but the data is of some value still. Looking at at least relatively comparing numbers, if you look at number 3 column there where you've got some 50s, low 50s, and then it moves down to the kind of 30s area, I would be looking at relative comparison between areas that may be higher or lower, so to speak. I wouldn't have the ability to use these numbers to make a decision with respect to an investigatory level but I can look for trends.

Q. So you're not looking at what any particular number would mean with reference to a scale, you're just looking to see if you have variation between 20 and 40 and 30 and that type of --

A. That's correct, that's correct. I would probably -- I might take this data and go look in the field and see what might be -- might be a reason for the numbers getting higher or lower, might have been selective resurfacing of the asphalt with the newer material or it might be older patch. There might be dips or bumps in different places that may affect the equipment as well. You know, I could still use it

to go at least look for relative differences and potential causes.

Q. And so when you say relative differences, are you -- is what you're saying that you're looking for significant deviations or --

A. I'm looking for, yeah, oddities, you know, some localized areas that may be lower than others. This one I would suspect that maybe the 10,000 at the beginning stations in the 50s there was a different asphalt material, and without going into the field and looking at it and seeing -- trying to identify where they started exactly and if it matches up with different asphalt I kind of have an answer for why it's different.

Q. Right. You'll recall that when Tradewind did the testing it was -- went from the LINC to the --

A. Yes.

Q. -- the Red Hill?

A. Yes.

Q. And so you may have answered this question, but just looking at this data, do you see significant deviations in your

review?

A. I see at the beginning higher numbers.

Q. There are some --

A. There are some that go down to the 20s there near the end of them. I would be looking for those trends. I see it going up near the end as well.

Q. So just to -- asking the question again, do you see significant deviations or not?

A. Oh yeah, like I said, I see those at the beginning and also near the end. I see different highs and lows. Again there's a couple of spots I think I see there where they are in their 20s.

Q. And --

A. I wouldn't call it a significant deviation; just it's a trend.

Q. And is that a trend that concerns you?

A. Not without going out and looking at the road. I mean, I would be looking to see if it's an anomaly with testing or if it's different textured surface pavement or they did a

patch that I mentioned. When I see -- individual values really don't mean much here. I mean, we've got a lot of testing data, every 100 metres, so individual data -- individual sections don't really concern me.

Q. You had talked about I think the variations in this data. Can the operation of the grip tester itself play a role in that?

A. We found -- yes, actually. We found in our work with ETR that the rougher the road surface was the more variation we got in grip tester numbers and grip numbers. And we attributed that to the weight of the vehicle, because the grip tester is a small device. I can pick it up and put it the back of a truck. The locked wheel brake force trailer you can't do that because the trailer has water aboard the system as well. And so the device moving around and bouncing around would cause variations in the grip numbers that we saw. I mean, that could be the situation as well. I would be looking for again a bump or a dip or something that was in the road, a settlement that might be contributing to the funny numbers that I see.

Q. So you reviewed the 2013 CIMA report?

A. Correct.

Q. And that was a safety review of a segment on the Red Hill from I think Dartnall to Greenhill, and CIMA finds that there is a high proportion of wet weather collisions between Mud and some portions south of Greenhill. Now, taking that with the data that you see here, the grip tester results, does that information, you know, the wet weather collisions, change your view of the Tradewind results?

A. I tried to look at the starting location of where these -- the grip numbers are based on the report, and the couple of areas where I see smaller numbers in the 20s were outside of the limits of that CIMA report, so I wouldn't directly link wet weather accidents to friction based on this data anyway.

Q. And so one of the things that Dr. Flintsch has kind of brought up in his evidence is the possibility of doing further friction testing. In what circumstance would you consider doing that?

A. If I was going to make a

definitive decision based on FN30 I wouldn't be using these grip numbers because, as mentioned, the correlation between the devices is not very useful. And so to decide to bring in friction testing equipment from the U.S. can also be expensive. Nothing really here is bothering me too much so I might -- you certainly could do this but I wouldn't say it's necessarily warranted.

Q. And then just moving forward, you know that the MTO conducted friction testing the following year in 2014. And so if we could pull -- bring up Dr. Flintsch's report which is EXP191, image 7. This is in your report as well but that's fine.

Mr. Hein, you looked at the 2014 MTO results?

A. Hm-hmm. Correct.

Q. And what was your view of those numbers?

A. Those numbers are above 30, and I see that there's been a trend going from -- this is a classic SMA trend where the 2000, the early numbers are a little bit low, we wear off some of the asphalt based on the surface in the first year under traffic and the

numbers go up. And they start to come down with traffic and it's levelling out just above the 30 mark there, so it's acceptable based on the 2014 number certainly.

Q. And since you talked about the trend and the levelling out I'll just ask you now. Dr. Flintsch has kind of described it as a significant decline or drop, I can't recall the exact wording. Do you agree with that?

A. It's typical, this is very typical of what we see in Ontario using those types of aggregates. It's the all drop, they will all drop depending on the surface was there, the amount of traffic, the weight of the traffic, so how many heavy trucks are on the roadway. It won't go up unless there's some action has been taken. It doesn't miraculously get better. This follows a pattern I would have expected of just about any asphalt in the province of Ontario.

Q. Does this pattern say anything to you about safety?

A. No, it's -- the friction on the roadway, you could have low friction and still have a perfectly functional roadway and a safe roadway. So this pattern is typical. The

available friction is coming down slightly but it doesn't mean that necessarily the road is unsafe.

Q. And I just want to clarify a statement you just made. You said you can have low friction and the roads still be safe. Are you suggesting that what you're seeing here is low friction or are you just making the comment that --

A. No, I'm just making a comment on the pattern. It's above 30. It's above the investigation limit for MTO.

Q. So that's 2014. And moving forward we know about the 2015 CIMA report which you reviewed?

A. Correct.

Q. I'm not going to ask you about the specifics, but you are aware that CIMA found that wet surface collisions made up about 50 percent of the collisions on the Red Hill Valley Parkway?

A. Yes.

Q. And in your view is 50 percent high for wet weather collisions on a roadway?

A. I would expect them to be

somewhere between 20 and 40 percent normally. You do have more wet weather results; that's why we test when the road is wet. 50 is -- I would consider that to be higher than I would expect, but again -- yeah, it's a little bit on the higher side I would say, yes.

Q. Let me just clarify one thing. You said that's why we test when the road is wet. You're not suggesting that you test when the road is wet. You're talking about the statistics, right?

A. We -- the brake force trailer testing, we put water on the road intentionally and test it while it's wet. That's what it is. Not during rain storms.

Q. Thank you. So CIMA in 2015 concludes that a combination of I think high speed and wet surface may be the primary contributory factors to collisions on the Red Hill Valley Parkway. Do you recall reading that?

A. Yes, I do.

Q. And on this topic Dr. Flintsch testified that we can look at friction as a supply and demand, if you can supply more friction you can lower the demand. Do you

agree with that?

A. Yes, I do.

Q. And does that apply, those concepts apply here?

A. Yes, yes, certainly. We can reduce the demand by reducing the speed.

Q. So ultimately what CIMA recommends is targeted police enforcement of areas with known high collision frequency and I think oversize speed limit signs. So you may have just answered the question, but in your view would that reduce friction demand and maybe --

A. Of course it would. If we're reducing the speed, it's not physically doing something to change the pavement surface but it's reducing the need to have higher friction under those because the speed limits are going down.

Q. In your experience how long would it take to validate if there is a reduction in friction demand?

A. You've heard from others as well talking about the variability of collisions and traffic information and how it goes up and down over the years. I would expect you

would need at least a couple years, three years, to look to see if there's a trend and that your collisions are going to down because you've reduced friction demand.

Q. So Dr. Flintsch has said you can try a number of things. You can also increase friction supply and that he would do a number of things. What do you say to that?

A. There are many things that you can do to reduce the demand. Again the signage, the reducing the speed limit, et cetera, usually those activities are much less expensive than providing more friction. Providing more friction you're going to either remove and replace a surface, put other types of surfaces on top of them, and they can be significantly more expensive and not necessary if you can develop it in another manner like signage or speed enforcement.

Q. Would in your view increasing friction necessarily decrease or reduce collisions?

A. No, it wouldn't necessarily reduce them no, correct.

Q. Why is that?

A. There may be no influence

of the collisions interacting with the friction. That's why you're doing a collision analysis to help identify locations where potentially it was friction that contributed to the accident, and in my experience the majority of accidents are not -- don't have anything to do with friction.

Q. Moving forward in the timeline in your report. Bring that back up. It's HAM64775 and we can go to image 8 on the one hand, and if we can also bring up the document HAM64785 which contains the updated southbound lane 2. So you set out the ARA 2019 friction values for the locked wheel in various figures, and I've left out one of the figures but I think this will suffice for the purposes of the questions.

Why do you feature the 2019 results in your report?

A. These are because these are the most recent and most comprehensive sets of data of friction for RHVP.

Q. And so when you're looking at these figures what are you looking for?

A. I'm looking for -- so they have been divided into 500-metre sections,

I'm looking for outliers of those 500-metre sections and for values that are less than 30.

Q. So just focusing on the -- well, first of all outliers, do you see any outliers?

A. In the northbound lane 2 I see one location that has a slightly lower than 30, and --

Q. So northbound lane 2 that's figure 3, correct?

A. Yes, correct, figure 3.

Q. And you're pointing out the 29.2 at the 2 kilometre mark?

A. That is correct.

Q. And what is your view on that?

A. It's slightly lower than the one surrounding it. I would consider it to be an outlier because the rest of them are all showing you 30s and above. Also it's within the testing limits of the equipment because the brake force trailer as you know takes a reading as the operator randomly pushes a button as he's pulling across the pavement surface. So if I went out and I did the same testing in the same location I

might get a value that's higher, I might get some values that are lower elsewhere, but it's not substantially different than the surrounding value so this wouldn't be of significant concern to me.

Q. When you say it's not significant concern, we talked about the FN30. Are you suggesting that it's not an absolute limit that you have to go out?

A. Absolutely. If it was 20 then maybe I'm going to be concerned. Because it's 29.2, and if you look at the ones below in figure 4, they are all above 30 and quite a bit above 30. And from the trends from previous testing you can see that they were levelling out, and so there's nothing here -- I'm not expecting that there is a significant friction problem because the numbers are again above the investigatory limits set by MTO.

Q. Just so I'm clear about your evidence, you just said you're not -- it's not showing a significant friction problem. Are you seeing a friction problem?

A. I am not seeing a friction problem at all at present.

Q. Just looking at figure 5,

which is on the right side where you have an updated chart, so we're looking at the updated figure 5 in HAM64785. There of course we see now a number of values that are just below 30. Can you comment on those?

A. I have a similar comment. Again these are very close to the 30 value. I said 30 is not cast in stone, 29.9 means it's bad. So they are -- the very close to each other. In this particular figure because they are within about 500 metres or 4 kilometres of each other I potentially might go and have a look again at the road surface to see if there's anything that's obvious that may be contributing to those slightly lower numbers.

Q. And when you say go out to look at them can you remind me what the factors -- what are you looking for?

A. Visual inspection, to go and look and ensure that there's been nothing done to the road --

Q. What do you mean by that?

A. In terms of a patch repair, let's say, or there might have been some issue with materials during construction that

would warrant replacement of the material. And because this is SMA, stone mastic asphalt, it's not something that everybody makes every day, and so if you're fixing something you might use different aggregate material. Maintenance and operations folks may not know the difference between them, and so I'm looking for some reason why this might be lower. I'm also looking for wear of the surface, I'm looking for cracking, other surface defects, potential for things like ravelling. Ravelling is where the individual aggregate particles may not be well glued together and you may lose a few of them here and there. So just looking for things that are not like the others around it.

Q. Dr. Flintsch has commented -- you know, in your report I think you described that below 20 values as minor inconsequential, but Dr. Flintsch says that a lower value may actually suggest that you have a localized friction problem, and of course, in figure 5 we see the two consecutive 29 values although they are very close to 30. What do you say to that?

