Red Hill Valley Parkway INQUIRY

OVERVIEW DOCUMENT #4:

THE MINISTRY OF TRANSPORTATION OF ONTARIO AND FRICTION TESTING

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A. Introduction

1. Overview Document #4 pertains to the MTO. Due to the lengthy time period and disparate topics covered, it is not entirely chronological. Rather, it is organized by subject-matter and, within those subject-matter sections, it is generally chronological. Overall, Overview Document #4 is divided into two parts.

2. Part I pertains to the MTO itself, its Designated Source of Materials list, SMA, MTO friction testing including but not limited to the RHVP, and interactions with the City of Hamilton. Part I proceeds more or less chronologically until the end of 2007. From 2008 to 2016 it is divided into three separate topics that proceed chronologically within each section.

3. Part II of this Overview Document involves the MTO's consideration of friction number standards and specifications from 2005 to 2015. Because it covers an entire decade, rather than interspersing this subject with all others over such a long period of time, it is presented on its own. This is not intended to suggest that this subject is unrelated to the topics covered in Part I, or is less important. To the contrary, they are closely related and should be read together.

4. Commission Counsel has endeavoured to confirm the names, organization, and position(s) held by the individuals referenced in this Overview Document. This information is provided in the body text where each individual is first referenced.[1] A complete list of

[1] Where more than one position is held by an individual within the time frame covered in this Overview Document, the information in the body text will reflect the position held at the time of first reference. For a complete list of all positions held by all individuals referenced in Overview Document #4, see Appendix A.

the individuals and their respective information can be found at Appendix A of Overview Document #4.

5. The facts contained in Overview Document #4 have not been tested for their truth. Commission Counsel and the participants may call evidence from witnesses at the Inquiry that casts doubt on the truthfulness or accuracy of the content of the documents underlying this Overview Document. The participants will also be able to make submissions regarding what, if any, weight should be given to any of these documents.

PART I. THE MTO, SMA, THE DSM, MTO FRICTION TESTING, AND INTERACTIONS WITH HAMILTON

A. Overview of MTO specifications

6. The Ontario Provincial Standards (OPS) organization publishes and maintains a comprehensive set of Ontario Provincial Standard Specifications (OPSS) for use by road and public works owners, contractors, and consultants in Ontario. The OPS organization consists of various Specialty Committees and committee members, with the majority being municipal representatives.

7. Provincial-oriented specifications are developed by MTO to reflect the administration, testing, payment policies, procedures, and practices of the MTO, and are not binding on municipalities. However, OPS Specialty Committees, including the OPS Pavements Committee, update and revise some of those specifications for municipal use by ensuring they reflect the administration, testing, payment policies, procedures, and practices of municipalities in Ontario. The OPS Pavements Committee is one such committee. It consists of a majority of municipal representatives in addition to industry

and consulting representatives, as well as an MTO representative (whose role is to speak to the nature of the provincial-oriented specifications).

8. As addressed in more detail below, relevant OPSS include:

(a) OPSS 310: Construction Specification for Hot Mix Asphalt;

(b) OPSS.PROV 1151: Material Specification for Superpave and Stone Mastic Asphalt Mixtures; and

(c) OPSS.MUNI 1151: Material Specification for Superpave and Stone Mastic Asphalt Mixtures.

9. In addition, the MTO publishes special provisions for incorporation into its contracts, which may be of general application or may be specific to a particular MTO contract. Relevant special provisions include:

(a) Special Provision No. 110S12, replacement of OPSS 1003: Material Specification for Aggregates – Hot Mix Asphalt ("SP110S12"); and

(b) Special Provision No. 313S45M, Amendment to OPSS 313 and OPSS 1149: Material and Construction Requirements for Stone Mastic Asphalt.[2]

10. Both OPSS and special provision documents may be included as contractual terms in pavement-related contracts with the MTO. In addition, the MTO may specify additional or different contractual terms in its contracts.

[2] MTO0000390; MTO0024596 attaching MTO0024597

11. The MTO also publishes directives. MTO's Surface Course Directive, PLNG-C-003, specifies the type of surface course to be used based on traffic volume. In 2003, Surface Course Directive was revised to permit the use of SMA for high traffic freeways (ESALs > 3 m /design lane).[3]

B. The DSM and aggregate sources

12. The MTO maintains a Designated Sources of Materials list (DSM). The DSM lists the products and their sources that the MTO will accept as suitable for MTO contracts. The DSM does not list all products that MTO uses.[4]

13. The DSM Criteria for Approval "specifies the general procedures that are followed in the approval process for listing products in the Ministry of Transportation's Designated Sources for Materials Manual … It sets out the criteria that specific products have to meet, supporting documentation that must be provided, and procedures that are to be followed so that the [MTO] may determine the suitability of the product for its use. In general, OPSS 128 governs DSM usage by MTO".[5]

14. At section 13 of the DSM Criteria for Approval are the application-specific submission requirements necessary to achieve DSM status, including for premium surface course aggregates included at section 3.05.25 of the DSM ("DSM 3.05.25"). DSM 3.05.25 sets out products and sources for coarse and fine aggregates for Superpave 12.5FC1, Superpave 12.5FC2, SMA, HL1, DFC, & OFC.[6]

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[3] MTO0000053
[4] MTO0004472
[5] MTO0004472 at image 4. This is the 2003 version of the overview of the DSM Criteria.
[6] MTO0004472 at images 15, 20-21

15. In a map dated November 2004, there were sixteen sources listed on DSM 3.05.25 as approved aggregates for "DFC, SP12.5 FC2 and SMA".[7] In a map dated September 2007, there were twenty listed sources for "DFC, SP12.5 FC2 and SMA".[8]

16. A July 2003 MTO publication by Chris Rogers (Manager, Soils and Aggregate Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), Bob Gorman (Senior Aggregate Engineering Officer, Soils and Aggregate Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), and Becca Lane (Senior Pavement Design Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), titled "Skid-Resistant Aggregates in Ontario" set out the approach to selecting aggregates with good frictional properties, their sources, and friction testing methods for same.[9]

C. MTO approach to pavement surface friction and aggregates before construction of RHVP by Hamilton

17. From at least 1982, the MTO evaluated pavement skid resistance (friction) by using (what have been referred to as) "tentative guidelines". In a 1982 publication, the "tentative guidelines" classified friction levels (FN, or SN) of 31 as "good" and 25 to 30 being "borderline", when measured at a speed of 100km/hr.[10]

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[7] MTO0022644 at image 2

[8] MTO0012328 at image 1

[9] MTO0003580 attached to MTO0003579

[10] RHV0000610: Kamel & Gartshore, 1982, "Ontario's Wet Pavement Accident Reduction Program". Cited in MTO0018621, April 28, 2004 article titled "Pavement Surface Friction on Ontario Highways" by Chris Rogers, Bob Gorman, Becca Lane and Frank Marciello.

18. On August 6, 2003, the MTO issued a "Ministry Directive" with the subject: "The Use of Surface Course Types on Provincial Highways" respecting various mixes including Superpave and SMA (this is noted above as the "Surface Course Directive, PLNG-C-003").[11] It stated:

> **Surface Friction Characteristics**
>
> Bituminous mix consists of about 95% aggregates, which have a great influence on the skid resistance or the frictional characteristics of the pavement. The skid resistance of wet pavements depends not only on the mix type but also on the physical properties of the aggregates used in the mix and the traffic volume and speed [5]. Thus, highways with AADT greater than 5000 vehicles/lane require high stone content in stable mixes with high wear and polish resistant aggregates.

19. An MTO paper dated April 28, 2004, titled: "Pavement Surface Friction on Ontario Highways", contained the following statements generally applicable to the MTO's approach to highway friction management:[12]

> Since the late 1960's, major efforts have been made in Ontario to measure and improve the frictional properties of pavements. This has included the use of improved types of asphalt mixes and the search for new aggregate sources with improved frictional characteristics. With increased traffic, there has been a greater awareness of the influence of the frictional properties of pavement on safety. An Ontario study in the early 1980's showed that an improvement in frictional properties of pavements will reduce accidents caused by skidding in emergency braking situations, sliding in curves, or during emergency maneuvers.
>
> Ontario has adopted a direct method of measuring the frictional properties of pavement surfaces using a locked wheel device. The brake-force trailer [ASTM E] technique, using a ribbed rather than a smooth tire, has been chosen.[13]
>
> ***
>
> Polish-resistance is much more difficult to measure and predict than wear-resistance. Micro texture is the fine scale (less than 0.5 mm) texture possessed or developed by the individual aggregate particles. It may be thought of as the "sandpaper-like feel" of the particle. Most materials, when freshly crushed, have a good micro texture. Desirable

[11] MTO0000053 at image 4

[12] MTO0018621. Authors: Chris Rogers, Bob Gorman, Becca Lane and Frank Marciello. The April 28, 2004 date is derived from the image of the pdf that appears on the March 25, 2008 email at MTO0018620 to which the paper is attached.

[13] MTO0018621 at image 2

aggregates are those that either resist loss of this texture or behave in such a manner as to regenerate this texture. These are generally termed "polish-resistant aggregates".

The test selected by MTO for evaluating micro texture is the Polished Stone Value (PSV) Test [BS 812, 1989]. The higher the PSV obtained in the test, the better the frictional properties of the aggregate.[14]

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The PSV is the most important aggregate characteristic affecting skid resistance of asphalt pavements. Studies in Ontario have confirmed the significance of PSV of aggregates in determining frictional properties of pavements.[15]

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MTO requires that sources of skid-resistant aggregate for premium asphalt surface applications be from a pre-approved list. The aggregate processing operation is inspected, and the bedrock is evaluated for quality and consistency. In general, satisfactory quarry sources contain rocks that are even-grained, homogenous, and consistent, with uniform quality throughout the site; and a consistent aggregate density. The quarry should not contain undesirable rock types such as coarse-grained mica-bearing pegmatite, marble veins, and weathered zones. A quarrying plan must be devised so as to ensure a homogenous, uniform product. Since the early 1990's, it has been a condition of approval of new sources that the aggregate maintain an average PSV of no less than 50 (quartzite excepted) with no value less than 48 and an AAV of 6.0 or less. In addition the aggregate must meet requirements for shape, frost resistance and water absorption.

MTO normally requires a 500 m pavement test section using the new aggregate. The aggregate producer is responsible for arranging for construction of the test section. The pavement is tested for frictional characteristics with the brake-force trailer for two years before the material will be considered for inclusion on the approved list. Inspection and skid testing will take place over the life of the test section.

MTO staff visit each source on a yearly basis and take samples for testing. In addition, quality assurance samples of material used on contracts are obtained for testing. In 2002, over 65 samples of coarse and fine aggregate were received from 12 sources used on a total of 35 contracts.[16]

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In 1999 and 2000, random testing was conducted of the frictional properties of pavements in central and northeastern Ontario. These had been paved with local sources of siliceous aggregates (granites and gneisses) in asphalt pavements. The average skid number (SN) was 43, with a range from 32 to 54. This is comparable to the range in SN found when specially selected aggregates are used on more heavily trafficked highways in southern Ontario.[17]

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[14] MTO0018621 at image 4
[15] MTO0018621 at image 6
[16] MTO0018621 at image 7
[17] MTO0018621 at image 9

9- CONCLUSIONS

1. The frictional performance of asphalt pavement is strongly influenced by the nature of the aggregate. In turn, aggregate performance can be predicted by laboratory tests such as Polished Stone Value and Aggregate Abrasion Value, augmented by experience derived from field performance.

2. In Ontario, satisfactory aggregates from a frictional point of view are confined to selected siliceous rocks of Precambrian age and dolomitic sandstones of Ordovician age found in eastern Ontario.

3. Limestones and dolostones usually give poor frictional properties in high traffic volume pavements. The Ministry of Transportation does not permit the use of carbonate rocks in surface course asphalt in areas where siliceous rocks are found.[18]

20. A November 4, 2004, presentation slide deck by Guy Cautillo (Senior Manager, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), titled “Pavement Friction at MTO”, described MTO’s practice around friction testing as follows: [19]

Fundamentals

- The frictional resistance of a pavement surface is quantified as a skid number (SN), also known as Friction Number (FN).
- Defined as "the ratio between the frictional resistance acting along the plane of sliding and the load perpendicular to this plane," the skid number is an important factor to consider when selecting materials for highway design and construction.
- MTO has adopted a direct method of measuring the frictional properties of pavement surfaces using a locked wheel device (ASTM brake-force trailer) with a ribbed tire.[20]

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MTO Practice

- Friction testing is routinely carried out to evaluate new aggregate test sections or when the surface of a new pavement or new pavement technology needs evaluation.
- Regions also request skid resistance testing in high collision locations, where lack of friction is suspected.

[18] MTO0018621 at image 11

[19] MTO0033718 (slide deck) attached to MTO0033716 (an August 29, 2008, email from Frank Marciello referring to attachments as “the current criteria used for the skid resistance evaluation. Attached presentations and video should give you an in depth knowledge of ASTM Friction Management in Ontario”)

[20] MTO0033718 at image 3

- Regional requests are serviced internally, with no spare capacity.

- The 1980's practice of aggregate pre-qualification based on laboratory testing and test sections has matured and continues to serve satisfactorily. No review required.

- A move to bi-annual network testing is estimated at approximately $6 M annually.[21]

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MTO Practice: Wet Pavement Collisions

1978: MTO implemented systematic procedures for the identification and treatment of highway locations with high rates of wet pavement collisions (black spots).

1980: The Ontario Wet Pavement Accident Reduction Program was documented in MSR-80-001 report by Research and Development Branch.

198?: Systematic procedures for the identification and treatment of highway locations with high rates of wet pavement collisions were abandoned after N. Kamel left MTO.[22]

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Friction Monitoring Practice

Ontario: Regional requests at locations with high collisions, deemed to have low friction and newly constructed pavements test sections (Network: 43,000 lane-km)[23]

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Pitfalls

- AASHTO 1967 recommended minimum SN value has not been revised since 1967 to-date. NCHRP Project 1-43 "Guide to Pavement Friction" will conclude by Jan 2006.

- To automatically resurface a monitored location with low SN or unusually high number of wet pavement collisions is poor practice. There are often other causative factors that must also be investigated. If these other factors are left untreated, resurfacing may lead to higher speeds and more collisions.

- Friction treatment warrants linked to litigation exposure.[24]

21. Frank Marciello (Pavement Evaluation Supervisor, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial

[21] MTO0033718 at image 5
[22] MTO0033718 at image 6
[23] MTO0033718 at image 8
[24] MTO0033718 at image 9. This is referring to the pitfalls of using friction warrants (thresholds at which treatment will occur. Selected U.S. friction warrants are listed at image 7 of the slide deck)

Highways Management Division, MTO) authored a document that described the machine used by the MTO to perform friction testing, the ASTM E274 Brakeforce Friction Unit.[25] Mr. Marciello was the operator of the testing machine. The description states:

MTO's ASTM E274 Brakeforce Friction Unit

- Since 1981, MTO has utilized a State of the Art, non destructive, objective, quality assurance technology to determine frictional characteristics of a pavement surface during simulated wet pavement conditions at posted speeds on Ontario highways
- Friction Number (FN) based on forces required to lock up the left ASTM E501 test tire on trailer device towed by a customized vehicle
- Determination of frictional properties to assess performance of micro and macro-texture within the matrix of pavement mix
- FN data collected, processed and distributed by the Materials Engineering and Research Office in Downsview
- Measurements and improvements in selection of asphalt mixes and the search for new aggregate sources with improved frictional characteristics
- Greater awareness of the influence of frictional properties of pavements on safety
- Pavement performance records on various pavement types, influencing capital programming decisions
- Ability to carry out measurements on suspected and/or accident prone highway sections which may or may not relate to friction
- Other pertinent uses include contract warranty performance, spot hazard locations, performance of texturized pavements, approvals of newly introduced aggregates, in/exclusion of aggregates to DSM list
- Requests for MTO friction work made by Head Office, Regional Engineers, OPP, Coroner's Office
- Data is crucial to formulating and implementing sound strategies for the maintenance, rehabilitation and safe operation the entire provincial highway network

[25] MTO0033717 document authored by Frank Marciello, attached to MTO0033716 (an August 29, 2008, email from Frank Marciello responding to an email requesting "the current criteria used for the skid resistance evaluation", with Mr. Marciello stating that "Attached presentations and video should give you an in depth knowledge of ASTM Friction Management in Ontario")

22. In March 2005, Mr. Marciello gave a presentation to the MTO's Geotechnical Committee (revised in 2013) that described the MTO's friction evaluation processes.[26] The presentation provided an overview for the rationale, method and equipment used for testing. The presentation stated that "Typical FN80 ranges in Ontario > 28-50" and that "Overall measured friction decreases progressively with increasing speed".[27] It also outlined the types of request for friction testing, divided into two categories: "Special Requests" (including "municipal concerns"), and "Spot Hazards" (including "Pavement section having an unusual number of accidents during periods of wet weather").[28]

23. Mr. Marciello described the historical MTO approach to friction in an email response to an external inquiry on September 4, 2013, which included the following:

> Pavement friction in Ontario is measured by using this Ministry's ASTM E274 Pavement Friction Tester, manufactured by Dynatest Inc. of Michigan, USA. It uses an ASTM E501 test tire to measure surface friction by recording the various forces required to lock up a trailer tire. A course surface will require a greater force to lock up the tire, thus improving the friction properties. Highway pavements are tested during simulated wet pavement conditions as per ASTM E274, at posted speed limits. The FN (Friction Number) that results, indicates the surface friction level.
>
> Currently, Ontario has a threshold friction requirement that applies to all pavements types at all test speeds. Mto is currently moving towards the possibility of establishing a standard.
>
> …
>
> Since the early 80's, a threshold Friction Number has been used to indicate further investigation into the pavement performance of a particular surface mix. Engineering personnel were notified of the results.
>
> We are currently assessing our frictional requirements on different pavement types at a standard speed, as per ASTM E274.[29]

[26] MTO0035791 (March 2005 presentation, amended in 2013 per MTO0035790 (June 20, 2013 email))
[27] MTO0035791 at image 14
[28] MTO0035791 at image 18
[29] MTO0035016

24. A June 7, 2005, slideshow by Tom Klement (Senior Research Engineer, Concrete Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) titled "Pavement Friction Testing and Management in MTO", stated:

> Drivers hate surprises!
>
> Pavement surface distress, including low friction, typically does not affect collisions, unless:
>
> • It is severe and localized, causing a driver surprise
>
> • It is located in road sections with increased demand on both the vehicle and driver, i.e. isolated curve
>
> Given a progressive feedback, drivers adjust their speed and focus
>
> ***
>
> Currently MTO does not use trigger values for site investigations. An example of a protocol based on selected U.S. practice is presented[30]

25. The September 27, 2005, minutes of the MTO's Geotechnical Committee meeting stated:

> Uniform interpretation of pavement friction testing reports
>
> Variation of friction numbers (FN) minimum on recent contract. Using mean FN can be erroneous because of high variation – need more detailed observations. Measurement intervals should be decreased when encountering large variations. Tom indicated that consultation be carried out with Traffic sections to determine areas of high friction demand and see if isolated low FNs need to be treated. "Slippery When Wet" signage should only be an interim measure. Tom noted that skid measurements are reproducible - possible correlation between maintenance activities and FN. KT indicated that surface course directive addresses using consistent patching. It is important to determine if low friction is a result of poor surface texture, aggregates polishing, and/or flushing.
>
> Eastern Region's wet pavement collision history / Friction Number correlation pilot
>
> 80% of ER network was tested. Tom indicated that preliminary results show that 30% of the time, concerns for low friction were justified. Tom noted that there is a high probability to have low friction where maintenance was performed (eg. using local aggregate mixes in

[30] MTO0013104 at images 3 and 18

> patching applications). Driver experience (adaptation) will also cause variations. Laura Donaldson is currently working on narrowing down problem areas. Tom will be generating a preliminary report, which should highlight high friction variability. [31]

D. MTO SMA use in Ontario to end of 2005, and identification of SMA friction issues

26. As of late 2005, the MTO had completed nine contracts using SMA. The first was a 1996 contract on Highway 401 and the rest were completed in 2004 and 2005.[32]

27. Minutes from a June 11, 2003 meeting between the Ontario Hot Mix Producers Association (OHMPA) and the Minister of Transportation included discussion regarding the increased use of SMA:

> **a) Stone Mastic Asphalt surface course for very high volume and heavy traffic**
>
> Response: In 2002, MTO issued a surface course directive, C-16 calling for the use of SMA on many high volume facilities. Based on a Southwest Region review of traffic volumes, additional roads in that region now specify Stone Mastic Asphalt as the required mix for the surface course.
>
> Details:
>
> - Stone Mastic Asphalt is a premium high performance mix, with high □resistance to loads and excellent frictional properties.
> - The price premium for SMA, relative to Dense Friction Course, is a barrier to widespread use. [33]

28. The September 28, 2005 minutes of the MTO's Joint Quality Assurance - Geotechnical Committee meeting noted concerns about friction associated with SMA contracts:

> SMA Warrants and Performance (Skid, Rutting) Issues
>
> The surface course directive indicates that SMA be used where required. CR noted that SMA does not appear to increase skid resistance. Rob Rollings indicated that a SMA contract in Central Region resulted in a shiny surface (except in the wheel track) in the pavement immediately after construction; initial skid resistance was in the mid 20s. CR

[31] MTO0011927 at images 2-3
[32] MTO0015047 at images 4 and 5; MTO0000118 at images 2 and 3
[33] MTO0023794 at image 4, attached to MTO0023793

> indicated that aggregate used in SMA has a lower number of edges compared to that of DFC. Low intial friction is probably due to thick AC film, which is lost with traffic. With trap rock, friction numbers do not get high with time – trap rock is a marginal aggregate from a friction point of view but does seem to give adequate but not great friction in DFCs. SMA does not seem to be meeting our technical expectations, high cost and rutting seems to occur.
>
> There was a consensus to delay future SMA projects until more information is obtained. [34]

29. A November 2005 MTO slideshow titled: "Performance Review of Stone Mastic Asphalt (SMA): Decision/Approval Item for EngCom November 2005" identified concerns with low initial/early friction.[35] It also provided an "Endorsement of the joint recommendation of the Geotechnical Committee and Quality Assurance Committee to pause implementation of SMA until current concerns resolved by allowing regions the flexibility to specify Superpave FC-2 as an alternative to SMA". The slideshow stated that "MTO regards friction values of less than 30 with concern due to significantly increased stopping distance."