A. Again we're simply

looking for trends in the data, and the previous testing showed that the numbers were all levelling off, so there may be some that are a little bit higher or lower than the others but overall I don't necessarily have this telling or pointing to me that this is a localized problem.

Q. And these are of course average values, right?

A. These are -- correct, these are average values, that's correct.

Q. So if we go to Dr. Flintsch's report, which is at EXP191, image 8. This is figure 3 Dr. Flintsch's report, ARA friction measurements from May of 2019, so that's before resurfacing in the southbound direction. You looked at this at this figure, Mr. Hein?

A. Yes, I have.

Q. And so the bar graph that we were looking at in your report were average values. What does this show?

A. This is showing you individually the friction numbers in each of the two wheel paths in each lane.

Q. Okay. And you can see

the red line there is dirty, and around the King Street/Queenston interchange area there's a number of -- that are below the red line. Does that cause you any concern?

A. Not particularly, because obviously you have two wheel paths, and vehicle have wheels on both sides and so if you hit the brakes you're going to be engaging both wheel paths. Typically you will have little bit more wear in the outside wheel path. That's the -- in the truck lane, the heavier truck lane, because trucks are -- the road has a crossfall to it so it means it's higher in the middle than it is on the edge slightly which means there's more weight on the outside of the vehicle which may be causing some more wear in that particular location, but again when you hit the brakes to stop you engage both wheels on the vehicle so that's why the average are provided.

Q. Sorry -- when you say both wheels are provided, can you maybe talk about that in reference to the friction results. Like what line should we be looking at?

A. So southbound lane 1 right wheel path southbound lane 1 left wheel

path. So we've got blue -- it's kind of hard to tell the difference between them, but the left wheel path is going to be slightly -- is going to be higher than the right wheel path and when you average the two they are going to be above 30 pretty much here.

Q. I see. Okay.

A. And normally we do -- we don't always do all wheel paths. We have the ability to do that. It costs a little bit more money to do. But when you have all the data it tells you full picture here.

Q. All right. Of course just to add to the story, we know that there are a number of curves, King Street area and Queenston. Does that change your view at all on how you view these friction results?

A. Not in terms of the friction results, no.

Q. What about in terms of safety?

A. Others have testified with respect to the other features. You have to look at everything wholistically to see if there's any contribution of a particular factor in terms

of collisions or frequency of collisions.

JUSTICE WILTON-SIEGEL: If I can summarize what you're saying, friction could be a potential contributing factor -- can't be a cause unless it were much lower, but could be a potential contributory factor in those areas but you can't tell just on the basis of this raw data. You would have to do a collision analysis to determine what the contributing factors to the accidents in particular localized areas would be.

THE WITNESS: Yes, I would agree. And typically we don't get that level of granularity from the basic collision reports.

JUSTICE WILTON-SIEGEL: Right. That may be a different issue.

THE WITNESS: That's correct.

BY MR. CHEN:

Q. While we're talking about that, just going back to your discussion about the supply and demand of friction. And I asked you whether increasing friction would necessarily decrease collisions and I think you stated that it may not because there may be no influence on the of the collisions interacting with friction, and you note that in your experience the majority of

accidents that you've looked at don't have anything to do with friction.

So Dr. Flintsch gave evidence that though deficient friction is seldom the main cause of a crash, there are some situations where low friction can cause crashes in the presence of other contributing factors. Do you agree with that?

A. Yes, I agree, correct.

Q. So putting that together, there is agreement that you and Dr. Flintsch think that friction is seldom the cause of the crash which I think you agreed with, right?

A. Correct.

Q. And that increasing friction in those circumstances wouldn't necessarily decrease collisions?

A. That's correct.

Q. However, as Dr. Flintsch states, there are some situations where low friction can cause crashes in the presence of other contributing circumstances. So in those situations, dealing with or combatting the contributing factors with countermeasures could reduce the demand for friction and --

A. Just repeat the last part of the sentence. I didn't quite hear it.

Q. So combatting the contributing factors to countermeasures could also reduce the demand for friction and reduce collisions?

A. That's correct.

Q. When we were talking about it before I think we just talked about speeding reducing the demand for friction, but not then going a step further and talking about the effect of -- on collisions?

A. Yes, and the countermeasures like reducing speed, et cetera, are going to be substantially -- have a substantially higher impact on it than incrementally increasing the friction on the pavement surface. So the impact of reducing speed will far outweigh the incremental increasing of friction of the pavement by 5 points or 10 points or something like that, for example.

Q. And so when you're speaking about increasing the friction by only 5 or 10 points, what are you referring to?

A. This could be doing some

suffering on the pavement. If you're going to do something -- there's no evidence here that shows there is a whole problem along the entire length of the highway, and so going and doing a mill and overlay, for example, of the whole highway because of friction does not -- doesn't make financial sense. You're going to get better bang for your buck by reducing speed or other factors, driver awareness, for example.

Q. So in responding to Mr. Commissioner's question I think -- maybe it was an earlier question of mine, you talked about what you think is a local friction value, and what was that value?

A. Low to me being the 20s, low 20s.

Q. And that's -- in your work in your career have you seen friction values like that?

A. Oh yeah, absolutely. I've seen them in other locations, yes.

Q. And did that result in any kind of investigations that resulted in friction being the main issue of -- you know, a safety review and friction being found to be the

main cause?

A. And example would be an evaluation I was involved in highway 115 for example. There were three sections of concrete, three different sections of asphalt, and friction numbers were low and so there was concern that they would be potentially contributing to accidents. And reviewing the accident reports and all the other factors that were involved, friction had nothing to do with the accidents -- virtually nothing to do with any of the accidents. It was driver fatigue, single vehicles driving off the roadway after long shift at General Motors. And so very seldom in my experience has friction become the primary cause of accidents.

Q. If we can go back to your report at image 9. While this is coming up, you say the friction in your experience is very seldom the primary cause.

In paragraph 23 there you talk about the complexities of accidents and the number of factors that can play a role. Do you see that?

A. Yes, I do.

Q. If you can just elaborate on that?

A. The report here, I know that traffic accidents are very complicated events. They have a lot of human factors associated with them. The condition of the road surface, the weight of the vehicle, the braking system, the air on the tires, the wear on the tires, the type of tires that are there, ultimately visibility and geometry and all these other things can potentially lead to a collision.

Q. I just want to quickly touch on the next topic which is a image 10 of your report, driver expectation. Just to paraphrase, my understanding is that Dr. Flintsch in his opinion is that the variation in the friction levels from the LINC and the QEW coming into the Red Hill, he of course describes the Red Hill friction values as relatively low and that difference is even more problematic because it creates -- there's a driver expectancy there that's violated with respect to friction. What's your view on that?

A. Well, I disagree with Dr. Flintsch in that situation. As I've just discussed, I don't agree that the friction values are relatively low. If you look at the

differences in friction levels, drivers have no expectation, they have no understanding what the differences are. And they encounter this on a frequent level, they encounter this all over the place because pavements of different ages, of different classifications of roadway, some that have different aggregate surfaces in them, they encounter different friction availability constantly on the roads where they are travelling anywhere they are travelling.

So it's not like you see snow or ice on the roadway and you know there's going to be a -- potentially you're going to skid. It's inherent with all of the surfaces that we drive on, be it chip sealed roadways in the countryside or concrete pavements on ETR or QEW, it happens all the time. And I don't think there would be any driver expectation that there would be something miraculously different as they moved from the LINC to the Red Hill Valley Parkway.

MR. CHEN: Mr. Commissioner, I was going to move to the next question but it's also 10:50. Would you like me to use up the ten minutes or shall we take --

JUSTICE WILTON-SIEGEL: How

long are you going to be on the next question?

MR. CHEN: It's probably going to be more than ten minutes; maybe 20 or so.

JUSTICE WILTON-SIEGEL: All right, then let's take a 15-minute break. We'll return at 5 past 11:00.

--- Recess taken at 10:50 a.m.

--- Upon resuming at 11:06 a.m.

MR. CHEN: May I proceed, Mr. Commissioner?

JUSTICE WILTON-SIEGEL: Yes, please do.

BY MR. CHEN:

Q. Mr. Registrar, could we please bring up images 12 and 13. While that is happening, the next question that you would -- I want to make sure right section -- that you address is necessity of remedial measures and timing specifically with respect to whether the Red Hill should be microsurfaced in 2014 and the question of shot blasting in 2019.

So in this inquiry we've heard evidence that recommendations were made to the City in 2014 to microsurface a large portion of the Red Hill Valley Parkway and we've also heard

evidence of a recommendation of shot blasting in 2018 or 2019. So I want to just first address the microsurfacing question. At paragraphs 30 and 31 of your report you talk about your understanding of how the microsurfacing suggestion arose in 2014. Could you describe that.

A. So my understanding of the request from Golder is just that they were retained to complete the pavement evaluation on the highway. The evaluation is something that is very commonly completed, and so this would entail surface condition survey, looking at the types of cracks, how severe they were, how much of extent they were, how many there were basically on the roadway. It also included some coring of the asphalt material, so removal of core samples, and testing surface friction.

In terms of the friction testing, Golder retained Tradewind to do the friction testing using the grip tester. As I mentioned previously, I think this is somewhat unusual in that Tradewind's primary business area was airports, and while we don't use the brake force trailer on airports, they certainly use the grip tester. So there's very little experience in

using the grip tester on roads in Canada certainly.

The results from that were put in an appendix with the report. Golder recommended resurfacing, milling, so removing the existing asphalt surface and replacing it for about 2 and a half kilometres of the roadway, intending to address the areas that have more significant surface cracking. And so again only a partial -- removal that one layer and replacing it with a new layer. And then that the remainder of the pavement could be done using microsurfacing which would have -- a comment was that it was -- would deal with the relatively low friction values if I recall the wording directly.

Q. And so just on the microsurfacing, in your view was microsurfacing necessary in 2014 to address friction?

A. I do not believe it would have been necessary to address friction because again friction values were reasonably good. It seemed to be more of a -- you know, you can do microsurfacing to address the cracking, and that its secondary importance was it would address what they called relatively low friction values.

Q. Right. And Dr. Flintsch, when he described microsurfacing he said if done properly. What do you think about --

A. I am not really sure the context of what -- why he said done properly. If anything done properly, obviously if you don't do it it won't work. Microsurfacing can be a difficult material to use in some cases because you need proper compatibility between the emulsion, the glue that's holding it together, and the aggregate matters that you have. And so there have been some issues in the past with it not working well. The Region of Durham has done a lot of microsurfacing over the years and found that it was necessary to clean and coat the existing surface with emulsion to help glue it down. But we certainly have been doing it for a long time so I think obviously it needs to be done properly, needs to have the right aggregate selection and things like that.

Q. Right. I think the spirit of the comment was that there could be challenges and -- which is what your -- you may be describing; is that fair?

A. Yeah, and also it

requires time to cure, so to speak. So it's using what's called an emulsion which is a mixture of asphalt, cement and water. When the water evaporates the asphalt cement comes back to hold the glue together, so that takes some time. Example, when I first did that on Morningside Drive in Toronto, we had cones set down the side where the device was applying the microsurfacing and a gentleman decided he wanted to get around something and drove his car through it. That makes a mess. And so we can back up and fix that but doesn't look so good on his car.

So there could be some disruption certainly to traffic and whatnot while the material cures. It doesn't take long but you have to let the water evaporate.

Q. In terms of microsurfacing, I'm just trying to recall your evidence previously, but did you make a distinction between the effectiveness on asphalt versus concrete?

A. In terms of -- I have done microsurfacing on concrete and it's worked. So 407 ETR is a very advanced group in trying things out. They don't need -- buy from the low

bidder. So they are very interested in seeing how we can maintain the white pavements white and black ones black, i.e., the concrete and asphalt. So we can make it work either way. It doesn't make much difference.

Q. At paragraph 33 of your report you refer to a cost benefit analysis in deciding on a particular remedy. Could you articulate that?

A. Certainly. In my career, particularly in Canada, I found that we don't typically by the cheapest up front; we look at the lifecycle cost. And so one of those documents that I wrote for the National Guide For Sustainable Municipal Infrastructure was timely preventive maintenance and we do lifecycle cost comparisons. So we look at what does it cost us to buy the product, how long is it going to last, what do we have to do in the future to maintain that roadway for a period of 50 years typically for a municipality. And so we're looking for cost value. If we don't get a return on the investment by having an extension of service life making it last longer then it's not worth to select that alternative. You have other choices of things you

can do to restore the pavement to a good condition.

Q. Okay. And would your view of the friction value at the time play into that cost benefit analysis?

A. Yeah, it might. If that's the reason why I was doing it. It certainly seemed the reason it was being done was primarily for addressing surface cracking. And in my experience with ETR was that it didn't give us value. We tried a test section and we got cracking right through within six months. And so it didn't -- I didn't need to improve friction so there was no value to me to do that.

Q. So you have the experience with microsurfacing and you've talked about the expense. What's your view on the expense if it was applied on the Red Hill Valley Parkway?

A. If we removed the sections, the kilometres that they had suggested mill and overlay it probably would have been very close to a million dollars I would say.

Q. So balancing that with the effectiveness, so you have the cost and you

have the friction levels, where do you come out on that analysis?

A. Again you didn't need to do it for friction, first of all. So the value to the City would have been a lot of money spent for little value related to friction. And if you look at the 500-metre sections in my graphics, the majority of it doesn't require anything so placing it for friction wouldn't have given you any value.

JUSTICE WILTON-SIEGEL: But if I can just make sure we focus this in the right area. I accept all of that, but that wasn't exercise -- as you have pointed out, that was before the City. The City -- the question was would you bear this expense to address the cracking.

And incidentally, if you did that then it would have a positive effect of some significance, who knows what, on friction. But it wasn't, as the last question suggested, a question of is there value in -- from a friction perspective that's worth a million dollars. It was really -- was it not is there value of a million dollars in terms of addressing the surface cracking.

And I think I understand your answer in that context to be probably not because your experience is it wouldn't have a long enough life.

THE WITNESS: That's correct, Commissioner.

JUSTICE WILTON-SIEGEL: Okay.

MR. CHEN: Just for clarity, what if it was the friction question.

JUSTICE WILTON-SIEGEL: Why would that be a relevant question?

MR. CHEN: Whether the friction value would play into the -- whether the City decides to microsurface or not.

JUSTICE WILTON-SIEGEL: Yeah. Maybe you have a different interpretation of what was being recommended than the witness.

BY MR. CHEN:

Q. I'm just trying to think that through. The witness has talked about the cost benefits of whether the City would -- should, would microsurface or not, and I had understood that microsurfacing being used as a way to treat friction. Stop there. And so whether the friction value then would play into that

consideration. Does that make any sense, Mr. Hein?

A. You would have to rephrase that, I think.

Q. Would the friction value play a role in the decision to microsurface?

A. If it was necessary to improve friction it could play value certainly, but it wasn't necessary to do that.

Q. Then at paragraph 34, Mr. Hein, of your report you talk about CIMA and their review in 2013. Why do you raise that in this context, the countermeasures?

A. The countermeasures that were recommended by CIMA included speed reduction among other things, signage, et cetera, so the cost to implement them would have been substantially -- while they don't change the friction of the road, they would have been substantial at reducing the friction demand and so you're achieving a value of potentially reducing collisions while not investing in improving the friction of the pavement.

Q. So this I guess goes back to the consideration of whether you're increasing

the supply of friction or whether you will reduce the demand of friction?

A. The comment (ph) is that almost all cases reducing the demand is much less expensive than providing more friction.

Q. So I hope I didn't ask you this before, but how would you determine which way to go, the more supply or the less demand?

A. We would look at the cost benefit associated with it. And I think CIMA took care of that, and identifying the elements that would have the highest benefit which is ones that you typically implement.

Q. Just moving now to shot blasting, which is over at page 11, image 13, paragraphs 35 and 36. And I think there's alignment here with Dr. Flintsch. There's -- Golder suggests shot blasting for certain areas of concern. So in your view, first of all, was that necessary. And this question, just so we have the timing right, is from March 2018.

A. Shot blasting is a very short-term improvement, and considering we're going to be resurfacing the highway in 2019, the value of doing that, particularly with something

like the skidabrader, would be something very expensive to have and then you are going to not need it a year later when you resurface the roadway.

Q. And in terms of the longevity, you indicate shot blasting, a short term solution and the results -- with results that sometimes only last about six months to a year; is that right?

A. Yes, that's correct. That was our experience on using the skidabrader on 407 ETR and from what I've seen from others who also are using it to increase texture, is that it's short lived in the months kind of thing as opposed to the years.

Q. And then -- sorry. Go ahead.

A. My comment was also using it on asphalt pavements, because there is very little -- for removing rubber on the runways certainly it was effective because it's very difficult to remove aircraft tire rubber from the surface. In terms of regular roadways, my personal experience has been it's pretty aggressive and it's done more damage to the

pavement than it did good, and again it didn't last very long.

Q. All right. So let's move on to the next question, which is the design image 14 and 15, Mr. Registrar. Question 5 is about Dr. Flintsch's view on the applicability of the UK guidelines to the Red Hill Valley Parkway.

In your career, Mr. Hein, have you used or seen the application of the UK guidelines in any Canadian context.

A. I have not. I've not seen it used to decision anything to compare it against -- used in Canada at all.

Q. And have you seen it being referenced in any guide, like the TAC guide?

A. It has been referenced in the earlier versions of the Transportation Association of Canada guide as an example of the framework what another agency is using for determining investigatory limits, for example. It was in the 1997 guide for sure. It might have been in the previous one, I'm not sure. And then it definitely wasn't in the -- most recent one, the 2011 one that was published -- or '14, sorry. It's '14.

Q. And so just going back to the '97 version, do you take anything from the fact that it's referenced and that provides a framework?

A. I mean, ultimately the direction that the new AASHTO guide is going that was just published a month ago is looking at friction demand and looking at advisory limits and things like that. And so I think it was the intention -- I was involved in writing one of the chapters of that guide but it wasn't the one on friction. But if I recall it was shown as a -- here is a framework of how we should approach this if we have sufficient data to be able to support it, and so the UK folks were doing some good work.

Q. So you've said you haven't seen the application, the use of the UK guidelines, and in your opinion what's the reason for that?

A. Part of it is because in Canada we've had very few agencies who measure friction on a continuous basis other than MTO and MTQ in Quebec. MTQ does something differently. I think we may have sufficient data in Ontario to eventually use our data to come up with something

similar to what they do in the UK, but there are lots of differences between -- it's always dangerous to take something from somewhere else and bring it to your jurisdiction without understanding the implications and the complexity of validating it for our conditions.

I mean, some things very similar. Obvious things different between the UK and Canada are things like wheel load limits, axle load limits. They have different configurations, they've got different weights, and so they will tend to polish their pavements more than ours do, as an example.

And some other thoughts were things like materials, things like asphalt mix designs are not the same in the UK as they are in Canada. The methodology they use is fundamentally different than what we do.

Q. All right. And Dr. Flintsch testified on this, and I understand he agrees that if you're going to adopt an investigatory level from a different jurisdiction you should definitely do the testing, but I think he also says that why not just use the UK standard as a reference because there's nothing

available -- nothing else available in Ontario to understand the grip numbers. What do you say to that?

A. My personal opinion is we have data for the lock wheel tester. We don't have data for grip tester. We don't have for SCRIM which they use in the UK. And I'm not disagreeing that it's an interesting framework. I'm just saying that it would be very dangerous I think to just simply adopt it or use it in Canada without any context, and in particular for one location, one jurisdiction, one road type such as the RHVP. This is a much larger research type effort that would be needed to implement something in Canada.

Q. And just on the topic of research and work to implement or adjust to the local conditions, you make reference to the Austroads report in your report?

A. Yes, correct. This was one of the first agencies that I'm aware of that thought the Brits were doing a good thing so maybe we can adopt that for use in Australia. And their first look at it was wow, this is going to be really, really expensive to do and doesn't really

warrant it being done, but then when they went through their -- they had a pretty good significant research program, to use the framework and to adjust it for their conditions in their country and get comfortable with using it there, and they made modifications to what the Brits had used. And they had some outliers in their own data as well in Australia. But it's not so easy just to grab something and then blindly use it without understanding the consequences, and I think they showed us that was the case certainly with their publications.

Q. So that's it for the applicability of the UK guidelines. Let's move on to the next question, which is images 16 and 17.

So as you know, Dr. Flintsch undertakes a conversion of grip tester numbers to FN and then adjusts to the 90 kilometres per hour, and his opinion is that the conversion that he undertook is at least reasonably accurate. Do you agree with that?

A. I do not. I do certainly see what he's trying to do to get from A to D with going through B and C, but I can't agree that it was reasonably accurate. I believe it was

fortuitous maybe that the numbers came in similar, but I think it's very difficult to take a process used by different piece of equipment in a different country and then convert it to have through several other processes that eventually gets to a different speed device and a different unit device that eventually gets you to where you want it to do at the end of the day. So I mean, mathematically it's valid, I suppose, but I would suggest that it would be very dangerous to assume that this is going to be correct in all situations.

Q. So in your report at paragraph 44 you describe it as a multistep conversion. What, if any, concern is there with needing a number of steps to complete the desired conversion?

A. The more steps that you introduce, different pieces of equipment and different methodologies and pass them through another one to get an answer is problematic. It just doesn't make -- to me it doesn't make a lot of sense. There are too many steps involved and all of them can have errors in them which just compounds the error.

Q. Are you expecting any particular conversion to have any reasonable accuracy?

A. Not based on my experience certainly. So for 407 ETR we tried a direct conversion between the grip tester and the brake force trailer by testing both pieces of equipment on the same pavement sections on the same day in the same temperature conditions at the same speeds as much as possible to try and go directly from one device to the other, and the answer was we got highly variable results.

So we tried to take out all of this multistep conversion and make it a one step conversion and the results were not very useful. They are all over the map basically.

Q. So does the fact that the results that were taken on the Red Hill being done at different times, different days, is that concerning to you?

A. Yes, yes, it is. I mean, every one of those steps is adding another possible variable in the conversion.

Q. At paragraph 46 you list three different studies, one from PIARC, Hermez,

the tire -- tyro -- tyro safe studies. I'm not going to take you to any of them. And Dr. Flintsch knows these studies very well. He may been involved in I think the PIARC one. But what do they conclude?

A. Just in general, over the years -- many, many years of doing pavement evaluations we have had different techniques and different pieces of equipment that measure different things. And so PIARC, the World Road Association, I've been Canada's representative on their pavements committee and their asset management committee for more than 20 years.

And so back in the 1980s smoothness was measured by 10 different devices, and PIARC set out to unify the methodology for smoothness and they came up with what's called the international roughness index. They went to Brazil, they did some work, they found, hey, we can measure the actual profile and these agree with each other. And so they said why don't we do the same thing with friction.

And so they tried, and they brought together all the pieces of equipment, and I've described them here in my report briefly, and

that they have done this more than once, in fact three times, and the conclusions were is that we cannot correlate the equipment to each other or to a single unit of measure that we would -- that we could use uniformly across the planet literally.

So there are -- it's very complicated, very, very complicated, and they have gone as far as saying that perhaps we should throw away all this equipment and use only one kind of equipment, which might be a better idea at the end of the day.

Q. These studies, they are from '92, 2000, 2008, do they remain authoritative?

A. Yes, they do. And there's always been talk about doing more related to this.

Q. You've touched on this. Dr. Flintsch said something that sometimes it's very true, you said that just because the numbers that he converted match up doesn't make it right. He has said simple doesn't mean wrong. What do you think about that?