30. According to the same November 2005 MTO slideshow, of the nine SMA contracts completed by the MTO, there were "Low initial/early frictional resistance concerns with SMA pavements: SN in the 20s (range 25 – 45)".[36]

31. In December, 2005, the MTO set out its concerns about low initial friction levels of freshly laid SMA in a "Regional Update" presentation with the stated purpose: "To alert regions to potential safety concern because of low initial friction values with recently constructed SMA."[37] In the presentation the MTO:

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[34] MTO0011914 at image 2

[35] MTO0015047 at image 7

[36] MTO0015047 at image 5. The slideshow shows friction testing results for each of the nine contracts individually at images 11, 12, 13, and 14.

[37] MTO0000118

(a) Identified the problem as first being raised in 2004, and confirmed in 2005.

(b) Identified the Ontario Hot Mix Producers Association (OHMPA) and Ontario Road Builders Association" as "strong supporters of the use of SMA and opposition to any pause in SMA implementation is anticipated."

(c) Stated that "data show initial mean FN of SMA sometimes falls below the desirable value of 30" and set out friction test results on the SMA projects completed to date.

(d) Stated that "Long term friction is not anticipated to be a problem based on performance of aggregate types used in DFC, and on comparison of trap rock SMA and DFC mixes (both mixes have similar friction and are above the 30 threshold)."

(e) Proposed short term measures for when the FN falls below 30, involving slippery when wet signs and/or application of sand or sand blast surfacing.

E. 2006: SMA Task Group established, and SMA friction investigations

32. January 17, 2006, was the first meeting of the MTO's "SMA Task Group". [38] The SMA Task Group comprised five MTO and four industry representatives and at the first meeting were:

> MTO: Mr. Cautillo, Mr. Rogers, Kai Tam (Manager, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), Anil Virani (Senior Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), Dennis Billings (Head,

[38] MTO0000220 and MTO0011905

> Geotechnical Engineering Section, Central Region, Provincial Highways Management Division, MTO)
>
> Industry: Joe Bunting (Chair, Education Committee, ORBA), Vince Aurilio (Technical Director – Field Engineer, OHMPA), Sandy Brown (Technical Director, OHMPA), Tom Dziedziejko (Director, Quality, Infrastructure, Aecon Group Inc., AME)

33. Mr. Virani was the Project Manager, and the co-chairs were Mr. Tam and Mr. Brown.[39]

34. The draft Terms of Reference for the SMA Task Group stated that "the main goal of the Group is to cooperatively address and resolve issues associated with SMA implementation in Ontario."[40] The specific goals of the Group were to:

> 1) Resolve issues with poor friction performance of SMA mixes, especially newly paved mixes.
>
> 2) Resolve construction and performance issues (flushing, rutting, segregation, pop-outs, poor joints, etc.) of SMA.

35. A slide show titled "Performance Review of Stone Mastic Asphalt (SMA) Industry Update" was presented at the first SMA Task Group meeting on January 17, 2006. It set out the history of SMA use in Ontario and friction measurements of Ontario SMA highway applications. The Industry Update referred to the FN "desirable value of 30" and "the 30 threshold" that triggered short term remedial action (signage and/or sand application) where the FN falls below 30.[41]

[39] MTO0011902; MTO0000221; and MTO0011823
[40] MTO0000221; and MTO0011823
[41] MTO0011824, in particular at images 12 and 14

36. On January 26, 2006, Todd Comfort (Area Construction Engineer, Provincial Highways Management Division, MTO) emailed Mr. Billings stating:[42]

> In addition to performance I think SMA is over priced. How can the industry flog a product that only get 2 additional years, 19 to 21, for 50% more cost? I believe cost is and (sic) issue. The little increase in AC and mineral filler does not add up. Are other jurisdictions getting their money's worth? I am tired of hearing that the price will go down if we tender more SMA jobs.

37. The second SMA Task Group Meeting was held on January 26, 2006.[43] The minutes stated:

> Sandy is not convinced there is a skid issue and questioned if any action is really warranted, noting that other jurisdictions don't appear to be reacting. MTO's measurements are at a faster speed and MTO's desire to aim for SN of 30 plus may be too conservative.
>
> MTO acknowledged that there is not a specification 'limit' or standard, but there is a comfort level at SN of 30 or higher. Historically this has been achieved in DFC mixes which only use approved aggregates.

38. On February 14, 2006, the third SMA Task Group Meeting took place.[44] The minutes stated:

> Sandy contacted Kevin McGhee of Virginia DOT. Info and pictures received from Kevin were sent out earlier by Sandy to all members. VDOT has not done any trials but they have provided pictures from Germany. VDOT's "unofficial" threshold SN40 is 20. Given the flattening out of SN / speed graph for SMA, it appears that VDOT's trigger value is lower than MTO's. Dennis is concerned that VDOT's number might translate to really low number for MTO (as low as 12!). Also of concern to Dennis is the perception that SN of 40 (if measured at low speed) is "good", but the same mix at higher posted speed will be much lower. Kai asked if Sandy could follow up with other US agencies regarding their threshold values. Sandy will follow up with both the US and European practices.

39. On February 19, 2006, Mr. Cautillo emailed Mr. Tam about SMA trials and FN thresholds.[45] He stated:

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[42] MTO0011830

[43] MTO0000223; and MTO0015013

[44] MTO0020050 attached to MTO0020049. The reference to "VDOT" is the Virginia Department of Transportation.

[45] MTO0028436

> Kai, why put a lot of energy into the FN?
>
> If we stick with the 30 that we are using as the minimum we should be ok. It does not matter if the low friction is experienced at the end of life or at the start.
>
> What others are doing is purely for comparison purposes but as far as we are concerned, once we select a limit we should stick with it for all uses.

40. On February 20, 2006, Mr. Tam responded stating:

> Guy, You are correct. We are sticking with the 30. The additional info is in support of our effort of "due diligent".[46]

41. March 2, 2006, was the fourth SMA Task Group Meeting.[47] The minutes stated:

> Clarified that VDOT's FN 20 is their absolute minimum. While Ontario does not have an absolute minimum, its desirable level of 30+ appears to be a better threshold. As transportation agencies seem to be assessing friction differently, we have to be careful how we equate different agency friction data."

42. On April 10, 2006, the sixth meeting of the SMA Task Group took place.[48] The minutes recorded a discussion that "there is a good history of using 30 as threshold" (referring to FN) based on two technical papers circulated. There was also a discussion of further testing and gritting specifications.

43. On May 1, 2006, Tom Kazmierowski (Manager, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) emailed Mr. Cautillo, Mr. Tam, Mr. Rogers, Mr. Billings, and Ms. Lane (all MTO) respecting "10 Years Comparative Friction Testing-SMA vs DFC- Hwy 401 - Contract 96-50 Milton" and attaching the test results.[49] He stated:

> Attached are the results of 10 years of friction testing on the Hwy 401 SMA and DFC surface from Trafalgar Rd to Regional Rd. 25 (Milton). There appears to be no advantage

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[46] MTO0028436

[47] MTO0000225. The reference to "VDOT" is the Virginia Department of Transportation.

[48] MTO0000228

[49] MTO0020111 attaching MTO0020112

> to the SMA surface over the 10 year period from a frictional resistance perspective based on this demonstration project

44. On May 19, 2006, Mr. Cautillo sent a draft email to Gerry Chaput (Director & Chief Engineer, Highway Standards Branch, Provincial Highways Management Division, MTO) for Mr. Chaput to send to the MTO regional directors to seek their assistance with SMA trials. The draft email stated:

> The purpose of this e-mail is to seek your support to incorporate Gritting Trials on new and existing SMA contracts to help us address the "potential low initial friction" concers that were identified last year.
>
> An industry/MTO Task Group was set up to review the problem and suggest short term solutions and long term changes to the specifications to eliminate the potential dangerous situation.
>
> The task force, has identified "Gritting of SMA" as a high potential short term technique for ensuring that we have adequate early friction. For the longer term changes the group is considering changes to mix design.
>
> Discussions between staff from the Butuminous Section of Materials Engineering and Research Offie and the regions have identified a couple of potential contracts where these changes could be tried, but we have run into some difficulties and we are looking to you to help us identify other sites. We need to identify contracts that will be paved this year where we can incoporate the SMA trials. These can be either contracts that currently call for SMA or that call for other surface course that could be changed to incorporate some SMA in lieu of conventional mixes.
>
> I am attching for your information a slide deck that Guy Cautillo and Kai Tam used last yeat when they spoke to you abou the potential problems with SMA.[50]

45. On August 3, 2006, Mr. Marciello circulated the results of the recent friction tests he conducted on Highway 11/17, to Mr. Kazmierowski and Dale Smith (Head, Geotechnical Engineering Section, Northeastern Region, Provincial Highways Management Division, MTO).[51] He wrote:

> Friction testing of the SMA and HL1 on Hwy 11/17 through the North Bay bypass was conducted on June 28, 2006. That is approximately 12 months after placement. With the high level of traffic through this facility (especially commercial) and the timing of the

[50] MTO0015197 attaching MTO0015198

[51] MTO0033002 attaching MTO0033003, MTO0033004, MTO0033005 and MTO0033006

> controlled intesections, it was only possible to collect a minimal amount of data on the SMA.
>
> Review the results showing SMA performance levels just above FN80 of 30 and if any questions arise, please call this office.

46. Mr. Kazmierowski then forwarded the results to Mr. Rogers, Mr. Tam, and Mr. Cautillo, stating:

> Even after a year, these skid numbers on the SMA of North Bay Bypass are still low. if tested at 100 kph, these numbers would be below 30 [52]

47. On August 14, 2006, Chris Raymond (Senior Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) emailed Mr. Virani, Mr. Tam, Mr. Rogers, and Mr. Kazmierowski, a slide presentation for Mr. Chaput titled "Review of SMA Short Term Performance Information Update for Gerry Chaput August 2006". [53] He wrote:

> Attached please find a draft version of our Early SMA Performance Review presentation for Gerry. It was developed with the awareness that Chris and Tom's views on the continued use of SMA are different than the views of our office. It is important that Gerry understand the different view points coming from MERO.

48. On August 23, 2006, Mr. Virani and Mr. Tam presented the "Review of SMA Short Term Performance Information Update for Gerry Chaput August 2006" to Mr. Chaput. Hannah Schell (Manager, Concrete Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) also attended the meeting and summarized it in an email to Mr. Chaput.[54] She wrote:

> To summarize the outcome of our meeting today to update Gerry Chaput on SMA issues:

[52] MTO0033002 attaching MTO0033003, MTO0033004, MTO0033005 and MTO0033006
[53] MTO0028708 attaching MTO0028709
[54] MTO0028648 attaching MTO0028649

-Anil, Kai (via teleconference) and myself were present. The presentation used as a basis for discussion is attached; input to the presentation was solicited from Tom Kazmierowski and Chris Rogers.

-Gerry's overall direction was as follows:

-continue use of SMA, pending provision of additional data as noted below under action items

-continue to collect data on early frictional performance of SMA pavements

-supportive of the general concept of a performance requirement for friction in future, as part of contract specifications (based on collection of sufficient data to provide support for specification limits, speed level at which measurement is made, etc)

-Issues raised:

-proposed signing may or may not be viable/appropriate from a legal standpoint

-length of time that low friction is an issue, relative to completion of contract operations, has impact on how signing could be handled (signing approach is based on assumption that friction issues are short term only, which may or may not be accurate for all SMA mixes)

-potential effectiveness of a lowered speed limit is questionable, as is enforcabililty once construction operations are over

-potential concern with gritting in may only be necessarly/appropriate on some contracts, and may be problematic if MTO is seen to be treating different contracts differently (i.e. diamond grinding treatment, versus gritting treatment, versus no treatment)

-rather than specification of gritting or other presciptive means of improving early frictional characteristics, a performance-based approach would provide advantages to both MTO and industry, but MTO would need to have substantial data to support the specification in terms of acceptance by the industry

-differing ability of contractors a concern

-Immediate actions will be:

-Hannah will contact Legal Branch to seek opinion with respect to acceptability/viability of "slippery when wet" or "new pavement--slippery" (Henry Weilenman)

-Bituminous Section will seek input of Traffic Office on viability of posting a reduced speed limit (Terry Short)

-results of those discussions will determine action on signing, should be brought back to Gerry for discussion at that point

-Gerry will provide an update to EngComm based on the presentation today, and will advise them that the short term plan is to continue with SMA work and that we will be

> monitoring friction on upcoming contracts and seeking a legal opinion on the proposed signing
>
> -Longer term actions (which include input from others, primarily Pavements and Foundations Sections and Soils and Aggregates Sections):
>
> -continue monitoring of early age frictional characteristics on upcoming contracts
>
> -continue to seek out information on alternative treatments for improving frictional characteristics (i.e. after-the-fact as well as during construction)
>
> -maintain contact with other particularly US jurisdictions regarding their experience

49. On September 7, 2006, Mr. Virani wrote to Mr. Kazmierowski, Ms. Schell, Mr. Tam and Mr. Raymond:

> Just to let you know that during a brief meeting with Kai and Chris Raymond this morning, we agreed that Chris will resume responsibility for the SMA issues our office is presently involved with. This includes the initial friction issue. I have provided Chris with all the recent e-mails. [55]

50. On September 25, 2006, Mr. Raymond emailed Mr. Rogers, Mr. Cautillo, Mr. Tam, Mr. Klement, and Mr. Kazmierowski on the subject of "Notes on SMA Update Meeting Sept 20" respecting SMA early friction issues, stating, among other things: "Chris Raymond to investigate at what point we say friction numbers are too low."[56]

51. On October 12, 2006, Kevin Bentley (Manager, Engineering, Southwest Region, Provincial Highways Management Division) wrote to Mr. Chaput attaching friction test results on a stretch of Highway 401 recently repaved with SMA, with average friction results by lane of FN 27, FN 29, and FN 31, stating:

> As I discussed with you at HST, we in SWR question whether we should continue to pave SMA on upcoming contracts, or should we rather be monitoring the development of friction

[55] MTO0031880

[56] MTO0000268

> on existing contracts and doing one gritting trial to see if that works? We are spending premium dollars on a product with which we are not all that comfortable with. [57]

52. On October 12, 2006, Mr. Raymond wrote to Mr. Tam copying others internally at MTO (Mr. Klement, Mr. Kazmierowski, Mr. Rogers, Mr. Gorman) stating:

> We had a discussion earlier this week about the applicability of a British study which indicated several years for full friction in SMA to be achieved. Attached please find some MTO data from Bob Gorman that indicates increasing SMA friction over several years with heavy traffic and friction may still be increasing. Note that there is a considerable increase in friction from 30 to 38. [58]

53. On November 5-8, 2006, Mr. Tam attended the Canadian User Producer Group for Asphalt (CUPGA) & Canadian Technical Asphalt Association (CTAA) Board of Directors meeting and workshop in Charlottetown. His trip report indicated the City of Hamilton presented there.[59] He wrote:

> City of Hamilton made a case study for use of perpetual pavement based on environmental impact study. Road construction must embrace the optimum selection of pavement design that would promote long term sustainability based on life-cycle cost and environmental impacts. Pavement that has less maintenance between major rehabs will fit these goals. This design concept was applied to Red Hill Expressway project in the City of Hamilton.

F. 2007: SMA recommendations and further investigations

54. In an email on January 5, 2007 to Mr. Rogers, Mr. Cautillo, Mr. Kazmierowski, and Mr. Tam, Mr. Raymond stated with respect to SMA early age low friction:

> I would suggest we not separate the frictional concerns into low speed and high speed as the concerns are related. Although the impact of poor Marco texture will impact primarily the high speed friction, the effect of micro texture is shared for both low and high speed testing. It is correct that skid numbers increase as the test speed decreases (figure 1), but it is important to note that independent suggested minimum skid numbers also increase

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[57] MTO0012676 attaching MTO0012677, MTO0012678, MTO0012679 and MTO0012680. The reference to "HST" is to the Highway Standards Management Team

[58] MTO0028661 attaching MTO0028662

[59] MTO0028926. The paper presented: "Sustainable Pavements – Making the Case for Longer Design Lives for Flexible Pavements", by Gary Moore, Ludomir Uzarowski, Michael Maher, and Vince Aurilio, is at GOL0001570

> with lower speed (figure 2) as do drivers expectations of typical pavement friction at a lower speed. In other words, a pavement with low friction at a high speed will have a higher skid number at a low speed but is very likely to have lower frictional quality that other pavements of good frictional performance. Note that the trend in figure 1 is supported with our observations from testing including the low speed SMA testing done on the HOV tunnel.
>
> Similarly, if this is a dry pavement concern we should note that frictional levels would be higher than with wet pavement but driver expectations of friction may also be higher than with a wet pavement.[60]

55. At a meeting on January 9, 2007, Mr. Raymond presented recommendations around the SMA issue to Mr. Chaput.[61] The background material to the presentation marked "DRAFT for Internal Discussion January 4, 2007" stated, in part:

> One concern that has emerged with SMA is low early friction. The rich asphalt binder mortar provides a thick coating on the aggregate, which provides good durability but low early life friction, as vehicle tires are not in direct contact with the pavement aggregate. Under traffic the thick asphalt layer on the surface of the pavement is worn away, exposing the aggregate and providing improved skid resistance. This process can take a few days, a few weeks, or a few months to reach a minimum desired level of friction depending on the amount of traffic, the type of aggregate, and the type of asphalt cement. Without good contact between a tire and the pavement aggregate, SMA pavements have shown friction numbers less than 30. On some projects, friction numbers considerably less than 30 have been observed, leading to extreme concern. The friction number of 30 is an approximation of the friction value used to determine minimum stopping distances in the Geometric Design Standards for Ontario Highways. Although adequate friction is generally achieved within a few weeks or months, the full frictional potential of an SMA pavement can take as long as a few years to be obtained. Another concern with SMA pavements is that under compaction the aggregates are rolled flat and do not provide adequate coarse aggregate projection to develop good macro texture. The frictional properties of a pavement are influenced by several factors with the aggregate source also being a major factor in performance. All SMA aggregates are supplied from the Ministry's designated sources list for materials, although inclusion on the list is based on performance in a Dense Friction Course (DFC) or Superpave 12.5 FC2 pavement. The lower early friction of SMA is illustrated in Figure 1 and 2.
>
> ***
>
> In addition to the concerns with low early friction, SMA also exhibits mature friction on some projects that is less than what would be expected for a comparable Superpave 12.5 FC2 or DFC. It should be noted that there is only contract with suitable mid life frictional values for SMA and this contract does meet the proposed minimum requirements for the Area Term Contracts. The frictional properties of SMA in comparison to DFC are illustrated in the following Figure 3. The figure indicates that traprock pavements have lower frictional values than the dolomitic sandstone DFC pavement. It must also be noted that the SMA

[60] MTO0028998 attaching MTO0028999 and MTO0029000

[61] MTO0015332 attaching MTO0015333 and MTO0015334

> plot is based on a single pavement constructed that utilized Marmora traprock rather than the Ontario Traprock that generally provides lower skid resistance levels. [62]

56. On January 11, 2007, Mr. Kazmierowski emailed Mr. Cautillo, Mr. Rogers, Mr. Tam, Mr. Raymond, Ms. Lane, and Mr. Klement, stating:

> Attached file breakouts the individual DFC mix frictional performance with time for various aggregate types. The majority of our DFC mixes are performing in the 40 to 50 SN100 range. The Ramastone was tested at 90 kph [63]

57. On January 18, 2007, Mr. Chaput and Mr. Cautillo presented the SMA recommendations to Ray Mantha (Executive Director, Asset Management, Provincial Highways Management Division, MTO).[64] The presentation slide deck, authored by Mr. Raymond, Mr. Tam, and Mr. Cautillo, stated:

> •The Ministry currently has no specified minimum pavement friction level however geometric standards are based on a minimum friction of approximately 30. Also most pavements exhibit frictional skid numbers of 30+ to 55, which determine driver expectations. A minimum skid number of 30 is proposed for Area Term Contracts.
>
> •Pavements with higher friction are safer
>
> •Pavement friction is heavily dependent on the type of aggregate (dolomitic sandstones are at the high end, traprocks are at the low end with variance with the individual traprock sources).
>
> •Pavement friction is traditionally not a problem for the Ministry because it is controlled through:
>
> A prequalification system for premium aggregates that includes demonstrated pavement field performance
>
> Requirement of aggregates to meet lab test requirements [65]

58. The presentation outlined the following recommendations:

> **Already awarded SMA projects**

[62] MTO0015334 at images 1 and 2
[63] MTO0015337 attaching MTO0015338
[64] MTO0015402 attaching MTO0015403; and MTO0015406
[65] MTO0015403 at image 5

MTO's Proposed Recommendations:

- Investigate contracts on case by case basis to examine:

  a. The performance of the particular SMA mix design based on previous performance to determine if it will provide good initial friction. If yes, proceed as per contract.

  b. If not, determine the cost to switch to SP 12.5 FC2

  c. If cost negotiations are unsuccessful, proceed per contract but with posting advisory "Slippery When Wet" signing and advisory speed tabs to be in place upon opening to traffic. Advisory signing would be removed when FN=30 or greater are safely reached. Additional measures would be required if an average FN below 20 is observed for a section of pavement.