A. Well, I concur that simple is always better. The higher the

complexity of something the higher the probability of failure. So I can't say -- I appreciate what he's done, I just think that perhaps it just happened to end up in the -- where the answer was and he's using that to then confirm that there's a value in doing what he did. I don't think it was necessary to do that, but I don't want to call it luck, but hey, maybe.

Q. Okay. And then at the end of this section, the last sentence paragraph 49, you say further independent testing would be necessary to validate any such conversion. What further independent testing are referring to there?

A. In order to adopt anything like that, like what is being done here, I mean you need to have lots of data, you need to have lots of types of pavements to show the differences between them, different temperature regimes. It's just -- it's not something that you could easily do and apply to the Red Hill. This is more of a higher level of government like the MTO or something like that, or in the U.S. the state transportation departments are the ones who are leading the work in this respect. So it's not

something you would see a municipality take on on their own at all.

Q. Question 7, this is the last question in your report. Images 16 and 17 -- 18 and 19, sorry. Which is on page 16 and 17 of the report. Okay.

So here you're referring to the ranking of the contributory factors to the wet road collisions and I think there's agreement here with Dr. Flintsch that you can't rank the four factors that are set out in paragraph 50 of your report, correct.

A. That's correct.

Q. And just very briefly, why do you say that?

A. I agree with Dr. Flintsch as well because there are lots of factors that influence vehicle pavement interaction and it's not possible to do them on a general basis, i.e., friction is number one because it's the reason, end of sentence. Every accident or every collision has potentially multiple factors that contributed towards it and so it would be not reasonable to pick globally what that ranking should be.

Q. Table 2 sets out the factors that may play a role in any accident?

A. That's correct. Each of those factors is -- you can see there are a lot of them there and so each of them may have some element or component that might be contributing to the potential of those accidents. And suggesting that so one is much higher than something else is an accident by accident decision likely to be made as opposed to something more on a global nature.

Q. And just drawing on your experience, have you had previous mandates in determining whether friction is a primary cause of a wet weather accidents?

A. We have -- I mean, ultimately I'm brought in because I'm the pavement guy and so I know lots about friction. And so a lot of times -- it somewhat becomes predisposed that they think friction is the primary problem and so you dig deeper into other factors, and my experience again has been is that pavement friction is rarely the major cause of accidents occurring. So -- I'll leave it at that.

Q. I think Dr. Flintsch agreed with you that that's the case.

A. I recall him saying the same, yes, agreeing.

Q. So that takes us to the end of your report but -- so there was one issue that the City or -- you have leave to talk about, which is the polished stone value, and we know that Professor Baaj dealt with that. Have you had a chance to review his report?

A. Yes, I have.

Q. Do you agree with the conclusions that were reached by Dr. Baaj?

A. I do agree with his conclusions, correct.

MR. CHEN: Thank you, Mr. Commissioner, those are my questions.

JUSTICE WILTON-SIEGEL: Thank you. Mr. Lewis?

MR. LEWIS: So Commissioner, I understand it's likely that Ms. Roberts of participants' counsel is the person who is likely to have the longest amount of questioning, other than me. So I would ask Ms. Roberts to proceed.

EXAMINATION BY MS. JENNIFER ROBERTS:

Q. Mr. Hein, hello. I'm counsel for Golder.

A. Nice to meet you.

Q. And you. I have a few questions and let me just ask you -- forgive me at the outset as I jump around because I think you addressed much of what I wanted to ask already.

A. Certainly.

Q. You address Dr. Flintsch's view that the change in friction between the LINC and the QEW and the Red Hill, as between them, violated driver expectation because of the change in friction. And you talked a little bit about the fact that it is the norm driving along a highway to experience whether -- objectively you know it or not, but different surfaces and therefore in fact what would be different frictional performance on each section. Do I have that right?

A. Correct.

Q. Were you aware that the LINC was resurfaced in 2011? That's part of the evidence. I'm not sure if that was part of what was put before you.

A. Yes, I was aware of that. Yes.

Q. So when the LINC was

tested by Tradewind in 2013 that would represent a high point in its frictional performance; is that correct?

A. Yes. The early friction performance would be higher, correct.

Q. As compared to the Red Hill at that point which had been in use for six years and at that point was beginning to show a friction decline.

A. That's correct.

Q. And it's perhaps an obvious thing but let me just say it. So the LINC was retested in -- using the ARA, retested in 2019. Did you have a chance to look at those numbers when you were also looking at the Red Hill?

A. I was aware that some of the testing was done on the LINC. I'm not sure if it was intentional or not, and also on the QEW on the south side.

Q. Just so -- the difference in 2013 between the LINC and the Red Hill was quite pronounced, and you saw that in the Tradewind numbers.

A. The numbers were -- I

gather were definitely -- relatively higher than what was on the Red Hill, correct.

Q. And then -- have you had a chance to look at what the difference was from the ARA testing in 2019?

A. Yes, and it showed a similar trend.

Q. Shows similar trend but the difference was not as significant as it was in 2008, correct?

A. I can't be specific about that. I'm not sure.

Q. I don't think the data is before you. I'm just trying to raise the point that that ebb and flow of differences between different segments of highways, it would be constantly changing depending on the relative age of the surface, correct?

A. That would be correct.

Q. Thank you. You talked about microsurfacing, and just so that I have this right you have observed that it's been a treatment in place that goes back I think to -- at least to the nineties. Do I have right?

A. That is correct.

Q. I think in your CV you talked about your involvement with JEGEL and bringing in that technology for use and starting -- sorry...

A. No problem.

Q. You talked about your understanding that microsurfacing was in fact a technique that had been used in many patients and you reference that he had you knew, for instance, Durham used it regularly. Did I hear that right?

A. That's correct.

Q. And you raised an example of an application where you didn't think it was effective in treating surface cracking because the cracking came through. Do you remember that?

A. That's correct.

Q. And let's just go back to the evidence in the review of the Golder recommendation from the 2014 Golder report.

That recommendation was to mill and overlay the two-and-a-half -- about a two-and-a-half kilometre section of the roadway.

A. That's understanding, correct.

Q. And you understood that

that was to treat the cracking on the surface?

A. That was to treat the more severe cracking on the surface I believe, correct.

Q. And the rest of the recommendation to use microsurfacing, that was to treat microcracking. I take it, sir, that the treatment using microsurfacing would have been effective for microcracking of the surface?

A. It may have been.

Q. But that microcracking is a different circumstance from the example that you gave where you thought microsurfacing wasn't effective for the surface cracking?

A. It was -- the issue is related to material quality issues that we had in Ontario at that time and the cracking was surface down material related again, and it was the same problem that we tried it with on the test section I was referring to.

Q. But you've got no reason to think that microsurfacing wouldn't have been effective to treat microcracking on an SMA surface, have you?

A. No, correct.

Q. Thank you. When you talked about the skidabrading and the use of BlasTrac, your experience also brewed some experience on -- sorry -- airports. And is it your experience that techniques such as skidabrading is used regularly on airports?

A. Skidabraders, yes, they have been used regularly on airports, correct.

Q. So when you say a skidabrader can sometimes be damaging to a surface, I pause at that. It is also the case that some surfaces are regularly treated and the observation that you made of the damage to the surface -- let me rephrase this.

A. Okay, you're starting to lose me. Go ahead.

Q. Let me try again. So when you make the observation from the experience that -- and I think you raise one example where you observed that the skidabrading had been damaging the surface. I just put it to you that that's not universally the case because airports use the technique regularly.

A. That was my personal experience, but yes, it could -- it's one data

point, so it's -- it's used in airport surfaces not -- it's used to remove rubber in many cases. That's the primary use.

Q. But also, I suggest to you, to improve the surface friction of a runway?

A. By removing the rubber it would do so, correct.

Q. And the treatment is used repeatedly. So by that I'm -- I ask you to agree with me it's not a universal experience that skidabrading is damaging to a surface as you observed in that one instance.

A. That could certainly be the case. Agreed.

Q. When you suggested the effect of any of these treatments such as skidabrading or using a BlasTrac was very -- was not enduring, I think you identified like six months, I just want to dig away at your experience with airports because my understanding is that the treatment can be more enduring. When you have seen the skidabrader used in an airport would that be a yearly exercise?

A. In Canada my experience has not been it's been used on a regular basis.

Not probably yearly. Would have been more than a year or something like that. I don't recall how many times it came in to Canada.

Q. I just want to go to the issue of the ARA locked wheel device.

You said you and gave testimony that when -- that in 2013 that Golder had first gone to the MTO to try to get them to do the friction testing and that you were aware of the evidence that MTO suggested contacting ARA about the ARA locked wheel device. Do you remember?

A. Yes, correct.

Q. And that was in the late fall of 2013. You also testified that ARA generally brought up the locked wheel tester every two years?

A. That's correct.

Q. And I take it, and you mentioned the expense of -- and having to cross the border so it wasn't done regularly. I take it when the ARA brings up the locked wheel tester to test for clients that that is done in the summer?

A. Typically that is correct.

Q. So Golder would have no expectation in November of 2013 that the ARA locked wheel device would be in the country?

A. Wouldn't -- no, I wouldn't expect they would -- they would expect it might be in the country. I don't know they would know or not. I don't know the answer to that.

Q. You gave evidence you talked about your involvement with TAC and your involvement in drafting in the introduction of the pavement design and management guide, and you mentioned and acknowledged that the involvement in the 1997 TAC and I -- let's go --

Registrar, can I ask you to call up two documents. I'm going reference from -- first one is HAM10056 and then the second someone Golder 3936. If we go to the 10056 first, please. This is an extract from the 1987 pavement TAC's pavement design and management guide. Registrar, can you please go to the next image.

Indeed, Mr. Hein, you are identified as national project team, and I think as you said you actually drafted some of the chapters, or least one of the chapters here.

A. That's correct.

Q. Registrar, can we please go to the next image. This begins on page 60 of the pavement design and management guide and this extract goes through different friction measurements and methods.

So I take it, sir, this is the opportunity for TAC to introduce, as a concept in pavement management, the notion of friction testing and the methodologies that are used to test friction?

A. I would assume so.

Q. Indeed if we go to page 62. So two more, go down.

In this section 2.6.2 friction measuring devices, there's a list of different devices. And TAC identifies 84 different such devices but then narrows down and talks about a number of them.

Registrar, can we please go to the next page. Among them is the skid trailer and the British pendulum tester. You've talked about the British pendulum tester as one you used at JEGEL.

A. Yes.

Q. The SCRIM and the grip

tester. So the grip tester is identified here as methodology for testing friction on roadways. That's correct?

A. Reading it -- hard for me to read the size of this.

Q. I'll have to do something about that. Registrar, can we please make it a little larger.

A. Much better.

Q. Do you see that?

A. I see it's written there. I don't see anything about roadways.

Q. Isn't the whole thing about roadways?

A. Not -- well, TAC's primary focus is roadways but not -- it used to have some airport work as well. We saw friction trailer on your previous image, is also an airport device that's not used on the roadways.

Q. I see that. Okay, so if we go back to page 62 it's a comprehensive -- that paragraph says "comprehensive survey of friction measuring devices used in the United States and Canada." It identifies there the locked wheel skid trailer, 51 - 60 agencies responding used the

locked wheel trailer, so that's the dominant device for use in roadway friction testing, correct?

A. I don't see the word roadway still, or am I missing it?

Q. Well, when they talk about agencies responding, my interpretation is that that would most likely be agencies who are managing roads. Do you disagree with that?

A. It's possible, although Transport Canada is also mentioned under (indiscernible).

Q. And Quebec uses the SCRIM on its roadways, sir?

A. I'm aware of that being done correctly.

Q. If we go forward to page 64, Registrar. Under section 2.6.4, uses of friction data. When it talks about "some agencies have well-established monitoring programs to identify specific friction related problem areas," on roads I assume?

A. I would assume that.

Q. It talks about other agency -- I think it means employ friction

measurement equipment on a reactive basis in terms of carrying out pavement, maintenance and rehabilitation to ensure public safety. Do you see that?

A. I see that.

Q. And then if we go forward, please, Registrar to page 66. This is the reference to -- thank you. Can you make that so we can see the whole table?

This is, if I understand from reading the bottom of 2.6.4, use of the friction data, it says "some agencies refer -- have developed criteria for identifying low friction pavement surfaces," and the example is at table 2.6 Pennsylvania.

You looked at something similar I think at the beginning of your report where you looked at different agencies particularly in the United States and what they are looking at for guidance in terms of -- to evaluate friction.

A. Correct. Sorry.

Q. And then it goes forward and identifies in the paragraph below a comprehensive actual standard for surface friction

of roads was issued in January of 1988 by the British Department of Transport and it uses the SCRIM surveys and provides for adjustment of surface friction to a level appropriate to accident risk. And that's shown in table 2.7.

And that's the standard where detail investigation to identify an investigatory level and it's shown in table 2.7.

Now, table 2.7 isn't part of this extract, sir, but it is in the Golder extract so forgive me for jumping around.

Registrar, can we please call up Golder 2936.

THE REGISTRAR: I'm sorry, 2936?

MS. JENNIFER ROBERTS: 3936. There we have it. There's your 1987 Pavement Design and Management Guide. And, Registrar, can you please go to page 67, which is actually the next page, the one we've just been looking at, and it's the third image. 67, next one, please. There we go.

This is table 2.7 which has just been referred to. You'll agree here that TAC is setting out the British Department of Transit

standard for investigatory level of road surface friction resistance.

A. What was the question? I didn't understand.

Q. I'm just observing what it is first.

A. Okay, yes.

Q. You'll agree with me that this is in the TAC guide and intended to provide guidance to industry and to agencies who are trying to evaluate the surfaces of the highways.

A. I would expect that this was an example what was being provided as the one was for Pennsylvania. I wouldn't say this is directly guidance.

Q. It is an example of guidance, is that the point --

A. Sure.

Q. Registrar, you can take that down. When you say in your report that you haven't seen UK guidelines used as a reference to assess frictional qualities, that is in fact not the case, sir, that it's in the TAC guide?

A. My comment is that I've not seen it used by any Canadian agency as a

reference for evaluating friction values in Canada.

Q. So it's in the TAC guide but you're saying in your experience you haven't seen it used?

A. That's correct.

Q. Okay.

MS. JENNIFER ROBERTS: I wonder I might have your indulgence. I'm trying not to repeat the evidence that has been given, and to bring -- to extend this more than needs to be done. Would you provide me the indulgence of five minutes to look at this?

JUSTICE WILTON-SIEGEL: Sure. Why don't we return at 12:15. Stand adjourned until 12:15.

MS. JENNIFER ROBERTS: Thank you.

--- Recess taken at 12:08 p.m.

--- Upon resuming at 12:15 p.m.

MS. JENNIFER ROBERTS: Thank you, Commissioner. Thank you for your indulgence. Those are my questions. I have no further questions. Thank you.

MR. LEWIS: I believe --

MR. CHEN: We've lost our volume. I can see you, but I can't hear you.

(DISCUSSION OFF THE RECORD)

JUSTICE WILTON-SIEGEL: Mr. Registrar, why don't we go off the live feed for a couple minutes until we're advised Mr. Chen is back on-line.

THE REGISTRAR: Absolutely. Going off-line right now.

--- Recess taken at 12:17 p.m.

--- Upon resuming at 12:22 p.m.

MR. LEWIS: We're back after that interruption. Mr. Bourrier is up next for the MTO.

MR. BOURRIER: Commissioner, I actually don't have any questions for this witness.

JUSTICE WILTON-SIEGEL: Okay.

MR. LEWIS: And last I checked Ms. Laurion for Dufferin did not anticipate any questions but that could change.

MS. LAURION: That's correct, Mr. Lewis, no questions.

MR. LEWIS: A bit of if it's and starts there. Commissioner, I normally would

take our lunch at 1. I'm not going to be super long, probably about an hour, maybe not. But I won't make it before lunch so I think what would be better is if I reviewed my notes and was able to slim down what I -- pick up some things, other things that were said today and it will be a more orderly and faster cross if we start after lunch.

JUSTICE WILTON-SIEGEL: Well, is that agreeable to everyone else then we would take usual break and that would put us about 20 to 2:00 to return.

MR. LEWIS: Correct.

JUSTICE WILTON-SIEGEL: 1:40. So let's stand adjourned until 1:40.

--- Recess taken at 12:23 p.m.

--- Upon resuming at 1:40 p.m.

MR. LEWIS: We're back. Commissioner before I commence, there is just a housekeeping matter, and we would like to introduce as an exhibit the affidavit of Ron Sabo which what is affirmed February 23rd, yesterday, 2023. The doc ID is RHV1043. Copies have been provided previously to participants' counsel, all of the whom advised they would not be cross-examining on the affidavit which relates to

documents recently found by Mr. Sabo that were produced to the inquiry on February 7th, 2023, and it supplements the overview documents and Mr. Sabo's evidence given on October 4th and 5th. 2022.

JUSTICE WILTON-SIEGEL: Okay.

MR. LEWIS: So with your permission I would ask the Registrar to there's mark RHV1043 as an exhibit, which I believe is 238.

JUSTICE WILTON-SIEGEL: That's fine, on the basis there's no objection from any of the participants.

MR. LEWIS: Note as Exhibit 238.

EXHIBIT NO. 238: Affidavit of Ron Sabo affirmed February 23, 2023; RHV1043

JUSTICE WILTON-SIEGEL: Thank you.

EXAMINATION BY MR. LEWIS:

Q. Thank you.

Mr. Hein, I'm going to test your memory on a couple of factual matters that don't pertain to your report as we get started.

But since this morning you referred in detail to a couple of specific projects on Morningside Avenue in the nineties and Scarborough and the SMA project on Miller Avenue in Markham. I'm confident you'll be able to help us out here.

The first thing, Registrar, if we could go to overview document Exhibit 8, and page 62 and 63 please. This is just what we call the overview document, one of the chapters in it, which introduces -- they are already in evidence but it introduces various documents and it's a lot of pages and this is just one particular issue that I want to bring you to.

If you look at page 16 -- paragraph 165, and we can expand any of these if you want. Can you read that or do --

A. I can read it.

Q. So paragraph 165 refers to you on January 22nd, 2018 e-mailing Dr. Ludomir Uzarowski under the subject line "Red Hill Valley Friction Problem." And you wrote:

"Next time you need friction testing on RHVP let me know. We have an ASTM brake force trailer in the Toronto area

every day here to do the testing."

And then you refer to hot in-place recycling technology not being new even remotely.

Dr. Uzarowski responds, "Thanks for letting me know. If I need it I'll let you know," and he agrees with you about hot in-place recycling not being new and refers to working for JEGEL and so forth.

And then you respond in closing a link saying day 2, article in the Hamilton spectator dated a week earlier, January 15th, 2018 titled "Scratching the Surface for Answers on Red Hill Paving." And you said "here is the link to the article not very well written," and then the article -- substantial part is excerpted on the next page.

Why were you writing to him about RHVP friction problem? That's the first the question.

A. You're testing my memory because I must've read the word "friction" or something or slippery or something in the article, because other than that I don't know why I would

call out specifically a friction problem. And I saw an article on this from the Hamilton Spectator, which is obviously the link that's there, and I was simply reaching out the Ludomir because I know him and used to work with him, and said if you need friction testing let me know. Basically since -- it's a business development kind of thing.

Q. I certainly get the business development part, but how did you know that Dr. Uzarowski was involved in friction testing. Let me tell you, that's not in the -- you're right it refers in the article -- agree, you know, some complaints about that and collisions and so forth. But it doesn't say -- and it refers to a consultant having tested the asph- -- being hired to test it and so --

A. So ultimately I knew that Ludomir had done -- he had been intimately involved in the Red Hill for quite a long time. It was being what's called a perpetual pavement. I'm sure he was hired by the City of Hamilton to do that kind of work. So I was fully aware that Hamilton was one of his clients, and I honestly don't recall specifically the friction -- I

must've read it somewhere, I just don't recall exactly where it was. I certainly knew Ludomir was working on the Red Hill Valley Expressway because he published the papers on it. I think I was invited to go to the opening I think at one point. If I recall correctly I couldn't make it. But -- I knew he was involved in the highway.

Q. Did you know he was involved in friction testing though? It was well known -- a lot of articles about it, so that's for sure. Did you know -- because it's very specific about "next time you need friction testing." So that's what I'm getting at.

A. I just don't recall.

Q. The other thing is something that you said this morning. It refers to a friction problem, and this morning you said ultimately -- I think I'm quoting you correctly, 'ultimately I'm brought in because I'm the pavement guy who knows a lot about friction. Often you have someone predisposed to think it is friction but it's rarely the major cause of accidents occurring.'

As that issue perspective, and you're friction expert and have heard a lot from

friction people, that it isn't always necessarily, so. And, as you said, it usually isn't. I wouldn't have thought that coming from this article you would then brand it a friction problem. That's why I'm wondering if you had heard that specific?

A. I would not -- I would expect that I heard something but I don't recall.

Q. Did you hear anything from someone inside the City about testing?

A. Oh, no, no, not at all. I had no significant relationship with the folks related to this area in Hamilton.

Q. Okay. Well, what about Gary Moore. You had worked with him before?

A. I've never met him to my knowledge. I know that we were hired to do some friction testing on the LINC and I -- I'm pretty sure we never met before but they definitely hired JEGEL, the company, to do friction testing.

Q. Right, and that was the next one I was going to ask you about, which was back in 1997 and 1999. JEGEL was retained to do British pendulum friction testing and sand patch macrotexture testing on the LINC, and there's a

couple of reports, one in 97 and one in 99 on the subject addressed to Gary Moore that are signed by you and Mark Berkovitch, then of JEGEL, as well.

So -- and they -- the reports deal with a comparison of skid resistance characteristics between sections with steel slag aggregates and traditional stone aggregates, and I'm wondering if you recall why Mr. Moore wanted to know what their relative skid resistance characteristics were. Do you recall?

A. Off the top of my head I do not. I believe -- so my partner, John Emery, was substantially involved in the use of steel slag aggregates for roadways in Ontario and there became some issues with those pavements with a reaction that happened with calcium oxide, I won't go into details, but it was banned for use in Ontario for the longest time. And I know the City of Hamilton, being the steel city, was interested in solving that problem.

I do recall definitely the LINC testing was done with the new steel slag, quote/unquote, that was being produced by Stelco or Dofaso, and they did some test sections up there. So it's possible again, my memory --

possible my partner was contacted by Gary, because they would have known each other, and then it came down to me and my group to go and actually give the testing.

Q. There's a fax that you then sent to Mr. Moore on July 20th, 99, which I can take you to, but it attaches information from the TAC guide?

A. I recall that.

Q. It's one Ms. Roberts took you to earlier, those excerpts. Did you review that just in advance of testifying today?

A. I did.

Q. Sorry?

A. I did.

Q. You did, okay. I'll take you to it if you want, but there's handwriting on there. Is that your handwriting? It seems to be pertaining to the --

A. It is my handwriting, correct.

Q. This just for the record is in HAM10056 and it's image 4 and maybe image 6 as well, but certainly image 4.

Say "we probably test it here

and here" and pointing to the measure by British pendulum microtexture and measured by sand patch macrotexture. So you're pointing out to him what the measurements were measuring; is that right?

A. That's correct.

Q. Do you recall why you sent this to Mr. Moore? Did he ask for it, do you know?

A. I recall him asking for it and I don't recall if it was by fax or if it was a phone call, but I recall -- I think it must have been a phone call because I think I recall saying I can send you a fax or some additional information, and that's why I faxed it to him.

Q. Do you recall why he wanted it, do you know?

A. No, I don't. I assume it's simply he didn't understand what it was and he was looking for more backup information.

Q. You can take that down, Registrar. Thank you. That I think does it for the memory test.

You were at ARA from about 2000 to end of 2019; is that right?