- Where feasible conduct sanding trial(s) using local equipment (i.e. not specialized European equipment)

SMA projects not yet awarded

MTO's Proposed Recommendations:

- Specify SP 12.5 FC2 with Contractor's option •to substitute SMA with dolomitic sandstone aggregate for SP 12.5 FC2 with LCCA price premium (13% under review). Option would only be practical for highways where dolomitic sandstone is cost competitive (i.e. typically Eastern Ontario). The current SMA warrant of 3 million ESALs would have to be meet (i.e. not all FC2 contracts would be eligible for contractors option) [66]

59. On January 19, 2007, Mr. Raymond wrote to Mr. Kazmierowski, Mr. Rogers, and Mr. Tam:

> Guy and Gerry presented our SMA issue to Ray on Thursday. Ray is in general agreement with our direction but first wants MTO to go to OHMPA with our delima (ie unrealized cost effectiveness, early life friction concerns, and long term friction concerns) to ensure they have the opportunity to provide input. Kai is currently reviewing a draft presentation for presentation to OHMPA. [67]

60. On February 12, 2007, Mr. Chaput and Mr. Cautillo met with OHMPA representatives. Mike O'Connor (Executive Director, OHMPA) reported it to other

[66] MTO0015403 at images 11-12

[67] MTO0015406

OHMPA representatives (including SMA Task Group industry members Vince Aurilio, Sandy Brown, Joe Bunting, and Tom Dziedziejko) as follows:

> On short notice I was invited to a meeting with Guy Cautillo and Gerry Chaput Monday morning to talk about SMA pavements. I was worried that their recent concerns with low friction numbers on new pavements with higher than expected prices for the mix and with reports of constructability problems including reported flushing and even rutting problems that MTO might cancel their entire program.
>
> As it turned out the low friction problem is their greatest concern. Although their price expectation of +15% to +20% over previous premium surface mixes have not been met (currently approximately 30%) and they have recognized some constructability problems like fat spots that they characterize as poor workmanship, I don't believe the total program is in jeopardy.
>
> You will find in this email a scanned copy of their frictional testing results that reports early life SMA pavements often generate friction numbers less than 25, that one year later that number is around 30 and that even the so called European SMA design rarely gets above 40 in the first few years of life and steadily declines soon after that.
>
> MTO do believe SMA with Ottawa sandstone will give them acceptable friction numbers but they will not pay the price to transport it throughout the entire province.
>
> With the apparent success of the PPA study group (Gerry will be briefed on its' recommendations this week and will no doubt accept them), MTO will invite similar participation from knowledgeable OHMPA members on an SMA study group through OHMPA. Guy Cautillo has been instructed by Gerry to put the group together and report back by the end of April. All aspects affecting friction and in the end the cost of SMA mixes will be reviewed and commented on.
>
> This is a heads up that Sandy, after receiving Guy's request, will be canvassing interested and experienced members to participate. [68]

61. On March 1, 2007, Mr. Cautillo and/or Mr. Chaput made a presentation to the OHMPA Annual General Meeting. That presentation mentioned the MTO's concerns over SMA friction, both with respect to low initial friction and long term friction.[69]

[68] MTO0021780 attaching MTO0021781

[69] It is unclear which of two slideshows was presented to OHMPA on March 1, 2007. MTO0012737 attached to MTO0012735, or MTO0015414 attached to MTO0015413. Both presentations reference MTO concerns with SMA friction (at image 17 in both) but the wording is different.

G. SMA Task Group II: further SMA friction investigations and recommendations

62. On March 8, 2007, "SMA Task Group II" met for the first time. Updated Terms of Reference were circulated, and the MTO made a presentation titled "MTO Use of SMA Pavement".[70] The members of the SMA Task Group II were:[71]

> Industry
> Joe Bunting - The Miller Group & OHMPA President
> Sandy Brown - OHMPA Technical Director & Task Group Co-chair
> Param Dhillon - DBA Engineering
> Tom Dziedziejko - AECON
> Paul Lum - Lafarge
>
> MTO
> Kai Tam - Task Group Co-chair
> Chris Raymond - Task Group Project Manager
> Tom Kazmierowski
> Chris Rogers
> Dennis Billings

63. The Terms of Reference of SMA Task Group II set out its goals as follows:

> Goals
>
> 1. The main goal of the Group is to cooperatively address and resolve issues associated with SMA implementation in Ontario.
>
> 2. The specific goals of the Group are:
>
> (1) To develop a plan to address SMA contracts in the short term.
>
> (2) To develop a plan to address future potential SMA contracts in the design stage with a 2007 award.
>
> (3) To develop a long term plan to deal with the low friction performance of SMA mixes, and value for money being received with SMA. Both early life and long term friction need to be addressed.[72]

[70] MTO0012033 attaching MTO0012034 and MTO0012035

[71] MTO0012099 at image 3; MTO0000139 at image 3; and MTO0015350 at image 1

[72] MTO0012034 at image 1

64. The presentation made at the March 8, 2007, SMA Task Group II first meeting indicated that “unforeseen safety concerns with low initial friction have developed with SMA”, and that “Long term safety (friction) of SMA remains unsubstantiated”.[73] The presentation stated the following with respect to pavement friction:

> •The Ministry currently has no specified minimum pavement friction level however geometric standards are based on a minimum friction of approximately 30.
>
> •MTO’s expectations for freeway pavement fiction is above a value of 40.
>
> •Pavement friction is heavily dependent on the type of aggregate (dolomitic sandstones provide superior friction, trap rocks exhibit acceptable friction).
>
> •Freeway pavement friction is traditionally not a problem for the Ministry because it is controlled through:–A prequalification system for premium aggregates that includes demonstrated pavement field performance –note that SMA aggregates were pre-qualified based on DFC performance. [74]

65. The presentation set out a number of possible options including a moratorium on SMA use, additional signing, reduced speed signing, and sanding requirements.[75] It stated in summary:

> •MTO has not realized the value for money from SMA (based on LCC analysis)
>
> •Performance concerns need to be addressed
>
> •SMA is a viable technology provided performance and value for money can be assured
>
> •The Ministry will continue to investigate SMA so that benefits can be capitalized and concerns/ obstacles can be overcome [76]

[73] MTO0012035 at image 3
[74] MTO0012035 at image 9
[75] MTO0012035 at images 15-16
[76] MTO0012035 at image 18

66. The minutes of the first SMA Task Group II meeting on March 8, 2007, indicated that Mr. Raymond delivered the presentation described above.[77] The minutes recorded the following about the Task Group's discussion:

> 2. Chris Raymond presented MTO's Use of SMA. The presentation provided background on MTO's use of SMA, the Ministry's concerns, and the Ministry's position that SMA is a viable technology provided performance and value for money can be assured.
>
> 3. Methods to resolve frictional issues were discussed with the focus being already awarded contracts with paving remaining. Sandy Brown expressed concern about a Ministry moratorium or interim moratorium on the use of SMA because industry has made investment in plant modifications to accommodate SMA technology and any moratorium would cause the return on these investments to be lost or delayed. As a result of this concern, Industry was not prepared to agree to switch any SMA contracts to Superpave 12.5 FC2 at this time.

67. On March 20, 2007, SMA Task Group II had its second meeting.[78] The minutes of that meeting stated:

> Sandy Brown expressed concern about a friction requirement for SMA as this is a new requirement and it affects SMA's competitiveness with PCC pavement. If a friction requirement is applied, it needs to be applied to both pavement types. Sandy referenced a paper entitled "Pavement Surface Friction on Ontario Highways" by Chris Rogers et al as an example of less than optimum friction in a PCC pavement.

68. A March 30, 2007, email and agenda respecting the Canadian Technical Asphalt Association 52nd Annual Conference to be held November 18th to 21st, 2007, listed Mr. Tam, Gary Moore (Manager, Design, Red Hill Valley Project, Public Works, Hamilton), Mr. Aurilio (OHMPA and formerly on the SMA Task Group), and Mr. O'Connor (OHMPA and formerly on the SMA Task Group) as members of the organizing committee.[79]

69. On April 3, 2007, Mr. Raymond emailed Mr. Tam, Pamela Marks (Senior Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office,

[77] MTO0015350 at image 1
[78] MTO0012061 at image 1, attached to MTO0012060
[79] MTO0028919 at image 2, attached to MTO0028918

Highway Standards Branch, Provincial Highways Management Division, MTO), and Mr. Virani, a draft presentation titled "R & D Projects for 2007 / Partners in Innovation."[80] It stated:

> SMA
>
> •Unforeseen safety concerns with low initial friction.
>
> •Long term friction has been less than expected.
>
> •Initial costs have not come down as much as expected raising questions about the value for money.
>
> •An MTO-OHMPA Task Force meet this spring to develop recommendations to address the Ministry's concerns with SMA.
>
> •The Ministry continues to research SMA so that benefits can be capitalized and concerns/ obstacles can be overcome.

70. The SMA Task Group II had its third meeting on April 5, 2007.[81] The minutes of that meeting stated:

> 2. Sandy reiterated his concern that if the Ministry imposes frictional requirements for SMA, then the same requirements should be applied to PCC pavements. It was agreed that discussion of PCC frictional requirements was outside the scope of this task force.
>
> 3. Discussion took place on the decision tree for awarded contracts. Sandy presented some additional frictional data for Ontario Trap Rock Aggregate. The data shows average frictional values that are not less than 30 and increase during the first 3 years to an average for the lanes of 38. It was noted that this is one of the first SMA contracts and that only limited frictional testing was conducted and the first frictional measurements likely represent friction several weeks after construction rather than during the first few days. No changes were made to the list of aggregates with demonstrated satisfactory performance.

71. On April 10, 2007, Ms. Lane emailed Mr. Kazmierowski seeking approval to present a paper titled "10 Years Performance of Canada's First SMA Freeway Trial"

[80] MTO0028924 at image 5, attached to MTO0028923

[81] MTO0013736

(respecting a section of Highway 401) at the CTAA annual conference on November 18 – 21, 2007.[82] She wrote:

> We now have 10 years of good performance from Canada's first freeway SMA trial. I think it is important information to share with the pavement/asphalt engineering community.
>
> The proposed paper would focus mainly on the pavement condition (roughness, distresses, rutting) and how well the pavement is performing. The adjacent DFC pavement, built at the same time is also performing well. The DFC used a polymer modified asphalt, which may be contributing to its good performance.
>
> I realize that we are currently addressing SMA friction issues, and the paper would be sensitive to this issue. The friction on this SMA trial has been monitored annually since 1996, and the average FN is only marginally less than the adjacent DFC. We can remain silent on friction if necessary.

72. Ms. Lane's email attached friction test results from 1996-2006 for the Highway 401 SMA freeway trial. The results disclosed an average FN38 for SMA and FN39 for the adjacent dense friction course asphalt (DFC), over the ten year period, with the SMA having an average FN34 in 2006 and the DFC having an average FN36 in 2006.[83]

73. On April 12, 2007, Mr. Raymond emailed Mr. Tam charts of SMA friction history sorted by aggregate type.[84] On the same day, Mr. Raymond emailed Geoffrey Lau (Co-op Student, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) a "skid table" listing friction test results, stating: "Geoffrey – here is the summary of all SMA testing". The attached chart showed FN from testing conducted at various SMA locations from 1997 to 2005.[85]

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[82] MTO0023256
[83] MTO0023255 attached to MTO0023254
[84] MTO0013731 attaching MTO0013732
[85] MTO0024550 attaching MTO0024551

74. On April 11-12, 2007, MTO representatives of the SMA Task Group (Mr. Billings, Mr. Tam, and Mr. Kazmierowski) updated other MTO employees by email as to the accomplishments of the SMA Task Group.[86] They recommended that all existing contracts where SMA has not yet been placed be evaluated by means of a "decision tree", stating:

> At the last meeting, the TG agreed to recommend that all the existing contracts, where the SMA has not been placed, be evaluated by means of a "decision tree" (see attached).The basic principle is that aggregates that produced acceptable initial friction (FN > 30), based on friction measurements taken from the different SMA sites paved over the last two years, will continue as per the contract documentation. For those contracts that were not able to achieve the FN > 30, the contractor will be given the option to use either a SuperPave FC2 mix in leau (sic) of the SMA mix (industry indicates this will be the preferable least cost option), or to sand/grit the new SMA surface (industry feels this is the least appealing option with high risks and perceived delays in construction), or to change their aggregate source to an 'acceptable aggregate' ie Dolomitic Sandstone, MRT Meta Gabbro, Marmora Trap Rock, Fowler McDougall Gneiss. This final option is less appealing and will probably result in additional costs."

75. On April 16, 2007, Ted Phillips (Supervisor, Geotechnical Engineering, Eastern Region, Provincial Highways Management Division, MTO) emailed a number of individuals at the MTO including Mr. Klement, stating:

> I have asked Darren to coordinate a meeting with you and with Head Office and Area Office reps to put together some info regarding a communications strategy for some of our Minor Capital work this summer. In a nutshell, we have some roads that to the travelling public will look in good to very good condition (with adjacent sections in obviously poorer condition) that require treatment mainly because of skid resistance. We may expect questions why we are treating good looking sections. While this is a good preventive maintenance strategy, postponing the life of the pavement, it is the skid resistance that has lead to the work.
>
> The quandary we will face is that Ontario has never published any target skid numbers, whereas other jurisdictions have. We have always handled our skid resistance issues through a set of aggregate requirements in different areas and on higher volumes. We use skid resistance in combination with other factors as indicators to make our decision, but have always resisted publishing target numbers.

[86] MTO0000134 (email chain) attaching MTO0000135 (Terms of Reference) and MTO0000136 (proposed decision tree for awarded contracts)

> FYI the topic of target skid numbers is also very hot on the ATC scene.
>
> Here's a some background presentations for you. [87]

76. On April 19, 2007, the SMA Task Group II had its fourth meeting.[88]

77. On April 23, 2007, the SMA Task Group II had its fifth meeting.[89]

78. The minutes of an MTO meeting with industry representatives on April 30, 2007, titled “Update of the Ministry’s Life Cycle Cost Procedure”, stated:

> The M-E PDG was used, with the updated traffic and rutting data, and the initial and terminal IRI levels, to estimate the life of flexible and rigid pavement designs. Major pavement performance parameters of the designs are:
>
> o Flexible pavement (FC2 surface) – 19 years to first overlay.
>
> o Flexible pavement (SMA surface) – 21 years to first overlay.
>
> o Rigid pavement – 18 years to initial retexturizing, 28 years to major concrete pavement restoration.
>
> ***
>
> Friction Information
>
> o Friction may become a more important issue in the future.
>
> o Short-term pavement friction is a requirement in the 7-year warranty jobs for flexible pavements in Ontario. MTO advised that a friction requirement was included because materials and construction specifications are not included in the contract, and warranties only address the first 7 years of performance. The only place friction has been used as a long term criterion is for Highway 407. [90]

79. On May 1, 2007, Mr. Chaput approved the recommendations by the SMA Task Group in dealing with SMA awarded contracts, including the list of approved aggregates

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[87] MTO0013104 attaching MTO0013105, MTO0013106 and MTO0013107

[88] MTO0013752

[89] MTO0013751

[90] MTO0013124 at image 2, attached to MTO0013123

and a decision tree for SMA awarded projects.[91] Later on May 1, 2007, Mr. Tam provided Mr. Chaput with an Information Note drafted by Mr. Raymond, Mr. Tam, and Mr. Kazmierowski, containing the Recommendation approved by Mr. Chaput that: "The Ministry supports the recommendations of the MTO-Industry SMA Task Group and implementation of the revised list of premium aggregates allowable for use in Stone Mastic Asphalt Pavement to minimize early age friction concerns."[92] The Information Note also stated:

> Industry was represented in the task group by selected members of the Ontario Hot Mix Producers Association (OHMPA), which supports the task group's recommendations.
>
> The recommendation on the restrictions of certain aggregate types is based on early age friction measurements performed on SMA pavements constructed with these aggregates, and comparison with these test results to other pavements that have been able to achieve acceptable early age friction.
>
> The Ontario Trap Rock aggregate source is being restricted from use in SMA because of observed poor frictional performance. Other aggregate sources are also affected based on their similar geological properties and the lack of good performance data. No performance concerns have been observed in Superpave 12.5 FC2 pavements.
>
> The revised aggregate sources list will contain the following 3 quarry sources: Lafarge Canada Incorporated - Brockville Quarry, Aecon Construction and Materials Limited - Marmora Source, and MRT Aggregate Incorporated.
>
> Pavement friction is heavily dependent on the type of aggregate used.
>
> SMA is a viable technology provided performance and value for money are assured. The Ministry continues to investigate SMA so that its benefits can be capitalized and concerns/obstacles can be overcome.