A. Correct.

Q. You had some involvement in the ARA testing done on the Red Hill in May 2019; is that right?

A. Yes, correct.

Q. Did you also in the September 2019 post resurfacing testing by ARA?

A. No, I don't believe so.

Q. I don't need to take you to it but there was some communications between you and people at the City about the testing in May 2019 and logistics for it. I take it from having been involved in that testing that you considered the testing to have been properly done and the results accurate; is that fair?

A. Yes, would be fair.

Q. And you in your report conclude that the ARA -- when I talk about the ARA results unless -- I'm talking about the May 2019 ones --

A. Fair enough.

Q. -- talk about the post ones right now, if at all. But that those results from the ARA testing at 90 kilometres an hour had overall pretty similar results to the MTO 2014 locked wheel testing, indicating that the friction

levels had levelled off?

A. I'm not sure how to answer that because the MTO did different sections than we did. We did more than MTO did. Did it support the conclusion that the average values were similar? The answer is yes.

Q. I mean it's in paragraph 32 of your -- as I note, 32 of your report. RHVP friction levels are acceptable in 2014. They levelled off by then. You're referring to the MTO testing?

A. Correct.

Q. And you know they levelled off because of the ARA testing?

A. Yes, I guess so.

Q. And then in your CV -- if we can go to image 30, please, of the report. I'm not taking issue with your qualification but there's just one issue here.

Under "Forensics and Litigation" the first bullet is:

"Subject matter expert for legal action related to pavement engineering and safety for a major highway in

southern Ontario 2019 to the present."

Am I correct that that refers to civil proceedings against the City of Hamilton pertaining to the Red Hill?

A. Correct.

Q. You weren't involved in the inquiry till much later?

A. That's correct.

Q. Like 2021 when you got involved, right?

A. That's correct.

Q. Part of what you, through ARA, at the time were retained to do in respect of civil proceedings, was the ARA testing we just discussed, right?

A. Yes, correct.

Q. And ARA was retrained by Gowlings, right, which was and is counsel to the City in --

A. Yes.

Q. -- in the civil proceedings?

A. Correct.

Q. And are you, or through

your personal consulting firm, retained still in respect of is civil proceedings against the City?

A. That's correct.

MR. CHEN: Mr. Lewis, just a point here, I'm not sure of the relevance of this particular line of questioning. I'm also kind of wary of privilege matters being touched on.

MR. LEWIS: I'm not going to get into anything privileged, and the retainer itself of course is not privileged, particularly since it's in Mr. Hein's CV, and because, Commissioner, the City explicitly represented in Mr. Chen's December 7th, 2022 letter to commission council seeking leave to file Mr. Hein's report that one of the three reasons for seeking leave was, and I quote:

"The Commissioner's findings may have influence beyond this inquiry and other legal proceedings, therefore it is important the Commissioner receives a balanced response on the technical issues relating to the safety and design of the RHVP."

So I just wanted to make sure about Mr. Hein's continued retainer in civil proceedings, which does overlap with this proceeding, and I do not intend to get into his instructions with respect to the civil proceedings, if that's what Mr. Chen is concerned about.

MR. CHEN: The relevance about his retainer is different from the relevance we were talking about in the letter. That was with respect to certain technical findings that would be made in the inquiry.

MR. LEWIS: Right, and Mr. Hein's report is -- that we're dealing with today was delivered at -- one of the purposes was about the influence that findings in this inquiry could have on civil proceedings.

Mr. Hein is also retained in respect of civil proceedings and, therefore, any testimony or report by him is something that could have influence in the civil proceedings.

MR. CHEN: So just --

MR. LEWIS: I don't think that's in doubt, is it?

MR. CHEN: Sorry, what?

MR. LEWIS: That's -- I want to -- I'm entitled to probe, as I just have, as to Mr. Hein's dual retainers, if I may put it that way, which I've done. I don't need to take it any further than that.

MR. CHEN: If that's the end of the inquiry then, sure.

BY MR. LEWIS:

Q. So you can take that down, please, Registrar, thank you.

So, Mr. Hein, you've worked I think extensively with the MTO during your career but you were never actually at the MTO yourself; is that right?

A. As an employee, no.

Q. We've had, I'm sure you're aware, a whole bunch of current and former MTO employees who have direct and personal knowledge of, over time, the MTO's friction management and testing processes who have testified.

I just want to be clear -- I don't take you, that's suggesting but let me know if I'm wrong -- I don't take you as suggesting that you have better knowledge of the MTO's

friction management and testing practices and procedures than its employees in those areas.

A. Of course.

Q. Okay. Regarding Highway 407, we had someone from the 407 ETR testify about the friction management practices, which was Mr. Craig White. I assume from the way you've described your involvement you know Mr. White?

A. Of course, yes.

Q. Is he effectively your client in terms of the person you deal with?

A. He's the operations manager, so yes.

Q. I don't mean in a technical sense.

A. Okay.

Q. You indicated this morning there was an issue with the grip tester on the 407 about it bouncing around, I think is the way you described it, not staying on the pavement and you thought that it was -- probably because it was much lighter than the locked wheel tester, that that would cause variations in the grip tester numbers that you saw. Is that a fair

characterization?

A. Correct.

Q. Mr. White did testify about that. And to summarize it, what he said was that as a result of testing at the higher speeds than the usually 50 kilometres per hour -- I think you did mention that about moving, getting the speeds closer together -- that it was on concrete where really there was a problem with that. And I think it was to do with the joints on concrete. But he said it was better on asphalt where, and I quotes, "it did give us good measurements." Do you disagree with Mr. White on that, or agree?

A. No, I agree with him.

Q. And asphalt, of course, is what we're dealing with on the Red Hill?

A. Correct.

Q. As for correlation, Mr. White testified that -- it wasn't bad when they correlated using both the asphalt and the concrete results, I think he said the R-squared was okay with that but less so definitely when they used individually asphalt and concrete results. Do you agree with that?

A. That's correct.

Q. Still a little more in the background. When you took your trip to the DR, Dominican Republic Len Taylor of --

A. Yes.

Q. I think you said that what is teach some folks down there about using the grip tester?

A. Correct.

Q. Was that with respect to airport runways or the road network, do you know, recall?

A. I would expect it was more roadway oriented than it was runways. I don't recall going out on a runway or anything in the DR related to that.

Q. So presumably if you were down there to teach them about it you weren't telling them that it wasn't okay for use on roads?

A. No, I did not.

Q. In your report, if we could go to -- I don't need -- in paragraph 10 you talk about, in your report, a number of the documents from are public/private partnerships and highways including the 407, right? And you indicate that examples of these are the 407, 427

north extension and the use of FN30 as an investigatory level on these facilities, right?

A. Correct.

Q. And you say the investigatory criteria for friction is identified as FV, friction value, as greater than 30 when travelling at the posted speed based on the 500-metre average values of friction. And one of the documents you cite, if we could pull that up, Registrar, is HAM64455.

And while he's pulling it up -- this is schedule 20 of the 407 concession agreement that you referenced in the report. Although he didn't have it in front of him this is also something that we asked Mr. White about, that he talked about when he testified back in June.

If we could go to image 6. If you could, Registrar, call up the bottom paragraph. I won't read it, but as I read it it requires an immediate investigation if FN equals 30 or below; is that correct?

A. State that again please.

Q. It requires an immediate investigation by 407 ETR when the skid number is 30 or below?

A. Correct.

Q. So then -- in the last sentence where it says "remedial action is also to be undertaken whenever a surface friction problem is thought to exist irrespective of the surface friction skid number," which to me recognizes that there can be a surface friction problem even if the FN30 requirement is met. If there's a problem it's thought to exist that you need -- it has to be addressed.

A. Yeah, that's what the wording says, correct.

Q. That's a sensible approach, is it not, because notwithstanding there being an investigatory level, whatever that is, whether its' 30, whether it's 25, whether it's 35, whatever it is, there's no absolute number at which a pavement safe or unsafe. Do you agree with that?

A. Agreed, yes.

Q. I think you talked about that earlier. You said that when you were talking about the numbers a shade below 30, you said it's not cast in stone that 29.9 is bad.

A. Correct.

Q. More, 30.1 isn't necessarily good if there's high friction demand there, right?

A. Correct.

Q. And so that is the approach that Mr. White talked about, was that if -- reflecting this I think -- that if in fact there is an issue that exists where it's above -- even if the FN level is above then they would need to investigate?

A. That makes sense.

Q. There's all sorts of things that come into an investigation. It's the kind of things that you talked about, which would be a visit to look at, to see if there's fat spots or see if there's polishing or to see where on the road is it in terms of the geometry or their tight turns or their close interactions. All things like that, right?

A. Correct.

Q. Would you also agree that generally speaking that's the MTO approach?

A. Generally speaking, yes.

Q. I mean it's not -- sorry?

A. This was the first time I

had ever seen an actual document have a specific requirement for friction.

Q. And I think that's fair. We heard a lot about it and, you know, there was a time where the MTO -- not just with the 407, what they were looking at and implementing standards and contracts and IL levels in contracts and --

A. Yes.

Q. Okay. So you can take that down Registrar, thank you.

You said this morning, if we could pull up figure 5, and it's maybe it's the revised one which was -- right, it's the A, that's where I couldn't find it. Thank you.

If we could pull up HAM64785, which is Exhibit 222A. I think this morning when you were talking about these numbers and the correction to the numbers for the southbound lane 2 from the ARA 2019 results averaged over the 500-metre spans, as you've done on all the figures 2 through 5, that because -- and specifically on the southbound lane 2 here, that because of the proximity of -- to each of the -- to the sub 30 numbers, proximity of those, that you might go look at the road surface to see if anything was

contributing to those numbers, to view the road, see if a patch repair was done with the different material or aggregate, looking for wear on the surface, defects like ravelling, things like that, that are different than the things around it.

A. Correct.

Q. And that sounds to me like an investigation; is it not?

A. Yes, certainly part of an investigation, yes.

Q. Exactly, and it's part of it. The other things you might do from a traffic safety perspective, as opposed to -- and I think you were frank in saying -- not sure exactly the words used, but you're the pavement guy, not a traffic safety guy, right?

A. That's correct.

Q. Is that another thing you might do for a full investigation is you look to what to see whether, like we were just talking about, the lower friction levels are in areas of again tight geometry is one thing?

A. Correct.

Q. Where curves or interchanges or ramps, those things are closer

together or there's a series of curves, those kind of things?

A. Sight distance, other things like that, correct.

Q. Yeah, the kind of things that a traffic safety person would be looking at. I know there's sort of a divide and expertise, I've learned that over the course of this inquiry, right?

A. Correct.

Q. So those are things that holistically, I think you even used that term, that holistically if you're doing an investigation that's triggered by an investigation level, that you would be looking at, right, to see are these -- do they matter or not?

A. Correct.

Q. And another thing of course that you do as part of that would also be, depending on looking at the collision statistics, and one of those is the wet road collision proportions, that's one of the things to look at, and an important one.

A. Correct.

Q. And that's because the

IL, the investigatory level, is not the be all and end all on either side of it?

A. That's correct.

Q. Right? Okay. If it's on a straightaway, if you've got something that's in the low 20s that might not matter if it's in a low friction demand area, I think you were saying.

A. That's correct.

Q. But it could even if it's over 30 it could matter in a high friction demand area for all sorts of different types of friction demand?

A. Correct.

Q. But at the same time I think from what you've said you would agree with me that whatever an investigatory level is, wherever it's set, we can use 30 or -- hitting 30 or below 30, whatever, or FN or SN or GN, whatever it is -- if you hit that level that is -- the purpose of it then is to trigger an investigation; not remediation but an investigation?

A. That's correct.

Q. So when you talk about that you don't agree with Dr. Flintsch that the friction was relatively low you also say that in

fact the results are acceptable for a pavement of its age and that's based on the FN30 guideline of the MTO.

A. Right.

Q. And some MTO witnesses have testified, I think it's consistent with what you're saying, that results in the low 20s, you said low 25, certainly low 20s where you have sort of -- you look at it and you have an automatic concern, right?

A. That's correct.

Q. But that's not about an investigation level. That's sort of the kind of thing where -- I think Becca Lane talked about this, and I expect you have some familiarity with from the MTO, but she and a couple others talked about if it's below 25, in the low 20s, then you might be looking at going straight to some remediation. But you might not be at all concerned if it's higher than that depending on the results of your investigation. But below 25 it's sort of like, oh, that's a real concern, just facially?

A. Not just only because of that. If there's a track record of it going down

faster or -- it levelled out, and so I'm not expecting it to go down to 25 in six months or something like that.

Q. Right, but trajectory matters.

A. Trajectory matters of course. May stay like this for 10 years.

Q. Right. When we look at those figures -- well, figure 5 we can look at, and I think the results of the corrections that you gave most, if not all, of them had minor corrections and you -- what it changes in terms of the FN30 is that instead of four of the 500-metre stretches being below 30 there are three, right?

A. Yes. For this section, yes.

Q. On the updated one it's the second -- starting from the left it's the second, fourth and fifth the ones that are still a little bit under 30?

A. Correct.

Q. Is that just the plotting was off between --

A. It was a transposition error where after 7 and 6.5 one value is

mis-skipped and then all the other ones were adjusted by the value it was skipped, so they had to be moved back to their original position.

Q. Got it. And what you said in your report was that, and I think you used the same words today but correct me if I'm wrong, but you stated that okay, yes, there are some values over 500-metre stretches that are a bit below 30, but they are all minor and inconsequential deviations. That's what you say in your report, right?

A. Correct.

Q. But in terms of an investigatory level, that seems to be having it both ways to me. Like, I totally get that it's not -- doesn't become unsafe if it's under 30, as we just described, that's not automatic. But in terms of an investigatory level, that is the trigger, right? That's why it's an investigatory level?

A. Investigatory level can be a range of numbers too.

Q. No, no, I'm just talking about this -- you pin your report on to say (skipped audio) adequate?

A. Correct.

Q. If that's the measure that you're using to determine whether or not friction is adequate, if it drops below -- I'm not trying to trap you into anything, I completely understand that it doesn't mean it's unsafe at that point. But it does trigger an investigation if that's the investigatory level you're applying, correct?

A. Yes.

Q. Maybe after the investigation is done maybe it's all fine for the reasons that we talked about. If it's on a straightaway, you don't have a lot of friction demand maybe it's doesn't matter. If there's a lot of friction demand maybe it does; is that fair?

A. Fair.

Q. Just on the driver expectation point about the adjacent friction. If we could go to Dr. Flintsch's report at page 8, which are the ARA detailed results that you were looking at earlier today. I guess it's 8 and 9 but -- yeah. Can you see both of those okay?

A. Reasonably well, yeah.

Q. We talked about at each end there's -- in the gray areas we've got, what, the different pavements and -- where it goes up. And it goes up some at the end of the LINC on the left and on the right at the north end of the QEW interchange it goes up a lot?

A. Yes.

Q. So really -- I mean, we know the 2019 ARA result averages for the Red Hill portion are in the low 30s depending on the lane, right, between 31 to 34 --

A. Correct.

Q. -- on a complete facility average. And then it's going up to -- quite quickly to the low 50s and mid-50s and there's even results on the southbound lanes coming onto the Red Hill from the north where it hits 60, but anywhere between 50 and 60 on both sides. Fair?

A. Fair.

Q. So that's a consistent difference between -- of around FN20 between the QEW interchange and the Red Hill, right?

A. Correct.

Q. And you said that the difference in friction levels is not significant.

So I appreciate what you said about typical drivers versus race car drivers and all of that and appreciating it. When you talk about that I assume you're not saying that a difference of FN20 is not a significant difference. You're referring to it not being significant to the average driver and their perceptions and expectations.

A. Correct, that's correct.

Q. I've heard your evidence and it does just seem that you have a difference of opinion with Dr. Flintsch on it. But there is one thing that I want to ask that -- I want to ask you about that.

It seems to me from what I've heard from you that it's not that the average driver appreciates the difference. They are not consciously thinking about what the friction is on different stretches of highway but, rather, is that they don't appreciate it, and they gain at some appreciation of if they hit the brakes on a high friction area they get some general sense of how long it's going to take them to stop, and if they're on a much lower friction area then they might not have that buffer. So it's more of a lack of appreciation of friction. Do you agree

with that or no?

A. Interesting way to describe it, but it's possible.

Q. Okay.

A. I'm looking at this graphic right now and you see the huge difference at the QEW, and I know there's some ramps there, I know some bridges there, bridge with different asphalt on it, but if it's a new facility that was -- you wouldn't -- nobody would know the difference between them. The average driver doesn't have any appreciation.

Q. I'm not sure the -- of using you. But just -- we heard about the LINC, how it was resurfaced just in 2011, but we know that the QEW interchange was completed in late 2008, early 2009, so we're not dealing with any new pavement there --

A. Right.

Q. -- either so ...

You can take that down, Registrar, thank you.

Regarding the UK standards. Before I get to that I want to come to a couple of things.

First of all, I don't see in your report any suggestion -- start with Englobe. You've reviewed the Englobe grip tester results?

A. Correct.

Q. And you don't take any issue with those as being inaccurate or unreliable, right?

A. Correct.

Q. We already discussed you don't take any issue with the ARA -- obviously the ARA results being inaccurate or unreliable, and I think similarly with the MTO results, although it's a shorter segment that they are --

A. Right.

Q. And you don't take any issue with -- as we discussed you agree that the MTO and ARA results show that skid resistance had levelled off from 2014 on?

A. Correct.

Q. And same with the Tradewind grip tester measurements. You don't suggest in your report that there is any issue with respect to the accuracy and reliability of the results themselves?

A. That's correct.

Q. And I don't think you take any issue with the observation that the Englobe results in 2019 are consistent with the Tradewind results showing like the ARA/MTO results, that the friction had levelled off?

A. Yes. So the grip numbers are comparable to each other, the break force trailer numbers are comparable to each other and they show it's levelling off, correct.

Q. Right. So they are -- broadly speaking, they are all confirmatory of one another, yes?

A. Yes.

Q. Broadly speaking, right?

A. Yes.

Q. In talking about the investigatory levels. I think everyone agrees, Dr. Flintsch agrees with this, I think -- with you that a jurisdiction shouldn't just import a friction management program including investigatory levels, holus bolus from another jurisdiction for the reasons that you say, I think, and in your report that you talked about this morning.

And if I could summarize it,

it's because there are issues about -- I think you talked about the axel loads and so forth is one thing and the amount of polishing that can occur, but also it's set by what is attainable in a particular jurisdiction based on things like mix design and available aggregates, right?

A. This is correct.

Q. Because there's no point mostly -- mostly aggregates are sourced within the jurisdiction because --

A. Of course.

Q. -- except here when they came from Quebec, but close enough.

So they -- because there's no point in setting an investigatory level which is too high for the aggregates that are available for use in your jurisdiction.

A. That would be correct.

Q. And part of it is also -- I mean, maybe you can obtain it but not at a reasonable cost, fair?

A. Yes.

Q. And there's always a cost benefit analysis. I mean, it's like no road is completely safe, there's always going to be some

collisions, so the question is what is the acceptable level.

A. Correct.

Q. But then you go past that to say that there's no relevant or use whatsoever to the UK guidelines in Ontario. That's what I take you as saying ultimately.

A. I'm saying, ultimately, that the guidelines should not be used in the context of Ontario conditions without validation. I'm not saying there's no value whatever. I'm simply saying the structure is there but this -- taking them and applying them is not good piece of engineering.

Q. Okay, but there's two things here. One is -- and I think we're completely agreed on this -- that Ontario shouldn't just be taking the UK --

A. Agreed.

Q. -- and demand categories and just using them here. I think we agree on that.

A. Okay.

Q. Where we may have some disagreement, and I think your disagreement with

Dr. Flintsch is whether or not anything can be taken from those in a particular -- from the UK standards in a particular instance. And I take you as saying, and please correct me if I'm wrong, that they cannot be used in any way in a particular instance?

A. Yes, I guess so. Yes.

Q. Okay. One thing I would think you would have to agree with, talked about, is -- one thing you UK guidelines recognize are the importance of friction demand categories where -- right? Where different investigatory levels are applied based on, number one, the type of facility, right?

A. Correct.

Q. And second, on geometric factors?

A. Correct.

Q. So the idea again of, however defined, tighter radius curves, for example, right?

A. Yes correct.

Q. And approaching interchanges. Those are all part of the analysis right? Okay. And the next part of your issue

with the grip tester results by Tradewind is the correlation that you discussed earlier. And what you said this morning was that the Tradewind data is of some value. I think you said you might take this data, you got the time, and go into the field and see if there might be a reason for the numbers getting higher and lower and that first you were talking about the higher numbers that were in the 50s on the LINC?

A. Correct. There's an obvious difference so go find out why.

Q. Right. Why is that, okay. So you then come to the conclusion that, okay, that's the LINC, it's a different pavement. Okay. But then you also referred to a couple of spots in their 20s and -- that you can't tell if that's concerning without going into the field to see if there's anomaly with testing or different texture surface pavement and so forth. But you're talking about an investigation, or part of one, right?

A. Of course, yes.

Q. And that's part of it. And part of it would also be even if it's not you, it's a traffic -- maybe you enlist a traffic

safety person but to go and say, hmm, are some of these places where we've got it in the 20s, high 20s or low 30s, remembering it's a grip tester, not a locked wheel tester, in the low 30s that -- and forgetting about the investigatory levels. But you see that those where they are and you look around and go, oh, wait, this is where the geometry is tight, if I can put it colloquially. That might be something you're also looking at, whether it's you or a traffic safety person?

A. Correct.

Q. And the reason I just flag the grip tester being different than the locked wheel tester is directionally you know that a grip number obtained from a grip tester is directionally going to be higher than a locked wheel tester results?

A. Correct.

Q. So you know when you're looking at the Tradewind report -- if you go back in time you know that those numbers in the 20s or low 30s aren't the same as what -- they are likely those are -- locked wheel tester is going to return a lower number, directionally?

A. Possibly. Don't know for

sure, but possibly.

Q. At the time of the Tradewind report, so when it's received -- the testing was done in November 2013 but it was also received at the beginning of 2014 -- at that point that's all the friction testing information that the City had in its possession apart from the 2007 pre-opening MTO results, right, which we can set aside, right?

A. Correct.

Q. And then they also had at that point the 2013 CIMA report that you talked about which is only about the stretch from Dartnall to Greenhill?

A. Correct.

Q. So when you state in your report that the Tradewind report and the Golder report at that time, that you're talking about in relation to those and the remedial -- investigation recommendation and the remedial measures talked about, but when you say that those were acceptable in 2014 and they had levelled off by then. The acceptable, first of all, you're talking about is in relation to FN30 and the --

A. Correct.

Q. -- results which the City didn't have, right?

A. Hm-hmm.

Q. That's a yes?

A. Yes, correct.

Q. So in hindsight you can say that, but you certainly couldn't have said that at that time if in you were in receipt of the report in the possession of the City?

A. And they had no test results from MTO, then correct.

Q. That's right, they did not. And also the City didn't know at the time that any friction -- that the friction had levelled off because they didn't have any other information, right?

A. Understood.

Q. So in that context I would like to put to you in there -- I know it's hard to do but you did talk about it so I'm going to ask you to do it.

In that context of receiving the Tradewind report and not having any of the other information except the 2013 CIMA report on a partial part of the highway, I suggest that if you

had received it, the Tradewind report and the Golder report, at that time with all the information you had, you would have done -- you would have recommended commencing an investigation, as Tradewind recommended, some sort of investigation -- you already said some of it would have triggered you to that -- or in addition to that you would have recommended an investigation involving additional friction testing using the locked wheel tester that you were familiar with.

A. Agreed.

Q. Thank you. What you would not have done was ignore the Tradewind report if that was the only friction information that you had?