80. On May 2, 2007, Mr. Raymond proposed incorporating the MTO's new approved list of SMA aggregates into the MTO's specifications to Mr. Rogers and Mr. Tam.[93] On May 3, 2007, Mr. Raymond emailed the revised specification to Raymond Ng (Senior

[91] MTO0000138 attaching MTO0000139, MTO0000141, MTO0000142, MTO0000143 and MTO0000144
[92] MTO0018526 attached to MTO0018525
[93] MTO0029318 attaching MTO0029319

Project Engineer, Provincial Highways Management Division, MTO) respecting contract 2007-2028 on Highway 427, stating:

> Further to our discussion this morning, please find attached SP 313S45M, which modifies the aggregate requirements for SMA on page 7. I am requesting an addendum be issued on this contract to implement revised aggregate requirements for SMA, which impact on safety through the inclusion of this modified SP to replace the standard version in your contract. The changes will not conflict with the asphalt test sections on the contract. I have discussed the impacts on the tender opening date (currently May 9) with John Barber (Estimating Office - Responsible for southwestern region) and he indicated a contractor may need 1 week to react to these changes. I request that you please review the impacts on the tender opening date.
>
> Please review the circumstances of this project to see if this addendum can be accommodated. [94]

81. On May 2, 2007, Mr. Raymond emailed Mr. Rogers and Mr. Tam regarding the new approved list of SMA aggregates, stating:

> The Ministry's new "approved list" of SMA aggregates needs to be implemented into our specifications. This can be done various ways and through discussions with the standards office, I have decided to modify SP 313s45M by adding the requirement for the sma aggregates to be from one of the following sources..... A copy of the proposed SP is attached for review - (see page 7) . Please ensure that the I have captured the right aggregate sources and return ASAP. I have also changed the DSM listing from DFC aggregates to SMA as aggregates are now listed for SMA. Also referencing DSM listed SMA aggregates allows flexibility for future changes through SP 100S58.
>
> I am recommending that the DSM be modified ASAP to reflect our new requirements for SMA aggregates as this is the appropriate place to convey our aggregate requirements and there is an ethical obligation not to mislead external agencies regarding our approved list of SMA aggregates. [95]

82. These changes required that, for SMA:

(a) both coarse and fine aggregates had to be obtained from the same source; and

[94] MTO0020385 attaching MTO0020386

[95] MTO0013771 attaching MTO0013772 and MTO0013773

(b) coarse and fine aggregates had to be obtained only from one of the sources specified in SP110S12 being a subset of the twenty sources listed on the DSM for approval for use in "DFC, SP12.5 FC2 and SMA".[96]

83. On May 3, 2007, Mr. Billings wrote in an internal MTO email to "Gotech Staff", regarding the SMA Task Group recommendations that:

> All paved SMAs continue to be friction tested at regular intervals. Testing starts as soon as possible after paving and is being done with the ministry's brake force trailer. We are on a learning curve with the testing data being obtained. We are seeing different early life friction depending on which aggregates are used. We are also seeing improvement in early life friction as the new SMA surface is exposed to traffic. This is something we anticipated. We are learning about how much time is required under traffic to get to desirable friction levels. We are also learning on which aggregates may perform better in an SMA mix. There is more for us to learn and this will be achieved in part by obtaining more pavement performance data over time. [97]

84. On May 7, 2007, Peter Verok (Manager, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division, MTO) wrote to Roger Hanmer (Regional Director, Central Region, Provincial Highways Management Division, MTO), Lou Politano (Manager, Engineering, Central Region, Provincial Highways Management Division, MTO) and Bob Stephenson (Head, Program and Planning, Central Region, Provincial Highways Management Division, MTO), stating:

> The attached list of all projects with SMA shows that the only job that we currently have with the problem aggregates is the 401 WB express. Ontario Trap Rock is one of the problem aggregates. The ministry has developed a process to deal with these. There are a few options, switching aggregates, sanding the hot mat, or switching to an FC 2 mix (old DFC). We are in the process of talking to Dufferin about these options and their associated costs. The rest of our jobs should be ok for now. Contractors select their aggregates from

[96] See for example, MTO0013771 attaching MTO0013772 (SP313S45M, October 2006, revised May 2007 per Mr. Raymond's email) at images 6-7; MTO0013811 (SP110F12 at s. 1003.05.01, June 2007); MTO0022324 (SP110F12 at s. 1003.05.01, February 2010); MTO0006659 (SP110S12 at s. 1003.05.01, July 2010), MTO0007091 (SP110S12, June 2011) at image 4; MTO0022495 (OPSS 1003, March 2012) at images 5,11; MTO0037420 (OPSS 1003 at s. 1003.05.01, April 2013); and MTO0009052 (SP110S12 at s. 1003.05.01, May 2014)

[97] MTO0000147

> a list of suitable sources. In new contracts I would assume that that list would be adjusted accordingly. For old ones we will have to negotiate to resolve it. [98]

H. March – June 2007 MTO communications respecting the RHVP

85. Ludomir Uzarowski's (Principal, Pavement and Materials Engineering, Golder) notes on March 27, 2007, state (in part):

> 1) Mike
> 2) Gary – report, RHVP – Tom Kaz, budget Section 17 Upper Wentworth [99]

86. On May 10, 2007, Mr. Politano advised Mr. Chaput that (1) that Hamilton was using a perpetual pavement design for the RHVP; (2) that Hamilton was planning on instrumenting and monitoring pavement performance; (3) that Hamilton had asked if MTO would be interested in participating financially; and (4) total cost was $60-70k, and OHMPA was contributing $10k. Mr. Politano, Mr. Chaput, and Mr. Kazmierowski discussed the issue in an email exchange and ultimately agreed to contribute $10,000 to show support and have access to the data generated. In the course of the email discussion, Mr. Kazmierowski stated:[100]

> I have already offered to do Skid testing on the SMA surface of Red Hill Ck Perpetual Pavement.

87. Dr. Uzarowski's notes on May 10, 2007 state:

> Gary Moore:
> - QEW
> - Retainer
> - RHVP
>
> OHMPA – Sandy
> Asphaltopics

[98] MTO0038287 attaching MTO0038288 and MTO0038289
[99] GOL0007397 at image 14
[100] MTO0000056

5) RHVP mix designs

2) RHVP – interested – to send it to Lou [101]

88. On May 11, 2007, Mr. Politano emailed Joe Costantino (Area Contracts Engineer, Central Region, Provincial Highways Management Division, MTO) to ask for Gary Moore's telephone number and email address so that he could contact Hamilton regarding contributing $10,000 to the instrumenting and monitoring of the RHVP.[102]

89. On May 14, 2007, Mr. Politano emailed Bill Jones (Manager, Planning & Environment, Central Region, Provincial Highways Management Division, MTO), Mr. Costantino, Peter Korpal (Head, Planning and Design, Central Region, Provincial Highways Management Division, MTO), and Mr. Hanmer regarding the RHVP.[103] He wrote:

> Bill,
>
> Rinaldo, Larry, Tom, Joe and I were given a tour of the RHCE last week.
>
> I would encourage you and some of your staff to arrange a similar visit. The project is miles ahead of any other in terms of environmental protection and mitigation. They have a 7 km creek realignment which has been a success; they have extensive planting of native materials; they constructed a $12M wild life crossing under the RHCE; they have many retention ponds; a trail system; etc etc, etc.
>
> It would be worth your while to spend the 2-3 hours the tour requires. If interested, Joe would be more than pleased to make the arrangements for you (right, Joe?).
>
> Roger, if arrange, you may also want to visit. They will be ready to start paving in 2 weeks.
>
> For your consideration.

[101] GOL0007397 at images 29-30
[102] MTO0018515
[103] MTO0018516

90. On May 15, 2007, Mr. Moore forwarded to Mr. Politano a proposal from Dr. Uzarowski to install the pavement monitoring instrumentation on the RHVP.[104] The Golder proposal made it clear that the RHVP's surface course would be SMA[105] and the MTO recognized it as such.[106] In his email on May 15 forwarding Mr. Moore's email and the Golder proposal, Mr. Politano stated:

> I spoke with Gary (Hamilton) and advised him that we are interested in participating in this initiative, but I did not give him a $ number. You had previously suggested a $10K MTO contribution towards this.
>
> Pl review this proposal and confirm that the $10K is still appropriate (or whether it should move up or down), and be prepared to discuss our contribution with Hamilton.
>
> I will respond to Gary and ask him to contact Tom directly to discuss this further. It appears that gary is away for the rest of this week. [107]

91. Between May 15-24, 2007, the MTO (Mr. Chaput, Ms. Lane, Mr. Politano, Mr. Kazmierowski) discussed the Golder proposal respecting RHVP pavement monitoring instrumentation and compared it to one submitted by the Centre for Pavement and Transportation Technology (CPATT) at the University of Waterloo.[108]

92. On June 20, 2007, Hamilton cancelled an appointment for Mr. Politano and Mr. Hanmer of the MTO scheduled for June 29, 2007, titled "Continuation - Teleconference with Scott Stewart and Chris Murray regarding the Red Hill Valley Project."[109]

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[104] MTO0020408 attaching MTO0020409, MTO0020410 and MTO0020411
[105] MTO0012109 at image 2, attached to MTO0012108
[106] MTO0013145
[107] MTO0020408 attaching MTO0020409, MTO0020410 and MTO0020411; and MTO0000006
[108] MTO0000006
[109] MTO0018502

I. Continued MTO SMA concerns

93. Mr. Raymond made a presentation to the MTO's Geotechnical Committee on May 22, 2007 titled: "Recommendations from the MTO-OHMPA SMA Task Group".[110] His presentation indicated that the MTO was "looking for SMA trials!!!" and contained the following:

> Concerns with SMA
>
> •MTO has not realized the value for money from SMA (based on LCC analysis)
>
> •Unforeseen safety concerns with low initial friction have developed with SMA
>
> •Long term safety (friction) of SMA remains unsubstantiated.[111]

94. Mr. Klement prepared a presentation for the same May 22, 2007 Geotechnical Committee meeting, titled "2007 Pavement Friction Update". Among other things, the presentation stated:

> - The presented analysis demonstrates that there are no threshold FN values at which a highway segment automatically transforms from being "safe" to "hazardous". Decisions to restore friction can be made on an individual, site-specific basis, with all relevant influencing factors being taken into consideration.
>
> - In all applications the goal is not to violate driver expectation. Thus while area-consistent low FN values can be tolerated, isolated low FN values, particularly in high friction demand segments, are to be avoided.[112]

95. The minutes of a June 18, 2007, MTO representatives (Mr. Tam, Mr. Rogers, Mr. Raymond, Mr. Billings, Mr. Gorman) met with an aggregate producer called Ontario Trap Rock Quarry, which was excluded from use in SMA by the new Surface Course Directive and MTO special provisions. The minutes of that meeting stated:

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[110] MTO0020488 attached to MTO0020487
[111] MTO0020488 at image 3
[112] MTO0020403 at image 21 attached to MTO0020402

1. Discussion took place regarding the frictional performance of SMA projects. There was agreement that mix design and construction practices have an impact on the frictional performance of the mix. It is the view of MTO that Ontario Trap Rock aggregate is more susceptible than other SMA aggregates to low early friction based on observed performance to date. [113]

96. On July 5, 2007, in relation to Mr. Klement's draft "Pavement Friction Rehabilitation at MTO" presentation, Mr. Smith wrote:

Here are a few additional comments (actually questions):

1. Would a policy result in more or less litigation risk? Not necessarily yes. If a policy exists and is adhered to, the litigation risk could be lower.

2. Would a policy result in more accident related requests for skid test results or testing?

3. Would lower levels of government in Ontario (municipalities) be obligated to adhere to the policy, either legally or by default? From my travels, I expect quite substantial lengths of county roads in SW Ontario posted at 80 km/hr would fall into the Class I category. [114]

97. Mr. Klement replied to Mr. Smith the same day, July 5, 2007, stating:

To address your questions:

1) We need a legal opinion on three related, but separate issues:

A) Are our current procedures that initiate skid testing adequate, or should we move in the direction of focussed network friction testing, i.e. based on wet/dry collision rates? Incidentally, the proposed policy would have no affect on the testing frequency; not unless we expand the policy scope.

B) What would be the legal impact of the proposed policy (Having the decision tree to friction-rehabilitate road surface or not formalized)?

C) What is a reasonable time-frame to restore friction on a highway segment once, following the proposed policy, a multi-disciplinary team assessment determines that a friction-rehabilitation is warranted? I enclose a NY judgement, recently distributed by Chris, that illustrates the legal outcome of a case, where no reasonable plan to rehabilitate a known friction-problem location existed and where the 5-year construction horizon was perceived by the Court as being purely arbitrary:

I was told that a request for a legal opinion must come from a manager or above...

2) I cannot see how the proposed policy, if adopted, would lead to more frequent skid testing...

[113] MTO0013809 attached to MTO0013808

[114] MTO0018665

> 3) Provided the policy is published (as a directive or in a manual), it is likely that municipalities would voluntarily adopt it. In safety matters they usually follow our lead (it was the case with MTO Roadside Safety Manual). [115]

J. Summer 2007 Ludomir Uzarowski and Golder communications and involvement with the MTO (non-RHVP)

98. On May 30, 2007, Dr. Uzarowski submitted a Pavement Design Report to URS Canada Inc. and the MTO respecting a 12.5km extension of Highway 404, recommending three possible pavement design options, one of which was a perpetual pavement, none of which utilized SMA.[116]

99. Beginning June 21, 2007, Golder was involved in "referee testing" for SMA in MTO Contract 2005-2025.[117]

100. Dr. Uzarowski applied for "Pavement Design High Complexity" designation.[118] On July 20, 2007, Susanne Chan (Pavement Design Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) forwarded the application internally, including to Ms. Lane, and Mr. Billings:

> Ludomir Uzarowski is applying for Pavement Design High complexity. He is previously approved under Pavement Design Low and Medium complexity when he was working in JEGEL in Nov 2003, but I have no record of him being approved under the High complexity.
>
> A. Balasumdaram and M. Mahar are previously approved in this category.
>
> Attached is the submission package from Golder. Please review and provide your comments. Thank you!

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[115] MTO0018665

[116] MTO0018686 at images 11-14, attached to MTO0018685

[117] MTO0030666 attaching MTO0030667 and MTO0030668; MTO0016090 attaching MTO0016091 and MTO0016092; and MTO0016586 attaching MTO0016587

[118] MTO0001942 attaching MTO0001943

101. On August 23, 2007, Ms. Chan emailed Mr. Kazmierowski to inform him that all MTO "GeoHeads", including Ms. Lane, agreed to approve Dr. Uzarowski for "Pavement Design -- High Complexity" designation.[119] Mr. Kazmierowski replied to Ms. Chan the same day to advise that Dr. Uzarowski was approved.[120]

K. August 2007 MTO communications respecting the RHVP and with Hamilton

102. On August 1, 2007, Mr. Raymond sent an email to Ms. Lane, Mr. Tam, and Mr. Rogers, stating:[121]

> Becca et al:
>
> I received a call yesterday (Tuesday Aug 31st) [sic] from Ludamir U. of Golder Associates. He had heard a rumour that the Ministry no longer allows Ontario Trap Rock in SMA. I informed Ludamir that the Ministry has had concerns with early life friction in some SMA pavements. In response to these concerns the Ministry is continues to investigate early life friction and has formed MTO-Industry task groups to discuss the issue the last two winters. As an interim measure the Ministry has developed a short list of acceptable SMA aggregates which are communicated through special provision (313S45 and now 110F12). The Special provisions do not currently list Ontario Trap Rock. Also in SWR we look at the cost implications of the limited SMA aggregate sources in the area to determine if SP 12.5 FC2 should be the surface course on potential SMA projects. Action has also been taken on carry over contracts to ensure acceptable early life friction.
>
> Ludamir expressed concern regarding the proposed use of SMA on a City of Hamilton project (Red Hill Creek Expressway) where the contractor has submitted a mix design using a Quebec source (Demix Varennes) – the aggregate is not on the Ministry's DSM. Ludamir indicated he was going to follow up with Chris Rogers regarding the background of this source. A possible outcome is that the City of Hamilton could make a request for friction testing.

103. At 9:55am Mr. Rogers responded, "What the city of Hamilton does is not our concern – provided we are not putting in $".[122]

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[119] MTO0018677
[120] MTO0038686
[121] MTO0001265
[122] MTO0001956

104. Also on August 1, 2007, the MTO set a teleconference appointment for August 28, 2007 at 9:00 am titled “Updated: Red Hill Valley Parkway with Hamilton”, with MTO attendees to be Mr. Politano and Mr. Hanmer.[123]

105. On August 7, 2007, Mr. Politano had an appointment scheduled for a “teleconference with City of Hamilton re: Red Hill Valley Parkway”.[124]

106. On August 24, 2007, Mr. Brown, the Technical Director of OHMPA (and member of the SMA Task Group), emailed John Blair (Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) and Mr. Tam of the MTO, along with Brian Eyers (Manager, Miller Group), Fernando Magisano (Vice President, Technical Services, K.J. Beamish Construction Co. Ltd.), and Mr. Dziedziejko (also an SMA Task Group member) respecting “ProVal Training” and using the RHVP as a test site for Inertial Profilers.[125] He stated

> With regard to a test site, I have been talking to Gary Moore at the City of Hamilton. The Red Hill Creek Expressway has complete main line paving but will not be opened until November 3. There will be addition work being carried out on site to finish things up but we should be able to co-ordinate with those activities. In addition, there will be installation of WIM gauges in mid-October that will be coinciding with a Pave-in sponsored by OHMPA.
>
> This looks like a good test site for our trials. We must be certain not to mark up their new pavement so no paint on the road, etc. The week of October 22 looks like the best time to try this from Gary's point of view. I have a conflict for the morning of October 25 (OHMPA BoD mtg) but that is all for now. I suggest we aim for 23 and 24 to carry out the trials and correlations. The site has not had profilograph work performed, so perhaps we should set that up for the 23 while the equipment is at the calibration site and that will leave the lanes open for the 24 to do the actual runs. I assume MTO will provide their profilograph but perhaps we should have another as well to examine variability in both types of measurements. Given that the route is 8 km long, we should be able to do a significant

[123] MTO0018533
[124] MTO0038286
[125] MTO0029602

> length of pavement and still have run-in and run-out space. I suggest that John and I visit the site (Sept 12, 13 or 14) to pick an appropriate location that we can take back to the City to make sure there are no conflicts.

107. On August 27, 2007, on the instructions of Mr. Chaput, Carole Mercier (Sign Designer, Provincial Highways Management Division, MTO) set an appointment for August 29, 2007, titled "*Red Hill Creek Expressway Site Visit*".[126]

108. On August 28, 2007, the MTO set two appointments for September 17, 2007:

(a) At 4pm, titled "*Pre-brief Red Hill Valley Parkway with Hamilton*" with MTO attendees Mr. Politano and Jason White (Head, Highway Engineering, Central Region, Provincial Highways Management Division, MTO) in "*Roger's Office*" (referring to Roger Hanmer).[127]

(b) At 4:30pm, titled "ANOTHER Conference Call – Red Hill Valley Parkway with Hamilton" with the note "Scott Stewart to call Roger".[128]

L. September 2007 MTO communications respecting the RHVP including friction testing

109. Dr. Uzarowski's notebook contains an entry dated September 10, 2007, which notes the following:

> Request for the City of Hamilton
> SN – give the location
> Frank tomorrow 403
> By 3 or 3:30 today.
>
> Give info – closed section, what
> Procedure to follow, close to either
> It is closed area At the posted speed.
> At a slower speed – is possible

[126] MTO0012743 and MTO0021941
[127] MTO0018534
[128] MTO0038303

> Estimate, 40 miles/hr, posted speed
> a wet test
> Monday 10.00 am Gary[129]

110. Another notebook of Dr. Uzarowski's contains an entry from the same date:

> 4) RHVP – Gary Moore
>
> IRD – Instrumentation
>
> SN testing,
>
> Chris Raymond – SN
>
> RBM spec
>
> Andro – deficiencies[130]

111. On September 11, 2007, Mr. Raymond emailed Mr. Marciello (cc Ms. Lane) about a telephone call with Dr. Uzarowski about the friction testing in Hamilton.[131] He stated:

> Ludamir called me this afternoon regarding the city of Hamilton friction testing we discussed this morning. He mentioned that there are very limited City of Hamilton staff around this week including the project manager, so we may not get the request for a few days. I informed him that we would conduct the testing once the request is received.

112. On September 17, 2007, in relation to a presentation Mr. Tam was to be giving regarding the SMA Working Group at the CTAA Conference, Mr. Raymond wrote, cc to Ms. Lane:

> I am preparing a presentation for you. We will need to review the presentation of any friction data with Becca as there are sensitivities with respect to the data.
>
> Also note that Frank is continuing to capture data on a daily basis. I am updating the graphs to represent the all current data but considerable new data is likely to be captured between now and November. [132]

[129] GOL0007410 at image 35
[130] GOL0007408 at image 75
[131] MTO0018696
[132] MTO0002076

113. On September 21, 2007, Mr. Blair wrote to Ms. Lane, Mr. Raymond, Mr. Tam, and Mr. Kazmierowski.[133] He stated:

> As you know, we have been working on implementing inertial profilers for smoothness acceptance of new asphalt pavement construction. Through our discussions with OHMPA, we have developed a list of requirements (that I've attached for your interest) that we would want for the inertial profilers that would be taking smoothness measurements on our contracts.
>
> We have also developed a draft specification and LS procedure which will eventually be used to take measurements and determine pay factors (through ProVAL). However, in order to provide additional information to help us continue with the development of these two documents, we are intending to take some measurements this year and compare those measurements with the measurements taken by California Profilographs on the same sections.
>
> Our intention is to measure a Reference section which we've established at our profilograph correlation site (located on the Eastbound lanes of Highway 407, east of Appleby Line) as well as one or more trial sections on active contracts that are relatively close to the GTA. It appears that one of those contracts is likely to be on the "Red Hill Creek Expressway" in Hamilton.
>
> OHMPA is arranging some of this and they tell us that, at the moment, it appears that the week of October 22 (probably the 23rd to the 25th) is the most promising.
>
> Kai and I were wondering if the ARAN would be available to participate and provide some comparison data with the two or three other profilers that will be involved?

114. Ms. Lane responded:[134]

> Bituminous Section is coordinating another round of profiler correlations in the GTA (see below). Will you (and the ARAN) be available October 23 - 25 to participate? The testing will all be "local" (i.e. Hwy 407 & Redhill Creek Expressway).
>
> Please let me know.

115. On September 25, 2007, Mr. Kazmierowski wrote to Mr. Chaput, Ms. Lane, and Tiffany Metcalfe (Team Lead, Organizational Effectiveness, MTO):[135]

> Gerry, attached is a proposed article for Asphalt Topics (OHMPA's technical magazine) on our Hwy 406 perpetual pavement. This is a good news article (although the City of Hamilton

[133] MTO0002396 attaching MTO0002397
[134] MTO0002840
[135] MTO0002120 attaching MTO0002121

> will not be happy that this is Ontario's first perpetual pavement rather than their Red Hill creek expressway) with no controversial issues, I recommend approval of the article

116. On September 27, 2007, Dr. Uzarowski emailed Mr. Raymond about conducting friction testing on the RHVP.[136] He stated:

> Please find attached the specification for the RBM mix developed for the Red Hill Valley Parkway. If you have any questions, please call me on my cell at [redacted] Also, as discussed with you before and with the City of Hamilton, could you please carry out the skid number testing on the RHVP pavement?

117. Mr. Raymond forwarded Dr. Uzarowski's email to Ms. Lane and asked:

> Can we please discuss the friction testing for the City of Hamilton's perpetual pavement project.
>
> Ludomir is requesting friction testing and the City does not have objections to the testing but the City is not making a request to the Ministry.
>
> The pros to conducting the testing is supporting perpetual pavement research, gaining additional SMA friction information with a new aggregate source, and general public safety.
>
> The cons would be that the City has not made an official request and we have limited resources to conduct friction testing outside our direct needs.[137]

118. Ms. Lane then forwarded Mr. Raymond's email to Mr. Kazmierowski, and asked:

> Hi Tom - I seem to remember we offered some "monitoring" of the Red Hill Creek expressway perpetual pavement - did that not include friction testing? [138]

119. Mr. Kazmierowski replied to Ms. Lane:

> Yes, but we should have Ludimir instruct the City to either request the testing or at least approve Ludimir's request for testing and give permission for us to test on their facility[139]

120. Ms. Lane then forwarded Mr. Kazmierowski's email to Mr. Raymond and asked:

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[136] MTO0000005; and GOL0003500 attaching GOL0003501

[137] MTO0000005

[138] MTO0000005; and MTO0000007

[139] MTO0000007

> Chris - Is City of Hamilton in agreement with the testing? We don't need a letter of request, but we do need their approval. [140]

121. On September 28, 2007:, Mr. Raymond responded to Ms. Lane and stated:

> Yes the city is in agreement but it is strange that the City are not willing to write a request. I asked Ludomir to specifically send me a request from the City a few weeks ago. [141]

122. Ms. Lane responded to Mr. Raymond:[142]

> Maybe they are concerned about the results from a liability perspective...
>
> Anyway, we had agreed earlier this year to provide testing (rather than money for instrumentation, which was their original request). Please coordinate with Frank.

123. Mr. Raymond then responded to Dr. Uzarowski's September 27, 12:13pm, email, copying Ms. Lane and Mr. Marciello.[143] He stated:

> Thank you the RBM information.
>
> Regarding the request for friction testing, I will arrange for Frank Marciello to conduct the testing.
>
> Frank will require information on the location(s) of testing with a reference point that he can identify while driving the skid trailer through the project at posted speed, as well as, guidance on how to access the highway (which I understand is closed to traffic) and of any potential hazards within the project that he may encounter (noting he will be driving on a closed section of highway).

124. On October 2, 2007:

(a) Mr. Blair sent an email to Jason Wade (Pavement Evaluation Technician, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), Ms. Lane, Mr. Marciello, and Mr. Tam, stating:

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[140] MTO0000007
[141] MTO0000007
[142] MTO0000007
[143] MTO0000001; and GOL0002618

> The Ontario Hot Mix Producer's Association (OHMPA) is planning on doing the inertial profiler measurements on the Red Hill Creek Expressway on October 23rd as part of a Perpetual Pavement "Pave-in". There will be at least two other devices there. October 24th will be the rain day. We're also planning on measuring the 500 m correlation section that we've established at our Profilograph correlation site which is located on the E/B lanes of Highway 407, immediately east of Appleby Line. That will be done the next day (October 24th or the 25th if it rains on the 23rd or 24th). I'll give you more details about access etc. once we've decided exactly which pavement sections we're going to do. We may also do a part of an MTO contract if we can find one where traffic protection isn't a major issue. Those measurements would also be done sometime during the three days mentioned. [144]

(b) Dr. Uzarowski emailed Mr. Raymond in reply to Mr. Raymond's September 28 1:10pm email respecting friction testing on the RHVP, and also to Andro Delos Reyes (Senior Pavements & Materials Geotechnical Technologist, Golder), stating:

> Thank you very much, Chris. We really appreciate.
>
> Andro,
>
> As you are on the parkway today, could you please contact Chris at 416-235-3717 or by email at Chris.Raymond@ontario.ca and let him know what the best current access is? Also, please check the parkway for any obstacles like line painting, any roadwork, etc. and let Chris know. [145]

(c) Mr. Raymond emailed Mr. Delos Reyes, copying Dr. Uzarowski and Mr. Marciello, stating: "It may be best for you to coordinate access details directly with Frank, who operates the skid trailer. His phone number is 416-235-3515."[146]

(d) Mr. Marciello emailed Mr. Delos Reyes, copying Ms. Lane, Mr. Raymond, and Dr. Uzarowski, stating:

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[144] MTO0002136. The "Perpetual Pavement Pave-in" is also dealt with in Overview Document #3

[145] GOL0003509

[146] MTO0000008

> Andro
>
> As discussed please provide location details, preferably a schematic showing the location/name of the limits associated with the test section and location/name of entrance and exit areas. Fax number is below, in case you need it.
>
> Driving lanes within the test section need to be relatively clean from debris, sand and other construction materials, equipment, vehicles and personnel. Is there a posted speed limit and if not, what is the expected speed limit. MTO simulates wet pavement conditions so weather and pavement conditions must be dry.
>
> The sooner I receive the information, the sooner I can schedule, pending management approval. [147]

M. October 2007 MTO communications respecting the RHVP including friction testing, friction on other highways, SMA pause recommendations, and Demix Aggregates

125. On October 3, 2007, Mr. Rogers emailed Mr. Gorman respecting a September 21, 2007 email from Mr. Kazmierowski about SMA friction testing numbers on the eastbound Highway 403 conducted on September 12/13, 2007, in which Mr. Kazmierowski had remarked: "Surprising low numbers for a dolomitic sandstone SMA." Mr. Gorman commented in reply to Mr. Rogers:

> I thought there was a problem also with the dol sst
>
> we should go and have a look and at the red hill creek expressway, as I think it is done. [148]

126. On October 4, 2007, Mr. Marciello emailed Mr. Raymond, Mr. Reyes, Dr. Uzarowski, and Ms. Lane, stating:

> Friction testing on the above roadway will occur on Tuesday October 9, provided the pavement conditions are dry, temperature is above 4 Deg.Celc. and no debris/contaminants are present. Testing will occur at the posted speed limit during simulated wet pavement conditions at a frequency of one test per approximately 500m of travel. Frequency of testing may change if certain pavement conditions are encountered. All 4 lanes will be surveyed, unless maintenance/construction activities are occurring.

[147] MTO0000008

[148] MTO0003244

> As discussed with Andro Delos Reyes of Golder Associates, I plan to be at the Red Hill Valley Parkway entrance at Barton Street by 10:00am. [149]

127. Mr. Delos Reyes forwarded Mr. Marciello's email to Philips and also to Dufferin at jwharrie@stlawrencecement.com, and stated: "Gentlemen, For your information and permission."[150]

128. On October 12, 2007, Mr. Marciello confirmed with Golder and Mr. Delos Reyes that ASTM friction testing by the MTO was scheduled to take place on October 16, 2007 at 11:00am.[151]

129. The same day, Ms. Lane wrote (email address of recipient(s) not shown in email) with the subject line "Pave-in Red Hill creek expressway":[152]

> Hi Jason,
>
> The Ontario Hot Mix Producer's Association (OHMPA) is planning on doing the inertial profiler measurements on the Red Hill Creek Expressway on October 23rd as part of a Perpetual Pavement "Pave-in". There will be at least two other devices there. October 24th will be the rain day. We're also planning on measuring the 500 m correlation section that we've established at our Profilograph correlation site which is located on the E/B lanes of Highway 407, immediately east of Appleby Line. That will be done the next day (October 24th or the 25th if it rains on the 23rd or 24th). I'll give you more details about access etc. once we've decided exactly which pavement sections we're going to do. We may also do a part of an MTO contract if we can find one where traffic protection isn't a major issue. Those measurements would also be done sometime during the three days mentioned.

130. On October 11, 2007, Mr. Raymond wrote to Kevin English (Head, Quality Assurance, West Region, Provincial Highways Management Division, MTO) respecting friction testing on Highway 401 stating:

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[149] GOL0006580; and GOL0002616
[150] GOL0002616
[151] MTO0002185
[152] MTO0002448

> Subject: RE: FW: 2005-3030 SMA locations
>
> Kevin:
>
> Please note that this trial is a trial because there is the possibility that the desired friction may not be achieved and we currently have a section of Hwy 401 with low friction. To ensure that the trial has achieved our desired friction, I want to proceed with testing early next week pending weather and other friction testing commitments. Please note that the SMA section with Aecon Marmora aggregate has not yet been tested for friction and it would be a shame to miss the opportunity to capture both pavement sections.
>
> Any further efforts that you can make to expedite the requested information would be appreciated. [153]

131. On October 15, 2007, Paul Janicas (Senior Quality Control Lab Supervisor, Dufferin) sent a letter to Jim Theodore (Contract Administrator, MTO Contract 2007-2031, Morrison Hershfield), under the reference line "Trial Section – SP 12.5FC2 using aggregates from Varennes Quarry – Demix". Attached to Mr. Janicas' letter was the RHVP mix design package prepared by Trow Associates Inc. for the SP 12.5 FC2 layer and various aggregate and hot mix test results for the RHVP mix design.[154] The letter stated:

> Dufferin Construction Company (DCC) would like to request a trial section, in the SP 12.5 FC2 (surface course), of approximately 500 tonnes to evaluate a potential alternate source of premium aggregate for use in Hot Mix on Ministry projects.
>
> The proposed SP 12.5FC2 mix uses a traprock source from the Varennes Quarry (Demix) in Quebec. This aggregate has been recently used on the City of Hamilton Red Hill valley project in both SP 12.5FC2 (proposed mix) and SP 12.5 SMA.
>
> The mix used on the Red Hill project is attached for your review.
>
> The design was completed by Trow Associates and does not have third party verification, as it was not a requirement of the above mentioned project.
>
> Should the Ministry be interested in this trial section, but require a verification, please advise DCC as soon as possible.

---

[153] MTO0001321

[154] MTO0038692; and MTO0038693. The package submitted by Mr. Janicas was produced in two parts. The full mix design package, which is the same as the two parts submitted by Mr. Janicas, is at DUF0002385.01.

> Also, please note that the Ministry is currently performing "skid resistance" testing on the SMA from the Red Hill Valley project, which uses these aggregates. By allowing this trial section, it would facilitate a full evaluation of this product.

132. On October 16, 2007, Mr. Raymond sent an email with the subject line "Low Friction on Hwy 401 at Woodstock Contract 2005-3030" to Mr. Tam, Ms. Lane, Mr. Rogers, and Mr. Kazmierowski.[155] He wrote:

> Becca and Kai:
>
> Frank Marciello conducted friction testing of Hwy 401 at Woodstock (Contract 2005-3030) on Monday October 15th. Based on preliminary discussions with Frank, the SMA with Aecon Traprock aggregate has values in the low 20s and the SMA 50-50 blended aggregate trial (OTR and Aecon Dolomitic Sandstone) has values in the high 20s. In response to these numbers, I am recommending that SWR be formally advised of the low friction and provided recommendations for signing the low friction. Signing options include advisory reduced speed signing (ie 80 km/hr), regulatory reduced speed signing, and advisory "Slippery When Wet" signing with advisory speed tabs. The signing would be only for the sections with low friction (the areas paved last year with OTR aggregate have higher friction). Advisory signing would be removed when friction levels of FN=30 are reached. Furthermore, we should teleconference with SWR to discuss our recommendations and options for the remaining paving on this contract and paving for the Hwy 401 London contract 2006-3034.
>
> Also note the following:
>
> - The original aggregate for this contract was Ontario Traprock and some paving was done in late 2006 with the OTR aggregate. Friction measurements were conducted on the SMA in 2006 indicating early age friction of 27 (lane1) to 31 (lane 3)
>
> - Based on recommendations from the MTO-Industry Task Group, SWR negotiated with Aecon to change the aggregate to Aecon Marmora Traprock as well as to incorporate a 50-50 blended aggregate trial with Ontario Traprock and Aecon Dolomitic Sandstone. The actual blend from the mix design is 60 % OTR and 40 % Dolomitic Sandstone.
>
> - Contract 2005-3030 is nearly complete with a few nights of SMA paving remaining. Current night time temperatures have halted paving but paving could continue if night time temperatures increase.
>
> - No paving is expected this year for the other Aecon Contract 2006-3034, Hwy 401 Wellington Rd. SWR negotiated with Aecon to switch from OTR aggregate to Marmora Traprock for this project. There is approximately 13,000 tonnes of SMA on the contract.
>
> - The signing option proposed to Gerry and subsequently to Ray Mantha in January 2007 was for carry over contracts where cost negotiations to SP 12.5 FC2 are unsuccessful, proceed with contract (ie SMA) but with posting advisory "Slippery When

[155] MTO0001325

> Wet" signing and advisory speed tabs to be in place upon opening to traffic. Advisory signing would be removed when FN=30 or greater are safely reached." The direction received from Ray Mantha was to develop an SMA strategy with Industry, which recommended restricting some aggregate sources.
>
> - Please note the friction testing information will be processed shortly
>
> - I am hoping that contractual information including the layout and paving dates will also be provided in the next couple of days.

133. On October 16, 2007, Ms. Lane wrote to Mr. Kazmierowski with respect to the Highway 401 low friction results in MTO contract 2005-3030:[156]

> Chris Raymond is recommending posting of slippery when wet signs on Hwy 401 Woodstock (see below). I realize that signage has been discussed at length but I am unaware of any decisions that have been made. The pavement in question is still a construction zone, with 80 km/hr posted speed.

134. On October 16, 2007, the MTO conducted friction testing on the RHVP.[157]

135. On October 17, 2007, Mr. Marciello circulated (corrected) SMA friction testing results from Highway 401 for SMA placed in 2006, and recently for MTO contract 2005-3030. These test results (FN in the low 20s in some places) were ultimately cited in support of the MTO pause on SMA imposed in November 2007, which is described below.[158]

136. Also on October 17, 2007, regarding the RHVP friction testing conducted by the MTO the previous day, Mr. Delos Reyes emailed Mr. Marciello stating: "Just a reminder, please email test result as discussed. Dufferin and Philips Engineering are highly interested."[159] Mr. Marciello replied to Mr. Delos Reyes, copying Mr. Raymond and Ms.

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[156] MTO0002877

[157] GOL0002619 attaching GOL0002620 and GOL0002621

[158] MTO0002218 attaching MTO0002219, MTO0002220, MTO0002221, MTO0002222, MTO0002223, MTO0002224 and MTO0002225

[159] MTO0002226

Lane, stating: “Thanks for the reminder Andro. I will forward results to Chris as they become available and he will in turn forward to the appropriate individuals/organization.”[160]

137. Also on October 17, 2007, Mr. Marciello emailed Mr. Raymond and Ms. Lane the RHVP friction test results from October 16.[161] He stated

> Due to construction activities throughout the contract, a representative portion of Red Hill Valley Parkway was friction surveyed on October 16, 2007. The SMA in both southbound lanes from the CNR Structure to Greenhill Ave in Hamilton was clear enough for a safe and effective data collection process.
>
> Please review the attached Read Only files and let me know if any changes are required. Of not, please forward to the appropriate personnel.
>
> Dufferin and Philips Engineering and Andro Delos Reyes are eager for the results.
>
> Note: Friction Numbers below 30 were collected in areas situated directly under overhead structures (least likely to get weathered)

138. The detailed friction test results (for the two RHVP southbound lanes)[162] follow the typical MTO format that Mr. Marciello used and are reproduced below:

[160] MTO0002226

[161] MTO0002227 attaching MTO0002228 and MTO0002229

[162] MTO0002228 and MTO0002229

PAVEMENT FRICTION SURVEY 2007

MTO — ASTM E274, E501 — MERO

Red Hill Valley Pkwy > DIR: SBL1 LANE: 1 DATE: Oct-16
SITE: CNR OH STRUCTURE TO GREENHILL AVE (HAMILTON)
LHRS: N/A O/S: N/A TEMP: 12 DEG

DIST	SPEED	AVG FN	DIST - LANDMARKS		COMMENTS
0.000			0.00 >	CNR STRUCTURE	SMA in Contract PW-06-243 (RHV) Unopened to Traffic
0.249	93.9	33.6			
0.438	90.2	28.7	0.49 >	BARTON ST	
0.619	92.4	34.3			
0.791	93.3	35.7			
0.967	93.0	32.5			
1.146	92.2	32.8			
1.307	91.6	33.8			
1.581	91.4	35.1			
1.748	90.9	28.1	1.82 >	QUEENSTON RD	
1.937	92.8	35.4			
2.120	91.5	35.5			
2.291	92.6	34.9			
2.499	91.1	33.6			
2.740	92.8	32.6	2.65 >	KING ST	
2.930	93.6	36.5			
3.129	93.6	34.9	3.14 >	CPR STRUCTURE	
3.316	90.4	34.2			
3.487	90.8	36.3			
3.677	90.2	34.2			
3.815	90.6	35.5	3.95 >	GREENHILL AVE	

AVG. SPD	91.9	33.9	AVG. FN
		28.1	Min. FN
		36.5	Max. FN
		2.2	Std.Dev.
		20	Field

PAVEMENT FRICTION SURVEY 2007

MTO — ASTM E274, E501 — MERO

Red Hill Valley Pkwy > DIR: SBL2 LANE: 2 DATE: Oct-16
SITE: CNR OH STRUCTURE TO GREENHILL AVE (HAMILTON)
LHRS: N/A O/S: N/A TEMP: 12 DEG

DIST	SPEED	AVG FN	DIST - LANDMARKS		COMMENTS
0.000			0.00 >	CNR STRUCTURE	SMA in Contract PW-06-243 (RHV) Unopened to Traffic
0.263	89.6	34.7			
0.442	90.9	29.6	0.49 >	BARTON ST	
0.609	91.0	33.9			
0.751	90.2	34.5			
0.908	92.5	35.4			
1.063	91.2	34.6			
1.210	90.6	34.6			
1.343	91.4	34.0			
1.477	90.9	35.9			
1.609	91.1	37.4			
1.743	93.1	28.4			
1.943	91.0	35.2	1.82 >	QUEENSTON RD	
2.091	90.5	34.9			
2.248	90.8	36.7			
2.400	90.3	33.5			
2.583	89.1	28.6			
2.759	90.0	29.7	2.65 >	KING ST	
2.905	90.7	36.8			
3.094	90.1	33.9	3.14 >	CPR STRUCTURE	
3.286	91.5	35.1			
3.481	90.2	34.2			
3.644	89.6	33.2			
3.793	88.9	33.6	3.95 >	GREENHILL AVE	
AVG. SPD	90.7	33.8	AVG. FN		
		28.4	Min. FN		
		37.4	Max. FN		
		2.5	Std.Dev.		
		23	Field		

139. On October 18, 2007, Mr. Raymond emailed Dr. Uzarowski and Mr. Delos Reyes the MTO friction testing results from the testing conducted on the RHVP on October 16, 2007.[163] He wrote:

> Attached please find the friction testing results for the Red Hill Valley Parkway.
>
> Please pass the results on to those involved with the project.
>
> You may wish to note that some of the friction numbers less than 30 correlate with being located under a structure.
>
> Should you have any questions regarding the results please do not hesitate to contract us.

[163] GOL0002619 attaching GOL0002620 and GOL0002621

140. Dr. Uzarowski replied to Mr. Raymond's email about the MTO friction testing, stating:[164]

> Thank you very much for the results. We really appreciate your help. I will discuss the results with the City.