A. As I stated, there's value to the information because you've got it at a fairly high frequency and relative differences mean something.

Q. Right. Moving back now to you and Dr. Flintsch to present day.

You discussed about your issues with the conversion, and I get that and -- I don't get the math so -- I'm an English major, I

don't get the math.

A. Understood.

Q. You were discussing about the issue, about it being simple, his approach, or simplistic and so forth. I'm actually not getting into whether it's critical or not. But you were talking about him basing the reliability of his conversions from grip number to FN90, him confirming the results of that as being generally in line with one another. And that's what you were taking issue with when you referred to it as simplistic, the confirmatory nature of it, right, and you're maybe it's just luck?

A. That's my -- exactly, correct.

Q. But -- and you said that the conversion itself was -- and this is where it's beyond me but -- mathematically valid --

A. Correct.

Q. -- but dangerous to assume that it would be correct in all situations?

A. That's correct.

Q. Right. But -- so all -- this isn't all situations though. So no one is suggesting that this conversion should, without

further testing and so forth as you described, that it should be relied on in other situations, that you just take this conversion and use it in another circumstance. No one is suggesting that.

In this circumstance, though, would you not agree -- if you don't, you don't -- but would you not agree with me that whether it's applicable in other situations, if you do the conversion and -- as we've already discussed all of the results are pretty consistent with one another, doesn't that suggest that maybe it doesn't matter, doesn't that suggest the conversion is reasonably accurate?

A. If you apply this to conversion, which we did, it takes you back to an FN number that's greater than 30, which means in accordance with MTO it's not considered to an investigatory requirement but --

Q. Except when it's below?

A. -- except where it's below, and the use of that GN number to apply the UK guidelines would strongly suggest that you need to be doing an investigatory action. So I look at the two and say well, if you use it here in Ontario and you rely on it you're not going to

have to do anything, and if you use -- if you don't use it, you use the UK guidelines in that respect, then you're going to have a significant problem and you're going to need to do an immediate action. So it's giving you two answers.

Q. Well, no because --

A. -- giving two --

Q. -- investigatory level. You don't have to take any action. All it means is that, like Tradewind, you should investigate this, which isn't all that different than -- if I've understood you correctly if you're applying an FN30 level over 500-metre stretches you have to look at those stretches, right?

A. It's recommended that you look at those stretches. It doesn't mean you got to.

Q. Fine, but you're the one that's saying that's what we need to apply. But what's adequate in Ontario is FN30, like the MTO says, and if that's the standard you're using you kind of got to go with that, don't you?

A. And I said I would go and look at it, correct.

Q. Great, thank you.

Last thing I want to talk -- I just want to come back to the friction is a contributory factor, and I don't want to make too much, I just want to make sure I understand what you were saying.

You said you agree with Dr. Flintsch that you can't rank causes generally, right? And the four particular categories which -- and those categories are inter-related, I think you would agree, right?

A. Agree.

Q. You can't look at them in isolation because they all go together.

A. Right.

Q. And you refer to the wet road collision proportion in 2015 that CIMA reported on, which is 50 percent on the --

A. Right.

Q. -- that that was high compared to what would be expected, and you said you would expect between 20 and 40 percent, 50 is higher than I would expect, a bit on the higher side. That's what you said?

A. Correct.

Q. And you've also reviewed

CIMA's January 2019 roadside safety assessment, right?

A. Correct.

Q. And that gave the wet road collision proportion as 64 percent for the Red Hill mainline and up to 88 percent between Greenhill and King and between King and Queenston, right? And I assume you're aware that those are also, broadly speaking, the areas where tightest horizontal curve alignment and is the closest exchange and ramp spacing is?

A. General, correct.

Q. So if 50 percent proportional of wet road collisions is a bit on the higher side for you, I take it these are proportions that are well over a bit on the high side?

A. Agreed.

Q. Very high, right?

A. High, correct. Agreed.

Q. 88 percent, very high?

A. 100 percent is very high.

Q. That's true. But it's not. 88 percent is pretty high.

A. All right.

Q. And I suggest that when you're looking at that and you're considering in a general sense, not a specific accident reconstruction sense but in a general sense, if you're looking at contributory factors, while it's not friction, you say it's rarely if ever but predominant cause, which is also -- Dr. Flintsch tell us it's that -- but that may not be the predominant cause but it is a contributing factor to the high wet road collision proportions; is that fair?

A. Fair.

MR. LEWIS: Just one moment. Thank you, I don't have any further questions.

So subject to any re-examination or questions by you, Commissioner, that is it for me. Thank you, Mr. Hein, I appreciate your time.

MR. CHEN: Can we get 10, 15 minutes to reassess if I need to ask any questions?

MR. LEWIS: You're on mute, Commissioner.

JUSTICE WILTON-SIEGEL: Sorry, I censored myself. Let's take ten minutes we'll

return at 10 to 3.

--- Recess taken at 2:41 p.m.

--- Upon resuming at 2:50 p.m.

MR. CHEN: Just a couple of questions, Mr. Commissioner.

JUSTICE WILTON-SIEGEL: Go ahead.

EXAMINATION BY MR. CHEN (CONT'D):

Q. Mr. Hein, Mr. Lewis had asked you about an e-mail where you wrote to Dr. Uzarowski and asked about the subject line, which I think was Red Hill Valley friction problem, and that was in I think January 22nd, 2018. At that time had you formed any conclusion that there was a friction problem on the Red Hill Valley Parkway?

A. No, I did not.

Q. And your evidence today was that the friction values on the Red Hill did not cause you any concern?

A. That is correct.

Q. Jumping around a little bit. Ms. Roberts had asked you questions about the use of the skidabrader and your experience with airports. You recall that?

A. Yes.

Q. And you were asked about whether skidabrading was used on a yearly basis and I believe you said in your experience it had not had been used on a regular basis and not probably yearly. Do you recall that?

A. Yes.

Q. So we've heard about your actual experience with skidabraders on roadways. Do you recall how long that lasted, the treatment?

A. The treatment that I was referring to on Guelph line was months.

Q. You talked about using a skidabrader at the airport to remove rubber. What's the typical use of the skidabrader, airports or roadways? What is it?

A. It has been -- at the time it was used mostly in airports because it was effective at removing the rubber, but it started to be used by other agencies for road -- typically interstate highway type roadways.

Q. So is the skidabrader commonly used for roadways in Ontario?

A. No. It hasn't been used -- Ontario 407 we did some concrete work with it.

The stuff I mentioned in Guelph Line. I don't recall it being used on any other roadways in Ontario.

Q. Ms. Roberts asked also you about the UK guideline being referenced in the TAC guide from two decades ago in 1997. Do you recall that? I just want to clarify a point on that. Was the UK guidelines reference or referred to in the subsequent versions?

A. No, it did not appear in the subsequent versions.

Q. If we could pull up Mr. Hein's expert report, HAM64775, image 4. Do you see that, Mr. Hein?

A. Yes, I do.

Q. I want to direct your attention to paragraph 8. You had a discussion with Mr. Lewis about the investigatory level and he had asked you about FN30 and whether remedial action may be necessary. I don't think he took you to your report but he was referring to that first sentence there in paragraph 8 where you say:

"FN30 at 90 kilometres an hour is greater to being acceptable friction value and that

generally results below this may merit further investigation."

That continues to be your opinion?

A. That's correct. In your statement you mentioned that he discussed the -- not the intervention, the action limit or -- you said something just a minute ago that warranted action or warranted --

Q. "May merit further investigation."

A. It's further investigation. It's not required action. It's simply meriting further investigation, correct.

Q. So if it's just under 30 -- you know, we looked at the ARA results and I think it was 29.6 or maybe even 29.7 --

MR. LEWIS: I would like to say something before this question is asked, Commissioner.

This is an inquiry and we're almost at the end of the evidence. I think in civil litigation this would not be proper reply because it's all part of the report. Mr. Hein

gave his initial evidence. I cross-examined on the specific point. There was nothing new, nothing that's the proper area of reply. I appreciate there's been a different result --

JUSTICE WILTON-SIEGEL: Let me hear the question first.

MR. LEWIS: Thank you.

MR. CHEN: Just to cut to the chase, I wanted to understand and seeking some clarity as to whether there's room for discretion or engineering judgment that can be applied when using FN30 as an investigatory limit.

JUSTICE WILTON-SIEGEL: I'll allow that question.

THE WITNESS: So in my mind definitely there is room that would merit additional investigation provided other factors were considered.

BY MR. CHEN:

Q. At the outset of the examination Mr. Lewis asked you about your retainer with the City in civil proceedings. Not entirely certain what the objective is there. I would like to clarify a couple of points.

You understand that you have

an obligation to be -- provide objective, non-partisan evidence in this inquiry.

A. That's correct.

Q. And have you been independent and objective in the evidence that you've provided today?

A. Yes, I have.

Q. I understand you've worked with John Emery for many years?

A. Correct.

Q. And you indicated before there aren't many Canadian professionals with expertise in pavement friction, correct?

A. That's correct.

Q. It's a small group and you all tend to know each other?

A. I'm sure we do.

Q. In fact, were you aware that John Emery, your former colleague, was initially engaged as an expert by commission counsel?

MR. LEWIS: I'm sorry, I'm going to object.

JUSTICE WILTON-SIEGEL: I don't understand where this is going, Mr. Chen.

MR. CHEN: I had understood there to be a question about the independence and objectivity of Dave Hein and just wanted --

JUSTICE WILTON-SIEGEL: I don't see what Mr. Emery's prior involvement has to do with Mr. Hein's independence.

MR. CHEN: I'm happy to move on.

JUSTICE WILTON-SIEGEL: Thank you. I think you should move on.

BY MR. CHEN:

Q. Mr. Hein, Mr. Lewis put to you that if you received the Tradewind report in 2014 and did not have the 2014 MTO results you would have recommended some sort of investigation or further -- or friction testing or additional testing using the locked wheel, and I think you agreed to that; is that right?

A. Correct.

Q. Just going back to that first. With respect to the investigation I believe you previously said that you may have done a site visit to identify any causes of low friction?

A. That's correct.

Q. And so not seeing anything, and I don't think you indicated earlier, but what would you have done?

A. I probably would have waited until another round of testing or another year and had looked to see if there are any differences that occurred.

Q. So that takes us to 2014. If you did further testing, and we know we have the 2014 results, would you expect to get something similar as to what the MTO would have had?

A. Yes, I would.

Q. Just to reiterate, did those results give you any concern?

A. No, they do not, did not.

MR. CHEN: Thank you, Mr. Commissioner, those are my questions.

JUSTICE WILTON-SIEGEL: Thank you.

First of all, Mr. Hein, thank you very much, you're excused. Before you go, though, I want to thank you for your report for the time you put in it and the time you spent today in giving your testimony. It's much

appreciated and very helpful to the inquiry.

THE WITNESS: Pleasure to be of assistance.

JUSTICE WILTON-SIEGEL: Secondly, let me then just recap for everyone's benefit where we are, as I understand it.

We've now concluded the evidence in Phase 2 of the public hearings, and I guess I should say I want to publicly thank again the participants and the experts for their evidence in this stage.

My understanding is commission counsel will determine if there's any further oral or affidavit evidence to be received in public hearings as a result of documents that the inquiry has received since the conclusion of Phase 1, but I don't anticipate -- I don't think it is anticipated by anyone that there would be further oral testimony at this time.

The next stage then will be three days of oral submissions that are scheduled for March 22 to March 24. These will be live-streamed, as have the public hearings to date. In advance of these oral submissions, the inquiry is to receive written closing submissions

from the participants by March 10. We regard that as a hard date which will be -- and those submissions will be posted on the inquiry's website.

I want to invite, and I should stress, that if any other member of the public who wishes to file a submission may do so provided they respect the March 10th date as well.

So with that, I thank participants and the commission counsel for their work in Phase 2 and we will stand adjourned now until 9:30 on March 22nd.

--- Whereupon at 3:02 p.m. the proceedings were adjourned until Wednesday, March 22, 2023 at 9:30 a.m.