141. Dr. Uzarowski then forwarded Mr. Raymond's email with the MTO friction test results to Mr. Moore and Marco Oddi (Senior Project Manager, Red Hill Valley Project, Public Works, Hamilton), stating:[165]

> Please find attached the results of the friction testing on the Red Hill Valley Parkway completed for us by MTO. I will call you to discuss the results.

142. Also on October 18, 2007, Rob Rollings (Head, Quality Assurance, Central Region, Provincial Highways Management Division, MTO) wrote an email with the subject line "2007-2031 – Trial Section Varennes Quarry", to Mr. Theodore, Ken Payette (Quality Assurance Office, Central Region, Provincial Highways Management Division, MTO), and Mr. Rogers.[166] The email stated:

> We received the package regarding Dufferin's request for an FC2 trial for this new aggregate and have the following comments:
>
> ·There are specific requirements for approval to be included on the DSM list for FC2 and a trial section is one of them, however, prior to a trial section being permitted, Head Office Soils and Aggregates have to sample and test the material and evaluate the operation.
>
> ·The Contractor is required to contact Chris Rogers Manager Head Office Soils and Aggregates to request the evaluation be done.
>
> ·Once this step has been done and if everything is acceptable then the issue of a trial section can be reviewed. At this time, the request for a trial section is premature.

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[164] GOL0003516

[165] GOL0003513 attaching GOL0003514 and GOL0003515; and HAM0000317_0001 attaching HAM0000318_0001 and HAM0000319_0001

[166] MTO0003260

> Please pass this on to the Contractor - it should be noted that the Contractor should have already been aware of these requirements as they have been through it before

143. Mr. Theodore replied:[167]

> Thanks for your response. The whole submission was very fishy to me. I couldn't understand the purpose and they could not explain it me either. Now I see why. I will instruct them accordingly.

144. Also on October 18, 2007, Ms. Lane sent an email to a number of MTO employees including Mr. Raymond, Mr. Tam, Mr. Kazmierowski, and Mr. Rogers, respecting the Highway 401 SMA friction test results in MTO contract 2005-3030.[168] She said:

> Friction data recently obtained on Contract 2005-3030 is attached. In particular, westbound lane 1 is exhibiting friction numbers in the low 20's, with an average FN(100) of 23. Results in WB lane 2 and EB Lanes 2 and 3 are all in the high 20's. We were unable to test EB Lane 1, because the lane was closed.
>
> We suspect that friction numbers are lower in Lane 1 in both the EB and WB directions, because Lane 1 receives less traffic than Lanes 2 & 3. If Lane 1 is also being occasionally closed to traffic, the friction will improve more slowly. The SMA surface needs the traffic abrasion to remove the asphalt film, expose the aggregates, and improve friction.
>
> At this time, we would recommend that the 80km/hr construction zone speed limit signs be left in place until friction numbers improve in lane 1.
>
> We will continue monitoring the friction on this contract and will advise you of any improvements.
>
> Please contact me if you have any questions.

145. On October 19, 2007, Mr. Klement circulated a paper titled “An Investigation of the Skid Resistance of Stone Mastic Asphalt laid on a Rural English County Road Network” to Mr. Rogers, Mr. Tam, Ms. Lane and Mr. Raymond at the MTO. Mr. Rogers forwarded Mr. Klement’s email with the attached paper to Mr. Gorman and Carole Anne MacDonald (Petrographer, Soils & Aggregates Section, Materials Engineering & Research Office,

[167] MTO0003376

[168] MTO0002881 attaching MTO0002882, MTO0002883, MTO0002884 and MTO0002885

Highway Standards Branch, MTO).[169] Mr. Klement introduced the paper saying "a good report on SMA early friction experience in U.K. with a recommendation to use "Slippery" signs.

146. On October 19, 2007, Dr. Uzarowski emailed Mr. Raymond and Mr. Delos Reyes about British pendulum testing on the RHVP. [170] He said:

> Chris,
>
> I talked to the City of Hamilton today. You can go ahead with the British Pendulum testing on the SMA on the Red Hill Valley Parkway before it is open to traffic. Please let Andro Delos Reyes from Golder know when you will be doing the testing.
>
> Andro,
>
> When you get the information from Chris, please let Marco, Walter and James know.

147. On October 22, 2007, Dr. Uzarowski sent an email to Mr. Raymond with the subject line "pavement shot blasting". [171] He said:

> The name of the company is Blastrac. You can find some info on www.blastrac.com It is a US based company, I believe, and if you want a Canadian company using the same equipment I should be able to give you a contact when I am in Whitby (Thursday, the soonest). Golder is having a general meeting in Whitby now and there was nobody to help me to find the contact right away.

148. On October 22, 2007, Mr. Raymond emailed a draft Information Note to Mr. Tam respecting low friction on the newly constructed Highway 401 SMA in MTO contract 2005-3030.[172] As described below, the final Information Note was approved on October 30, 2007.

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[169] MTO0022073 attaching MTO0022074
[170] GOL0003512
[171] GOL0003511
[172] MTO0015566 attaching MTO0015567

149. On October 23, 2007, the OHMPA demonstration on the RHVP titled “Perpetual Pavement Pave-in & Inertial Profiler Demo respecting the RHVP” took place.[173]

150. On October 25, 2007, in relation to the drafting of the Information Note respecting low friction on the newly constructed Highway 401 SMA in MTO contract 2005-3030, Mr. Tam emailed Ms. Metcalfe to answer her question about the meaning of friction testing numbers.[174] He stated

> The friction number of 30 is an approximation of the (approaching worst condition) friction value used to determine minimum stopping distances in the Geometric Design Standards for Ontario Highways. The number 30 is a minimum friction number to be considered safe, low 20 is considered unsafe.

151. On October 29, 2007, Mr. Raymond wrote to Ms. Lane about inviting Mr. Kazmierowski to a meeting scheduled for the next day with the title “Regarding Future SMA Direction”.[175] He said:

> Yes - I wanted to give Tom the option to attend but he is not available until later in the week and Kai wanted the meeting asap. Tuesday is the only date that will work this week or early next week so I did as instructed by my other supervisor. My understanding is that Tony has convinced Kai to consider discontinuing the use of SMA and this meeting is to discuss. As an FYI this was the committees recomendation last year but Ray came back with the direction to develop a solution in conjunction with industry (OHMPA).
>
> Regardless of what happens tomorrow, I would think that we still need to get Tom and Sr. Managements buy in as well as Industry's buy in.

152. After many revisions by MTO staff, the final Information Note approved on October 30, 2007, by Mr. Chaput, stated:[176]

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[173] GOL0003406; and GOL0003911_00006. The “Perpetual Pavement Pave-in” is also dealt with in Overview Document #3

[174] MTO0029572

[175] MTO0001353

[176] MTO0015603 at images 2-3, attached to MTO0015602

- Some SMA paving occurred in late 2006 with the use of Aecon Marmora Traprock aggregate. Early age friction testing on this pavement yielded acceptable values of approximately 30

- A joint MTO-Industry Task Group was formed March 2007 to investigate concerns with SMA friction and recommended in April 2007 to restrict the use of one other source - Ontario Trap Rock aggregate in SMA.

- The MTO-Industry SMA Task Group investigated alternative techniques to improve the early age friction by sanding the SMA pavement during construction, but did not recommend any technologies for further investigation.

SMA for Contracts 2005-3030 and 2006-3034

- In response to the Task Group recommendation, the region negotiated a change order with the contractor to switch to Aecon Marmora aggregate for Contract 2005-3030 Highway 401 at Woodstock. This resulted in a cost premium of $18.85 per tonne of SMA. The region is also negotiating a change order for Contract 2006-3034 Highway 401 at London.

- In addition to switching aggregates, the region also agreed to negotiate a short trial to investigate the performance of blending 50% Ontario Traprock aggregate with 50% good performing dolomitic sandstone aggregate. A short 800 metre trial in the eastbound lanes 2 & 3 was constructed with early age friction values in the high 20's. The trial did not increase the early age friction as expected, because the addition of 50 % dolomitic sandstone did not provide sufficient aggressive micro-texture to overcome the thick asphalt film. The cost of constructing the trial section involved the same cost premium as for the Aecon Marmora Aggregate, which resulted in an additional cost of approximately $20,000.

- Early age friction testing of SMA constructed with Aecon Marmora aggregate yielded unacceptable friction values in the low 20's in Lane 1 with virtually no traffic, and high 20's in lanes 2 & 3 after about 2 weeks of traffic.

153. On October 30, 2007, Mr. Tam emailed Mr. Kazmierowski respecting friction and aggregate issues, stating:[177]

> We just finished our mtg, with Dennis Billings giving the regional perspective, Tony Tuinstra - contract office. Chris Raymond is preparing an IN/Decision note for you to Gerry. Incidentally, Chris Rogers had not been talking to Aecon about their Marmora Trap yet.
>
> We feel addressing early low friction base on aggregate alone is not doable base on the FNs that we got so far. Marmora Trap was OK before, now it is not. To achieve an acceptable friction, there has to be proper selection of aggregate, appropriate mix design (e.g. not too clean with excess AC to fill voids and inundating microtexture, and proper construction techniques. All three steps must be right. These are the issues/"sciences" that we have to address/R&D.

[177] MTO0015553 at image 1, attaching MTO0015554

> In short, our internal group recommend that:
>
> a) Current contracts to be dealt with on a case by case basis for CR. CR will review what they have. SWR contracts using the Aecon Marmora Trap to change to FC2.
>
> b) Contracts in the design stage will use FC 2. Hold off from using SMA until we resolve all the issues and the "sciences". In this case, we are still supporting SMA and we will also avoid the political fallout of delisting Aecon Marmora Trap. This option could a tough sell, but industry understand and agree with the safety standpoint.
>
> c) Regarding how to manage industry, we will work with industry TG on developing R&D to resolve issues. If you and Gerry agree with the above, we can start talking to SWR. We will prepare a status report before we talking to industry.
>
> This is just FYI and comments for now, will provide the IN later.

154. On October 31, 2007, Mr. Kazmierowski sent an email to Mr. Chaput and Mr. Tam that attached a slide deck titled “MTO Use of SMA Pavement, Presentation to Gerry Chaput November 2007”.[178] The slide deck stated, among other things:

> Decision Sought: Approval to temporarily pause the use of SMA pavement until low early age friction concerns are resolved.[179]
>
> Description: Measures to restrict SMA aggregates have been unsuccessful in resolving early frictional problems. One aggregate source (Aecon Marmora Traprock) previously acceptable has now shown to have low early age friction in (SWR Contr. 1005-3030).
>
> ****
>
> Proposed Recommendations
>
> Already awarded SMA projects
>
> Investigate contracts on case by case basis to examine:
>
> a.The performance of the particular SMA mix design based on previous performance to predict if it will provide good initial friction. If yes, proceed as per contract.
>
> b. If not, determine the costs to switch to SP 12.5 FC2.
>
> c. If cost negotiations are unsuccessful, proceed per contract but with posting advisory “Slippery When Wet” signing and advisory speed tabs to be in place upon opening to traffic. Advisory signing would be removed when FN=30 or greater are safely

[178] MTO0012581 attaching MTO0012582

[179] MTO0012582 at image 2

reached. Additional measures (e.g. Diamond grinding) would be required if an average FN below 20 is observed for a section of pavement.[180]

****

Proposed Recommendations

SMA projects in design

Specify SP 12.5 FC2 in place of SMA. (The impact of this recommendation will primarily affect Central Region as it is the only region with considerable use of SMA pavement.)[181]

****

The Ministry currently has no specified minimum pavement friction level however geometric standards are based on a minimum friction of approximately 30. Also most pavements exhibit frictional skid numbers of 30+ to 55, which determine driver expectations. A minimum skid number of 30 is proposed for Area Term Contracts.

Pavements with higher friction are safer.

Pavement friction is heavily dependent on the type of aggregate (dolomitic sandstones are at the high end, traprocks are at the low end).

Pavement friction is traditionally not a problem for the Ministry because it is controlled through:

- A prequalification system for premium aggregates that includes demonstrated pavement field performance.

- Requirement of aggregates to meet lab test requirements.[182]

N. November 2007: MTO communications respecting RHVP friction, MTO pause on SMA, and Blastrac SMA texturing demonstration

155. On November 2, 2007, Dr. Uzarowski emailed Mr. Raymond with the subject line "Friction on SMA on Hamilton's Red Hill Valley Parkway".[183] This email appears to be

[180] MTO0012582 at image 5
[181] MTO0012582 at image 6
[182] MTO0012582 at image 14
[183] GOL0003510; and GOL0002622

responding to Dr. Uzarowski's October 22, 2007, email respecting Blastrac.[184] Dr. Uzarowski said:

> The contact person from Blastrac for pavement texturing is Greg Bowers, Blastrac - Highways and Airports, 770-533-1888 greg.bowers@blastrac.com I have a binder on "Highway and Airport Product Overview, Improved Texture" for you.
>
> If you would like to tour the RHVP pavement and instrumentation, we would have to organize it next week. Of course Becca is also welcomed to join you. The official opening ceremony is on Nov 16. I will take some time off to take care of Ela starting probably the week of Nov 12 and I don't know yet for how long. Please let me know. You can call me on my cell 905-441-6044.

156. Mr. Raymond forwarded Dr. Uzarowski's email to Ms. Lane, with the following introduction:

> Please let me know if you want to tour Ontario's first perpetual pavement project (OHMPA's claim not mine). [185]

157. Ms. Lane accepted the invitation.[186] Mr. Raymond responded to Dr. Uzarowski's email, stating:

> Thanks for the Blastrac information.
>
> Please pass my get well soon thoughts to Ela.
>
> I have been really busy here with SMA issues and construction of MTO's first pervious pavement at Geulph Line and Hwy 401. I will follow up with you regarding a tour of the site once I hear from Becca. I think that pendulum testing of the SMA will not happen. [187]

158. Also on November 2, 2007, Mr. Raymond emailed Mr. Brown and Mr. Tam, with the subject line "Reconvening the SMA Task Group, stating:

> As per the voicemail I left you today, the Ministry is requesting the SMA Task Group reconvene to discuss concerns that have recently developed with the Task Group's previous recommendations. I am requesting a half day meeting within the next two

[184] GOL0003511
[185] MTO0000399
[186] MTO0002897
[187] GOL0002622

> weeks. My preferred dates are any time (am or pm) on November 9th, 13th or 14th. I regret the short notice and timing for the meeting, however, the recent developments require immediate attention. [188]

159. Mr. Raymond then emailed Mr. Tam, stating:

> Sandy called to talk to me regarding the background for the meeting. I informed Sandy that the meeting is in reaction to low friction on a project with Aecon Marmora aggregate. I informed Sandy to follow up with you regarding details.[189]

160. On November 3, 2007, the Red Hill Valley Parkway Official Opening Ceremony took place.[190]

161. On November 5, 2007, Mr. Tam sent an email with the subject line "Use of SMA in 2007 – 8" to a number of MTO employees.[191] The message read:

> We had an internal group meeting last Tuesday Oct 30th and reviewed the results that we have so far collected, and in particular the SWR Contract 2005-3030. (Contr 2005-3030 has early friction of FN 100 = 23, and uses an aggregate (Aceon Marmora Traprock) that was acceptable on the "approved list" of aggregates for SMA.)
>
> Findings are that measures to restrict SMA aggregates have not successful in resolving early frictional problems. Aggregate blending does not ensure adequate early age friction.
>
> I wish to communicate to you the following direction and recommendations that are OKed by Gerry:
>
> Future direction from this point on will be to pause the use of SMA until low early age friction concerns covering aggregate selection, mix design, and construction are resolved.
>
> For contracts that are already awarded:
>
> Investigate contracts on case by case basis to examine:
>
> a.The performance of the particular SMA mix design based on previous performance to predict if it will provide good initial friction. If yes, proceed as per contract.
>
> b. If not, determine the costs to switch to SP 12.5 FC2.

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[188] MTO0001367
[189] MTO0001373
[190] HAM0032560_0001
[191] MTO0003380

c. If cost negotiations are unsuccessful, proceed per contract but with posting advisory "Slippery When Wet" signing and advisory speed tabs to be in place upon opening to traffic. Advisory signing would be removed when FN=30 or greater are safely reached. Additional measures (e.g. Diamond grinding) would be required if an average FN below 20 is observed for a section of pavement.

For contracts in design:

Specify SP 12.5 FC2 in place of SMA. (The impact of this recommendation will primarily affect Central Region as it is the only region with considerable use of SMA pavement.)

Next Steps:

We have arranged a meeting with the SMA MTO/Industry Task Group to held next Tuesday to inform and discuss these recommendations with industry. As well, we will work with industry on research projects that aim at resolving the different issues. We will continue monitoring the SMA projects that we have.

Chris Raymond and I would be happy to work with your staff to resolve your SMA issues. Please let us know how we can assist.

Looking forward to hearing from you.

162. On November 6, 2007, Mr. Raymond emailed an Information Note (Briefing Note) titled “PAUSING THE USE OF STONE MASTIC ASPHALT PAVEMENT”, to Mr. Tam and Ms. Lane. The Information Note began as follows:

Issue:

The Ministry is pausing the use of stone mastic asphalt (SMA) pavement due to concerns with low pavement friction immediately after construction.

The decision to pause the use of SMA is related in part to low pavement friction on a construction contract on Highway 401 at Woodstock.

The issue affects selected projects on 400 series highways primarily in Central and Southwestern Region.

Recommendation:

The ADM should be aware of the decision to pause the use of SMA and the low pavement friction concerns encountered on Highway 401 at Woodstock.[192]

[192] MTO0001378 attaching Information Note MTO0001379; and MTO0015608 attaching MTO0015609

163. On November 7, 2007, Mr. Tam emailed a draft presentation titled “Early SMA Friction Characteristics”, by Kai Tam, for the CUPGA Workshop, November 18, 2007.[193] Among other things, the draft presentation stated: “Low early age friction is not solely related to the aggregate type (although significant); it is also influenced by mix design and construction.”[194]

164. On November 13, 2007, the SMA Task Group met to discuss the MTO’s pause on the use of SMA.[195] The MTO slide deck presentation for the meeting sent to the SMA Task Group by Mr. Raymond on November 10, 2007, for the meeting stated in part:[196]

> MTO’s Position
>
> Ensures public safety by providing adequate early age friction is paramount important.
>
> Focus on selective aggregate source for SMA is not working, because aggregate used from the “approved list” will still not able to provide acceptable early friction.
>
> Temporarily pause the use of SMA. Need to address all concerns covering aggregate selection, mix design, and construction before further use.

165. The minutes of the November 13, 2007, SMA Task Group meeting stated that:

> Kai began the meeting by stating that the Ministry is temporarily pausing the use of SMA in new contracts to ensure public safety. The purpose of the meeting is to explain the reasons for this decision and to develop a plan on how to resolve the early age friction concerns with SMA. Kai gave a presentation outlining the low early age friction recently observed and the details of the Ministry’s temporary pause on the use of SMA. The Ministry does support SMA as a viable technology but requires early age friction safety concerns to be resolved. [197]

[193] MTO0015637 attaching MTO0015638
[194] MTO0015638 at image 13
[195] MTO0001384 attaching MTO0001385
[196] MTO0001385 at image 3
[197] MTO0001405 at image 1

166. On November 14, 2007, Ms. Lane wrote to Ms. Chan, Mr. Raymond, and Mr. Klement regarding looking at possible treatments to improve friction on SMA:

> The SMA taskgroup (Chris is the project manager) would like some brainstorming on how to address early friction issues with SMA. A spinoff group (us?) will be working with Sandy Brown of OHMPA to look at possible treatments to remove the asphalt film. Some suggestions included - diamond grinding, water blasting, skid abrader, gritting, and even studded tires...
>
> Over the next few months, I welcome your suggestions / ideas. Please research, surf the net etc - lets see what we can come up with. [198]

167. On November 16, 2007, Mr. Raymond emailed Greg Bowers (Manager, North American Market, Blastrac) (cc Ms. Lane) on the subject of "Inquiry Regarding Blastrac Technology." [199] He wrote: :

> Thank you for the discussion regarding your Blastrac process this morning. As discussed, I would appreciate if you could provide me some technical literature on its application for removing excess asphalt cement on newly constructed SMA pavement. Any examples where the process has been used in this application along with agency contracts would be appreciated. I would also be interested in general information regarding the cost of the process.
>
> In our discussions I mentioned that following a review of your technical literature, the Ministry may be interested in a product demonstration next summer. Since talking to you, there may be an opportunity to conduct a demonstration next month and wondered how soon your equipment could become available.

168. Mr. Bowers replied to Mr. Raymond the same day, stating:

> Here is a presentation prepared by our Richard Jenman form the UK. There is a lot of information in this document. There is a section that specifically covers the early life skid resistance problems associated with SMA surfaces and the results we achieved with our process. I've also included a photo of our equipment working on the roads in Australia.
>
> I'll follow up with some additional information that you requested regarding budget estimates.
>
> As far as a demonstration in December, I'll have to check on equipment availablility and get back with you. [200]

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[198] MTO0002911

[199] MTO0001407

[200] MTO0002357 attaching MTO0002358 and MTO0002359

169. On November 17, 2007, the RHVP opened to the public.[201]

170. On November 21, 2007, Mr. Bowers emailed Ms. Lane and Mr. Raymond a quote from Hi-Lite Canada ULC to provide an SMA pavement texturing demonstration. Mr. Bowers wrote:[202]

> I've spoken with our contractors and Hi-Lite Markings is capable of demonstrating our process during the month of December. They have the most experience on roadways and I am confident they will be able to provide a cost effective solution to your problem.
>
> I have attached a budgetary proposal from Hi-Lite for your consideration. As we discussed on the telephone this estimate is based on prior work completed on a similar application. The project cost may vary up or down depending on the results of the demonstration and several other parameters that we will determine during the demonstration. We have targeted the week of December 11 for the demonstration but the exact schedule will be dependent on the weather. We'll have to work when the weather permits.
>
> The US will be on Thanksgiving holiday Thursday and Friday so I will contact you on Monday morning to discuss this further.
>
> Thank you for your interest and I look forward to talking with you again on Monday.

171. On November 22, 2007, Mr. Raymond replied to Mr. Bowers' email, stating:[203]

> Thank you for the follow up information on a trial in December.
>
> I have further investigated the opportunity for a demonstration of your technology and found out that the pavement I was proposing will no longer provide all of the conditions required for a suitable trial in December. The section of highway is being opened to traffic this week and winter has arrived in southern Ontario.
>
> We are still interested in the possibility of a demonstration trial in 2008. I will discuss opportunities and site selection requirements with the Ministry's SMA task group and let you know what we decide.
>
> One issue for further discussion is whether a demonstration can be conducted on a 400 series highway. The intent of the trial would be to demonstrate your technology's ability to

[201] HAM0021284_0001 attaching HAM0021285_0001; HAM0021286_0001; and HAM0007949_0001
[202] MTO0002486 attaching budget proposal at MTO0002487
[203] MTO0001412

> enhance early age friction on SMA pavements. The majority of SMA pavement is placed on 400 series highways (often at night).

172. On November 22, 2007, in response to an email from Mr. Politano asking "what ever became of the perpetual pavement monitoring on RHCE by Hamilton, and our willingness to financially participate?", Ms. Lane wrote:

> I think we agreed to assist with performance monitoring - for example, we recently carried out friction testing and ARAN testing for that project.
>
> Regarding actual dollars - I think we had only discussed a token amount ($10k) and they were looking for significantly more $... not sure of the outcome. [204]

173. On November 23, 2007, Mr. Raymond emailed Mr. Gorman a summary of SMA friction test results for various 400 series highway locations.[205]

174. On November 26, 2007, Mr. Rogers emailed a July 2003 report on skid resistant aggregates in Ontario (by Mr. Rogers, Mr. Gorman, and Ms. Lane), and the then current DSM aggregate Requirement Guidelines for listing in DSM 3.05.25.[206]

175. On November 26, 2007, the MTO Geotechnical Committee met.[207] The minutes of that meeting record that Mr. Rogers gave an update on SMA:

> SMA Update MTO/Industry Task group last met in April 07 but has recently reformed to address issues arising form this years construction season. In the spring the industry indicated they were not willing to apply sand to the hot pavement surface, but instead endorsed a list of selected aggregates that have been used successfully in SMA in the past (MRT/Marmora/Dolomitic Sandstone).
>
> A number of trials were constructed in 2007. FC2 /SMA trial with Dolomitic Sandstone produced friction in the mid 30s for the SMA and 40s for the FC2. Low AC SMA trial with MRT aggregate was placed on 401 but without apparent dramatic improvements in friction at early ages. Hwy 401 SMA in the Woodstock area using Aecon Marmora aggregate

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[204] MTO0002925
[205] MTO0001442 attaching MTO0001443
[206] MTO0003579 attaching MTO0003580 and MTO0003581
[207] MTO0001201 at image 12, attached to MTO0001200

> resulted in friction in the low to mid 20s and has been the trigger to pause the further implementation of SMA.
>
> There is general agreement that the low friction is a result of masking of aggregate microtexture with AC film.
>
> Over the winter a lot of work will be done by the task group and sub groups to investigate the cause of the thick asphalt film and come up with a cure.
>
> For jobs in design to be constructed next year we will be switching to FC2. For designs that have been awarded the ministry is going to work with the contractors on their mix designs. On a project specific basis will we have the option to negotiate to FC2 if we are not happy with the SMA mix design.
>
> PL will follow up at PHM forum to see what opinions of senior management are with respect to SMA.
>
> CR reminded the committee that it is only an early friction issue, after about a year friction does increase

176. On November 27, 2007, in response to Mr. Raymond's email on November 22, Mr. Bowers wrote respecting the pavement Blastrac texturing demonstration:

> I know from your phone message that you were tied up in meetings all day yesterday.
>
> Regarding the one issue for further discussion (demonstration on 400 Series Highway) the only concern we have is traffic control. If you would provide that, we have no problem doing the demonstration. If you cannot provide that we would have to contract with a local company to provide the T.C. This would add additional cost. Night work is not a problem as our equipment is equipped with lights and light towers are generally available.
>
> Speaking with our contractor Hi-Lite Markings, we were wondering if it might be wise to have a meeting with your team or at least conference call to discuss the timeline and project parameters.
>
> Let me know you thoughts. You should be able to reach me on my cell 770-533-1888 any time today. [208]

O. December 2007: MTO communications respecting RHVP friction, Demix Aggregates request for approval, and SMA low early friction

177. On December 7, 2007, Ms. Chan emailed Ms. Lane, Mr. Raymond, and Mr. Klement, regarding her research on remediation of low SMA early friction. [209] She stated,:

[208] MTO0000628

[209] MTO0002577 attaching MTO0002578

> I have completed a through research regarding SMA early friction issue. If you think I should look into further on any topics, please let me know. Below is the summary of my research for your information. See attached summary file for details.
>
> A few agencies specify the use of sand/grit or micro-incrustation to improve the SMA friction. However, it is recognized that this will have adverse effect on surface texture depth and the sand/grit is expected to be lost in a few months after trafficking. But this is still a less expensive and viable option to improve early friction issue.
>
> Another method to improve early SMA friction is re-texturizing the surface, which could be a costly strategy. It includes micro-milling (carbide-tipped with 1mm texture depth); precision-milling (carbide-tipped with 5 mm texture depth) and diamond grinding (diamond tipped saw to improve surface smoothness). Also, high pressure water blasting, shot blasting (skidabrader), sand blasting are used to restore surface textures. Although majorities of the blasting methods are used for PCC pavement, a few literatures indicated it can be used with asphalt concrete pavement.
>
> Further to texturization, the idea of running the SMA with studded tires vehicle seems to be a viable option. Some literature indicated studded tires have tungsten carbide pin that strike to the pavement surface which cause damage. However, SMA is originally developed to resist studded tire wear, so using studded tires to run on SMA should not cause major damage. Nevertheless, studded tires could produce similar effect as micro-milling (also carbide tipped) to retexture and improve SMA friction issue. The concept of using studded tires to improve SMA friction needs to be examined more closely. For example, what type of vehicle to install the studded tires for this application and how many times the studded tires should roll over the SMA in order to produce acceptable friction level for the traffic, etc…

178. On December 7, 2007, Mr. Janicas emailed Mr. Rogers requesting to begin the process to place the Varennes Quarry aggregate used on the RHVP on the DSM list. [210] He wrote

> Attached is a letter from Demix Aggregates formally requesting to begin the approval process to be placed on the DSM list for there Varennes Quarry aggregate.
>
> Please note, this aggregate has already been used in Ontario.
>
> It was placed on the City of Hamilton Red Hill Creek Expressway in the form of SP 12.5 FC2 and SP 12.5 SMA.
>
> Please advise us of the next step in the process.
>
> Thank you in advance,

[210] MTO0000039 attaching MTO0000040

179. Mr. Janicas' email attached a letter from Demix, dated November 22, 2007, identified Demix Aggregates as a division of St. Lawrence Cement and requested the MTO start the process for the aggregate from the Varennes quarry (located about 25km southwest of Montreal) to be placed on the MTO's DSM list (Designated Sources for Materials).[211]

180. On December 11, 2007, Mr. Marciello emailed the RHVP October 16, 2007, friction test results to Mr. Rogers and Mr. Gorman with the subject line: "Friction Results on Demix Aggregate in SMA in Hamilton".[212]

181. On December 12, 2007, Mr. Moore and Dr. Uzarowski spoke at the OHMPA Fall Seminar on: "The Red Hill Expressway – Canada's First Municipal Perpetual Pavement Designed from the Ground Up".[213] It was attended by up to nine MTO employees.[214]

182. On December 13, 2007, Mr. Rogers wrote back to Demix (Dufferin / St. Lawrence) respecting its request to have Varennes Quarry aggregate included on the DSM list as follows:

> Re: Approval of Your Varennes Quarry for SP 12.5 FC1 Coarse and SP 12.5 FC2 Coarse and Fine Aggregates
>
> Thank you for your e-mail dated December 10, 2007. This response is acknowledgement of your application to have your quarry placed on the ministry's Designated Sources for Materials List (DSM #3.05.25) for SP 12.5 FC1 and 2.
>
> We are somewhat familiar with the rock from your quarry. In 1992, we tested a sample of the coarse aggregate from the quarry. The test results are portrayed in Table 1. Our Petrographer has classified your rock as a Syenite (Trachyitic Phonolite). The test results

[211] MTO0000040 attached to MTO0000039
[212] MTO0003601 attaching MTO0003602 and MTO0003603
[213] GOL0002947; and MTO0020688 attaching MTO0020689
[214] MTO0020688 attaching MTO0020689

> are generally acceptable. The only exception is the Polished Stone Value (PSV) test results, which did not meet our ministry's criteria.
>
> I note that your quarried aggregate was recently used on Hamilton's Red Hill Valley Parkway in a 12.5 SMA mixture (Contract No. PW-06-243). We plan to monitor the performance of your aggregate in the expressway.
>
> I have attached a copy of the Requirement Guidelines that reflect MTO require-ments in order for your source to be listed on the above-mentioned DSM (Appendix 1). Also enclosed are the following:
>
> - A map of Ontario showing the location of all sources of HL3 Modified, HL1, and DEC skid-resistant aggregate; and
> - A copy of a report entitled "Skid-Resistant Aggregates in Ontario".
>
> The next step will be for us to visit your quarry to take a sample from a stockpile meeting our grading requirements. In view of the weather, I do not see this happening before April 2008.
>
> Should you require any further information, please do not hesitate to contact either Bob Gorman at (416) 235-3736 or myself. [215]

183. Also on December 13, 2007, Ms. Lane emailed the RHVP October 16, 2007, friction test results to Mr. Kazmierowski with the subject line “Friction Results on Demix Aggregate in SMA in Hamilton”, stating:[216]

FN90 = 34
Min. = 28
Max. = 37

184. Mr. Kazmierowski responded to Ms. Lane stating: “Not great results but still consistently acceptable even at 90 kph. Have you shared these results with our MTO task group members?” [217]

[215] MTO0000042 attaching MTO0000043
[216] MTO0002942 attaching MTO0002943 and MTO0002944
[217] MTO0002945

185. Ms. Lane replied to Mr. Kazmierowski, stating that “They went to Chris Raymond and Bob Gorman – I am not sure if he shared them with the MTO rask group members.”[218]

186. Ms. Lane then emailed the RHVP October 16, 2007, friction test results to Mr. Tam, Mr. Rogers, and Mr. Billings, stating:

> Not sure if you received this data from the SMA placed on the Red Hill Creek Parkway in Hamilton. Friction was measured at 90 km/hr prior to opening. [219]

187. On December 13, 2007, Mr. Rogers replied to Mr. Marciello’s December 11 email respecting “Friction Results on Demix Aggregate in SMA in Hamilton”, stating:[220]

> Thanks - interesting to see the low friction areas - I wonder why - rich spots?

188. On December 14, 2007, Mr. Billings forwarded Ms. Lane’s December 13, 2007 email respecting “Friction Results on Demix Aggregate in SMA in Hamilton” to colleagues in the MTO (Rob Kohlberger (Geotechnical Engineer, Geotechnical Engineering Section, Central Region, Provincial Highways Management Division, MTO) and Henry Bykerk (Aggregates Supervisor, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO)), stating:[221]

> The Demix Quarry is not on the ministry's DSM. Note that FN data was obtained at test speeds ~ 90KPH.

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[218] MTO0002945

[219] MTO0002946 attaching MTO0002947 and MTO0002948. On January 2, 2008, Mr. Tam responded to Ms. Lane’s email, stating that he had “*not seen this before*.” (MTO0015640)

[220] MTO0003812

[221] MTO0012307

189. On December 17, 2007, Mr. Marciello responded to Mr. Rogers' December 13, 2007, email, stating: "I can only assume the lower friction spots are underneath structures:[222] Mr. Rogers responded to Mr. Marciello, stating: "good idea".[223]

P. 2008-2016

1. RHVP, MTO friction testing of RHVP, Demix Aggregates and other Dufferin aggregate approval requests

(a) 2008

190. On April 11, 2008, Mr. Kazmierowski, emailed Mr. Chaput a number of work plans.[224] This included a Work Plan marked "Final" for 2007-2008 for the Pavement and Foundations section in which it identifies various business goals. "Business Goal #4" to "Accelerate Implementation of New Technologies" included as one of the "Key Commitments / Supporting Actions" for this goal: "4.1 Monitor performance of municipal Stone Mastic Asphalt (SMA) sites and develop a database". This item further stated "5 municipal sites selected" for a "Multi-year in-house study", and that the MTO had "Completed roughness and friction data collection and delivery to the users in Oct. 2007".[225]

191. On May 1, 2008, Mary Chaly (Administrative Assistant, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) circulated an draft "90 Day Accomplishments Jan-March 2008" and "90 day Plan April to June 2008 Work Plan" for the MTO by email to the

[222] MTO0003758
[223] MTO0003818
[224] MTO0012692 attaching MTO0012695 and others
[225] MTO0012695 at image 14

"Senior Engineers" (including Mr. Raymond, Mr. Marciello, Joseph Ponniah (Senior Research Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), and Mr. Klement).[226] They contained the following statements:

> Completed survey requests to determine extent of early friction issues on SMA pavements (Re: Hwy 401 in SWR, CR and ER. New 404 SMA NB direction). Completed Municipal SMA testing on unopened Red Hill Creek Expway in Hamilton and on Mississauga Rd (Friction concerns in area of high accident rate – Re Chris Rogers). Overall Ontario Completion 95%.[227]
>
> ****
>
> Sources of skid-resistant aggregate
>
> Investigate 2 new source of premium aggregate for use as source of skid resistant aggregate. One is owned by De-Mix (Dufferin) in Varennes PQ, SE of Montreal and the other is a new potential new quarry north of Kingston on Hwy 15 called Canadian Wollastonite. The objective is that by increasing numbers of sources (currently about 32) we will encourage competitive bidding of this commodity. [228]

192. On May 29, 2008, Gary Todd (Manager, Design & Contract Standards, Highway Standards Branch, Provincial Highways Management Division, MTO) circulated internally at the MTO, including to Mr. Chaput, an Information Note on "the Hamilton vegetation issue". [229] The Issue/Question in the Note was "What is MTO's position on the City of Hamilton's plan to allow median vegetation to naturalize" respecting the RHVP and LINC, and the Note indicated the MTO has been asked its opinion. The Note stated in part:

> Key Message:
>
> MTO has standards and best practices for the control of vegetation in its Maintenance Manual
>
> MTO has had a long standing policy of permitting natural regeneration to occur

[226] MTO0001653
[227] MTO0001654 at image 4 (the "90 Day Accomplishments Jan-March 2008" document)
[228] MTO0001655 at image 5 (the "90 day Plan April to June 2008 Work Plan" document)
[229] MTO0012619 attached to MTO0012618

> Vegetation that obstructs visibility or causes safety concerns is removed or periodically cut
>
> MTO makes its standards and best practices available to Ontario municipalities but does not influence or control their policies or practices
>
> Noxious weeds must be controlled by the property owner as required when identified through a weed control order issued under the authority of the Ontario Weed Control Act

193. On June 12, 2008, the MTO conducted RHVP skid testing.[230] Mr. Marciello emailed the results to Mr. Gorman, Mr. Raymond, and Mr. Ponniah, on June 18, 2008.[231]

194. On June 16, 2008, Mr. Gorman emailed Mr. Marciello and Mr. Bykerk 37 photographs of the RHVP asphalt, roadway, and signage.[232]

195. On July 17, 2008, Ms. MacDonald and Mr. Gorman visited the Demix Varennes (Dufferin) quarry near Montreal. On July 23, 2008, Mr. Gorman emailed photos taken at the quarry,[233] and their Request for Permission to Travel forms stated:

> Demix Aggregates has requested that their Varennes quarry (located near Montreal) be included on Ontario's Designated Sources for Materials (DSM) list for premium wearing coarse aggregates. Their quarried aggregates were recently used for SMA in the city of Hamilton's Red Hill Valley Parkway. As part of the DSM approval process, the initial step is to visit and inspect bedrock within the quarry and the quarrying operations. Samples of the coarse and fine aggregates will be taken for testing in our Downsview laboratories.
>
> If acceptable, the Varennes quarry may be listed on our Ministry's DSM list # 3.05.25 for asphalt aggregates. We normally charge a fee to recover costs.
>
> This is a usual business trip associated with program delivery. [234]

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[230] MTO0000011, MTO0000012, MTO0000013 and MTO0000014

[231] MTO0024001 attaching MTO0024002, MTO0024002, MTO0024003, MTO0024004, MTO0024005

[232] MTO0016866 attaching MTO0016867, MTO0016868, MTO0016869, MTO0016870, MTO0016871, MTO0016872, MTO0016873, MTO0016874, MTO0016875, MTO0016876, MTO0016877, MTO0016878, MTO0016879, MTO0016880, MTO0016881, MTO0016882, MTO0016883, MTO0016884, MTO0016885, MTO0016886, MTO0016887, MTO0016888, MTO0016889, MTO0016890, MTO0016891, MTO0016892, MTO0016893, MTO0016894, MTO0016895, MTO0016896, MTO0016897, MTO0016898, MTO0016899, MTO0016900, MTO0016901, MTO0016902 and MTO0016903

[233] MTO0022678 (email only, 13 photos omitted) and MTO0022692 (email only, 30 photos omitted)

[234] MTO0012826 at image 1 and MTO0012828 at image 1, attached to MTO0012823 (November 18, 2008 email); MTO0022155 at image 1 and MTO0022157 at image 1 attached to MTO0022153 (January 29, 2008 email). Also see MTO0000044 December 4, 2008 letter referring to July 17, 2008 visit.

196. On July 23, 2008, Mr. Blair emailed draft "Minutes for Inertial Profiler Task Group Meeting #14" for its meeting on July 22, 2008, to Mr. Tam. On July 27, 2008, Mr. Tam emailed Mr. Blair back with comments. The minutes stated:

> Purpose of Meeting
>
> The main purpose of the meeting was to track the progress of the implementation of inertial profilers and to discuss the proposed side-by-side measurements between profilographs and inertial profilers during the 2008 construction season.
>
> ****
>
> Measurements Taken Last Year:
>
> Regarding re-visiting the Red Hill Creek Expressway to investigate the one area of rejectable localized roughness that was found by the inertial profilers (but not found to be rejectable by the profilographs), SB still needs to arrange the visit. JB said that, it might be easier to arrange a visit with just himself and SB.
>
> ****
>
> Action: SB will check back with the City of Hamilton to determine a date when interested task Group members can re-visit the Red Hill Creek Expressway.[235]

197. On December 3, 2008, Dr. Uzarowski forwarded to Lisa MacKenzie (Marketing Coordinator, Golder) the October 18, 2007 email from Mr. Raymond attaching the October 16, 2007 MTO skid testing results.[236] Ms. MacKenzie replied to Dr. Uzarowski and asked for Mr. Raymond's address.[237] Dr. Uzarowski said he did not have it and asked her to call Mr. Raymond and ask for his address.[238]

198. On December 4, 2008, Stephen Senior (Head, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial

[235] MTO0015755 at image 1, attached to MTO0015754
[236] GOL0003506 attaching GOL0003507 and GOL0003508
[237] GOL0003505
[238] GOL0003505

Highways Management Division, MTO) wrote to Estel Gagnon (Chef Section Qualite, Demix Agrégats, Dufferin affiliate):

> Dear Ms. Gagnon:
>
> Re: Approval of Physical Properties of Your Varennes Quarry for SF 12.5 FC1 and SF 12.5 FC2 Coarse and Fine Aggregates
>
> We have completed testing of your coarse aggregate and screening samples taken from your quarry (MTO MAIDB No. Q03-003) on July 17, 2008.
>
> The laboratory test results are portrayed in Table 1. All of the test results are favour-able and meet the specification criteria as outlined within Special Provision 11 OF1 2, Amendment to OPSS 1003, November 2004, Aggregates for Hot Mixed, Hot Laid, Asphaltic Concrete. In addition, we have submitted the screenings and coarse aggre-gate samples for Superpave Consensus Property Requirement testing. Both the fine and coarse aggregate sample test results meet AASHTO specification criteria.
>
> During our visit on July 17, we had the opportunity to inspect the quarry and sample the processed aggregate. Our Petrographer has classified your rock as a syenite (trachyitic phonolite). Main minerals include feldspar, albite nepheline, and albite.
>
> Because your quarried aggregate was used on Hamilton's Red Hill Valley Parkway in a 12.5 SMA mixture (Contract No. PW-06-243), we will allow this city job to act as the trial section needed for your source to be included on the ministry's Designated Sources for Materials List (DSM #3.05.25). This contract has undergone one winter of service demand and requires at least two winters before an approval decision can be made. The mix must obtain the desirable level of friction before the source can be considered for DSM inclusion. We plan to monitor the performance of your aggregate in the parkway.
>
> Should you require any further information, please do not hesitate to contact either Bob Gorman at (416) 235-3736 or myself. [239]

199. Mr. Senior's letter appended "Table 1 Laboratory Test Results", which included a value for Polished Stone Value of 52. [240]

(b) 2009

200. On March 16, 2009, Mr. Gorman asked Ms. Lane to conduct skid-resistance surveys for the 2009 season for a list of pavements. Mr. Gorman specifically requested that the "Red Hill Valley Parkway SMA be evaluated as soon as possible, since it will

[239] MTO0000044 attaching MTO0000045
[240] MTO0000045

have passed its second winter." Mr. Gorman also included a table of contracts and which years (from 2007 to 2011) each contract should be surveyed. The table noted that the RHVP should be surveyed every year from 2007 to 2011.[241] Mr. Gorman described the RHVP test section as:

> **Red Hill Valley Parkway, CNR Overhead Structure to Greenhill Avenue (Hamilton), Southbound and Northbound**
> The paving job is located in both southbound and northbound lanes along the length of the project (Contract No. PW-06-243 [RHV]). The total section is approximately 7.5 km long. This is the first full-service municipal perpetual pavement in Ontario. The pavement is a 12.5 SMA and consists of Varennes quarried 12.5 mm stone, Varennes screenings, and E.C. King filler. Paved in June 2007.

201. On May 7, 2009, the MTO conducted skid testing of the RHVP.[242]

202. On May 8, 2009, Mr. Marciello emailed Mr. Senior, Mr. Gorman, and Ms. Lane attaching the friction testing results of the RHVP from the previous day. [243] He stated:

> **Demix Aggregate in SMA from Quebec**
>
> Gentlemen
>
> Might be too early to tell but it appears that friction levels/trends may be starting to decline with time.

203. On May 11, 2009 Mr. Senior replied to Mr. Marciello's May 8 email regarding the RHVP friction testing results: [244]

> Frank, both Bob and I agree that there is no clear indication of any early trend in the data. Maybe you just have a 'gut' feel for what's going on out there. Time will tell.
>
> We will be sending out a notice regarding conditional approval of the source, pending satisfactory performance of the pavement and of the source materials. Thanks for everything.

---

[241] MTO0021224 at images 1 and 5, attached to MTO0021223
[242] MTO0005228 attaching MTO0005229, MTO0005230, MTO0005231 and MTO0005232
[243] MTO0005228 attaching MTO0005229, MTO0005230, MTO0005231 and MTO0005232
[244] MTO0005815

204. Also on May 11, 2009, Mr. Marciello replied to Mr. Senior respecting the RHVP friction testing and approval of Demix Aggregates, that: '"conditional" is the key word.'[245]

205. On May 20, 2009, Mr. Senior wrote to Ms. Gagnon as follows respecting conditional approval of trap rock aggregate from the Demix Varennes Quarry for Superpave asphalt: [246]

> Re: Approval of Your Varennes Quarry, MTO No. Q03-003 for SP 12.5 FC1 Coarse and SP 12.5 FC2 Coarse and Fine Aggregates
>
> We are pleased to advise you that your trap rock from your Varennes Quarry is now conditionally approved as a source of Superpave 12.5 FC1 coarse and Superpave 12.5 FC2 coarse and fine aggregate. The condition is that we obtain satisfactory pavement friction from the Hamilton Red Hill Valley parkway SMA mixture where testing is conducted in future years.
>
> While approval is effective on the date of this letter, it will take a few weeks to place your quarry on the Designated Sources for Materials List (DSM #3.05.25). Approval is based on acceptable test results (see Table 1) and satisfactory performance in the northbound and southbound lanes of the above-noted 12.5 SMA mixture located on the Red Hill Valley Parkway (Contract No. PW-06-243).
>
> After two years of service, the surface course of the SMA pavement has developed satisfactory frictional properties, as indicated by friction determined during recent skid-resistance testing.
>
> Please note that continued approval of your aggregate is conditional upon it continuing to meet the requirements of OPSS 128, 1001, 1003, and such special provisions that alter these specifications, and maintaining an average Polished Stone Value of no less than 50, with no value less than 48.
>
> Please also be aware that your quarry needs to be operated in such a manner as to ensure a homogenous product with consistent bulk relative density and other physical properties.
>
> As you are aware, in order to be listed on our DSM list, you also have to be registered on "The Road Authority" website, for which there is an annual fee. Information can be accessed on the www.roadauthority.com website or by telephone at (905) 459-9200.

206. On July 17, 2009, Jack Wear (Engineering Manager, Authorities, Road Authority) sent an email to Ms. Gagnon and Mr. Gorman confirming that "Bob Gorman will add

[245] MTO0005238

[246] MTO0000046 and MTO0000047

Demix and Trap Rock would be added to the MTO's Designated Sources for Materials List DSM 3.05.25 on Monday."[247]

207. By August 10, 2009, Demix was listed on the DSM Aggregate Source list for SP 12.5 FC2.[248]

(c) 2010

208. On March 30 and 31, 2010, the MTO conducted friction testing on the RHVP.[249]

209. Even though the RHVP testing had already occurred or was in process, on March 31, 2010, Mr. Gorman requested that Ms. Lane arrange for skid-resistance surveys for the 2010 season for a lengthy list of pavements, which list included the RHVP (described in the same way as it was in the 2009 request).[250]

210. On April 1, 2010, Mr. Marciello emailed the results of the March 31, 2010, RHVP friction testing to Mr. Gorman, Ms. Lane, and Mr. Senior, and stated:[251]

> SMA in RW-06-243(RHV) – Quebec Aggregates
>
> Friction surveys were conducted on the above site from Green Hill Ave northerly toward the QEW to CNR OH Structure (north of Barton St) on May 30, 2010. The attached Read Only files will show a decline in friction in the NB lanes averaging 5 FN. Some values are at or below FN100 of 30.
>
> SB lanes performed at similar levels (mid 30s) as in 2009
>
> Please review and if any questions arise, please call or email me

---

[247] MTO0000048

[248] MTO0012843 attaching MTO0012844; Also see DSM list and map as of January 2012 at MTO0023134 attached to MTO0023133

[249] MTO0034018 attaching MTO0034019, MTO0034020, MTO0034021 and MTO0034022

[250] MTO0012869 attached to MTO0012868

[251] MTO0034018 attaching MTO0034019, MTO0034020, MTO0034021 and MTO0034022

211. Also on April 1, 2020, Mr. Gorman replied to Ms. Lane, Mr. Senior and Mr. Marciello respecting the RHVP friction testing that: "We will have to watch this one[.] Maybe do again after the summer?[252] Mr. Marciello agreed.[253]

212. On November 15, 2010, Mr. Marciello and Ms. Lane had an email discussion under the subject line "Red Hill SMA". Mr. Marciello wrote to Ms. Lane: [254]

> Arrangements to have the site friction tested were initiated by Chris Raymond in Oct 2007, just before overall completion of the SMA contract (PW-06-243) in Hamilton's Red Hill Valley Parkway. Discussions of friction surveys took place between Ludomir Uzarowski(Golder Associates 905 441-6044), the City of Hamilton and MTO(Chris Raymond). First data was collected on October 16, 2007 with the assistance from Andro Delos Reyes (Golder Associates 416 710-4761). I have a hard copy of the emails.
>
> Northbound lanes have shown declining friction performance properties from the start, while southbound lanes improved in the first year then started declining afterwards.

213. Ms. Lane responded the same day: "Good stuff Frank - thank you. Perhaps I will call Ludomir for a City of Hamilton contact."[255] She then asked Mr. Marciello for the most recent RHVP friction testing results from the spring of 2010,[256] which he provided.[257]

(d) 2011

214. On January 31, 2011, Dufferin requested the MTO's permission to use aggregate from Hutcheson Sand and Gravel in SMA on the QEW (Third Line to Trafalgar, MTO contract 2007-2125). Hutcheson Sand and Gravel was listed on the DSM for Dense

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[252] MTO0023000

[253] MTO0034023

[254] MTO0033270 (Mr. Marciello also forwarded his email, without comment, to Mr. Gorman on November 22, 2010: MTO0034304)

[255] MTO0033270. There are no documents in the database indicating whether Ms. Lane contacted Dr. Uzarowski.

[256] MTO0016927

[257] MTO0034297 attaching MTO0034298, MTO0034299, MTO0034300 and MTO0034301.

Friction Course (DFM) asphalt, but not approved for use in SMA.[258] On February 4, 2011, Mr. Payette confirmed to Mr. Virani that the MTO had approved Dufferin's request.[259]

215. On March 17, 2011, Dufferin requested the MTO's permission to use Ontario Trap Rock in the SMA on the QEW (MTO contract 2007-2125).[260] On March 30, 2011, Mr. Payette and Mr. Virani reviewed the request.[261]

216. On March 17, 2011, as in previous years, Mr. Gorman asked Ms. Lane to arrange for skid-resistance surveys for the 2011 season for a list of pavements, including the RHVP. The table attached to the request (listing 2002 to 2012) indicated that the RHVP should be tested annually from 2007 to 2012. [262]

217. On March 31, 2011, Mr. Gorman circulated a memo which stated: [263]

> Re: 2010 Test Results on Aggregates used for SP 12.5 FC1, SP 12.5 FC2 and SMA Mixes
>
> The attached table contains the results of all testing conducted from 1980 to 2010 (inclusive) on aggregates from thirty-four sources listed on the Designated Sources for Materials (DSM) List #3.05.25. This table spans over thirty years of premium wearing course assessment, collection and laboratory testing. The test results are generally good.
>
> Changes in DSM List 3.05.25 include the addition of Demix Aggregates – Varennes Quarry located east of Montreal and the Magnetawan First Nations Britt Quarry. In addition, there are ten candidate sources that are in trial section awaiting consideration for DSM approval.

[258] MTO0031111
[259] MTO0031110 and MTO0031111
[260] MTO0031116
[261] MTO0031115 attaching MTO0031116 (there is no follow-up in the database on this issue)
[262] MTO0012884 at image 6, attached to MTO0012883
[263] MTO0007160 attaching MTO0007161

218. Mr. Gorman's March 31, 2011, memo attached a February 2011 MTO study titled "Test Results on Aggregates Used for Premium Quality Asphalt Pavements" containing 30 years of aggregate test results (not friction testing) including from Demix Varennes.[264]

219. On May 25, 2011, the MTO conducted friction testing on the RHVP.[265] On May 26, 2011, Mr. Marciello emailed the testing results to Mr. Senior, Mr. Gorman and Ms. Lane.[266] He raised an issue with the 2010 RHVP friction testing results:

> Data for 2010 was collected and reported at 100km/h. That's 10km/h over all the previous years' collection speed. This would definitely explain why this SMA's performance dropped significantly last year. I made and reported an adjustment to 2010 data in the data below
>
> The Hamilton site was also tested yesterday, so the attached Read only files reflect performance levels since 2007.
>
> Overall performance in 2011 is in the low to mid 30 range
>
> Most lanes (NBL1, SBL1 and SBL2) within the test limits of Greenhill Ave and the CNR Overhead Structure had their average FN90 reduced by 2. This also caused some minimum values to dip below 30
>
> NBL2 maintained its same frictional levels when compared to 2010

(e) 2012

220. On March 29, 2012, as in previous years, Mr. Gorman requested (this time to Betty Bennett (Head, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO), that skid-resistance surveys be done for the 2012 season for a list of pavements, including

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[264] MTO0007161

[265] MTO0034404 attaching MTO0034405, MTO0034406, MTO0034407 and MTO0034408; see also MTO0000024

[266] MTO0034404 attaching MTO0034405, MTO0034406, MTO0034407 and MTO0034408

the RHVP. The table attached to the request continued to note that the RHVP should be surveyed every year from 2007 to 2012.[267]

221. On April 10, 2012, the MTO conducted friction testing on the RHVP. [268]

222. On April 12, 2012, Mr. Marciello emailed the results of the April 10, 2012 RHVP friction testing to Mr. Senior, copying Mr. Gorman and Karen Smith (Head, Geotechnical Engineering, Central Region, Provincial Highways Management Division, MTO), stating: "Other than a few FN90 hovering under 30, looks consistent with 2011".[269]

(f) 2013

223. The MTO did not conduct friction testing of the RHVP in 2013. As discussed in detail below, the MTO conducted network-wide friction testing that year.

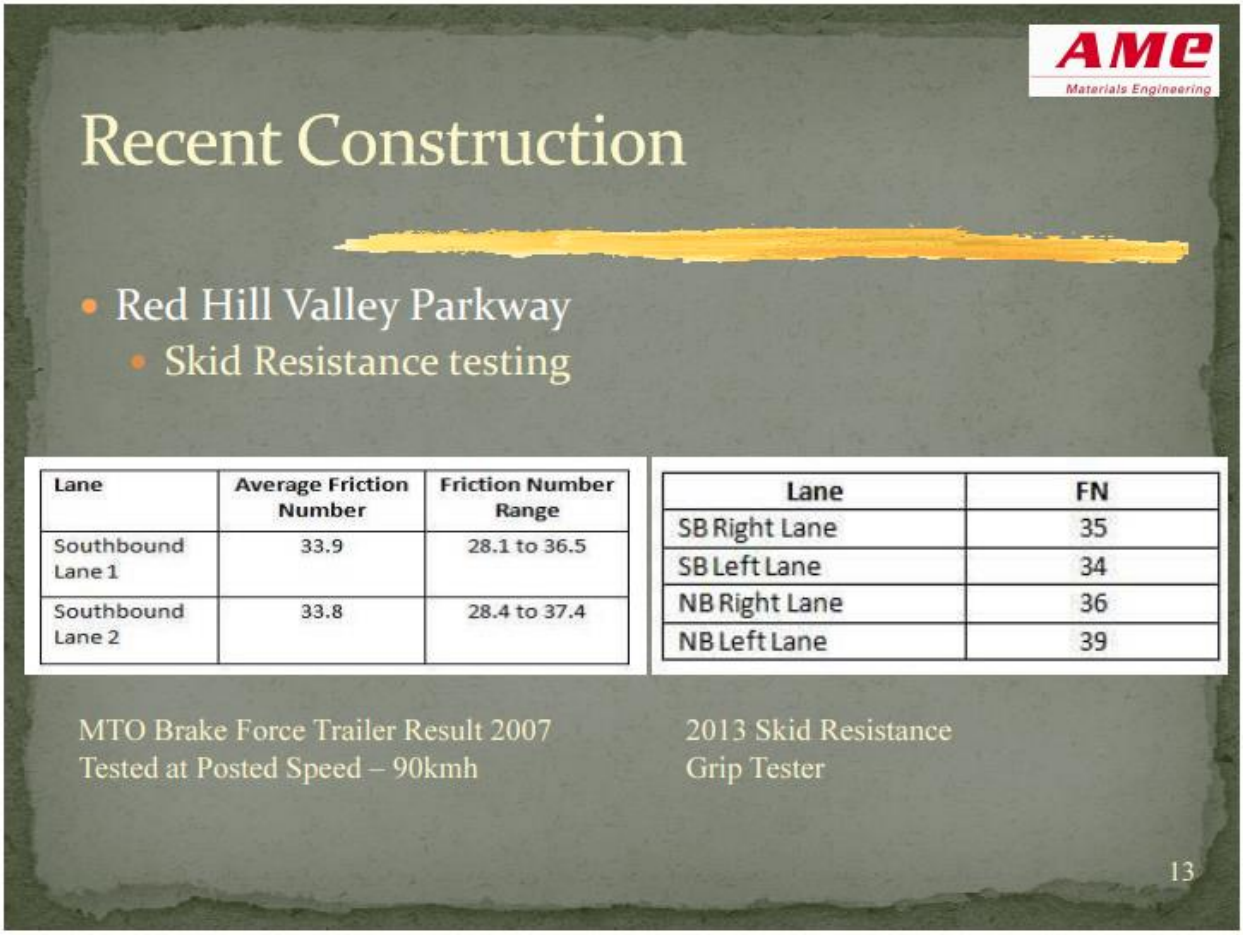
(g) 2014

224. On January 27, 2014, Mr. Virani emailed Mr. Dziedziejko slides from a presentation given at the CTAA November 16-18 Annual Conference titled "Improving Early Age Friction of Stone Mastic Asphalt Pavement in Ontario". Mr. Dziedziejko was listed as one of the authors of the presentation. Mr. Virani stated "I hope the attached helps" in his email.[270]

225. On January 29 and 30, 2014, Mr. Dziedziejko presented at the Municipal Roads Technologies Workshop.[271] His presentation was titled "SMA For Municipalities There

[267] MTO0012900
[268] MTO0007829, MTO0007830, MTO0007831 and MTO0007832
[269] MTO0007828
[270] MTO0016730 attaching MTO0016731
[271] MTO0015946 attached to MTO0015945

and Back Again". The slide deck provided an overview of SMA, including its benefits, past use by municipalities, and the MTO pause on its use. Mr. Moore, Mr. Virani, and Mr. Aurilio, were listed on the slide titled "acknowledgements". The slides also included specific discussion of the use of SMA on the RHVP, including that the "City Rates Performance to Date as Excellent".[272] One slide contained the friction testing numbers from MTO testing in 2007 and Griptester testing in 2013,[273] and is reproduced below:



[272] MTO0015946 at image 12

[273] MTO0015946 at image 13. As described in Overview Document #6, Mr. Moore had emailed this friction information to Mr. Dziedziejko on January 24, 2014

226. Various individuals at the MTO were provided with a link to access presentations from the conference on March 19, 2014. On March 19, 2014, Ms. Schell sent Ms. Lane, Ms. Marks, Seyed Tabib (Senior Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management, MTO), Mr. Senior and Stephen Lee (Head, Pavements and Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) an email including this link, writing:

> Don't know if you might be interested in seeing any of the presentations from this session, put on by OGRA.
>
> Pamela, I had mentioned the one on SMA by Tom Dziedziejko to you previously I think. It was the speaker previous to him who was talking about using asphalt cements with low chloride content.[274]

227. Mr. Tabib forwarded the email and link to Mr. Virani and Imran Bashir (Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) on March 21, 2014, attaching the slides from Mr. Dziedziejko's presentation.[275]

228. On April 1, 2014, Mr. Gorman sent Ildiko Dezsi (Administrative Assistant, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) a 2011 memorandum regarding friction testing requests.[276] The memorandum was addressed to Ms. Lane from

[274] MTO0015945
[275] MTO0015945 attaching MTO0015946
[276] MTO0022897

the Soils and Aggregates section, and identified various pavements they requested to be friction tested, including the RHVP.[277]

229. On July 12, 2014, the MTO conducted friction testing on one northbound lane of the RHVP. The MTO conducted friction testing on the remaining northbound lane and two southbound lanes on July 23, 2014. [278]

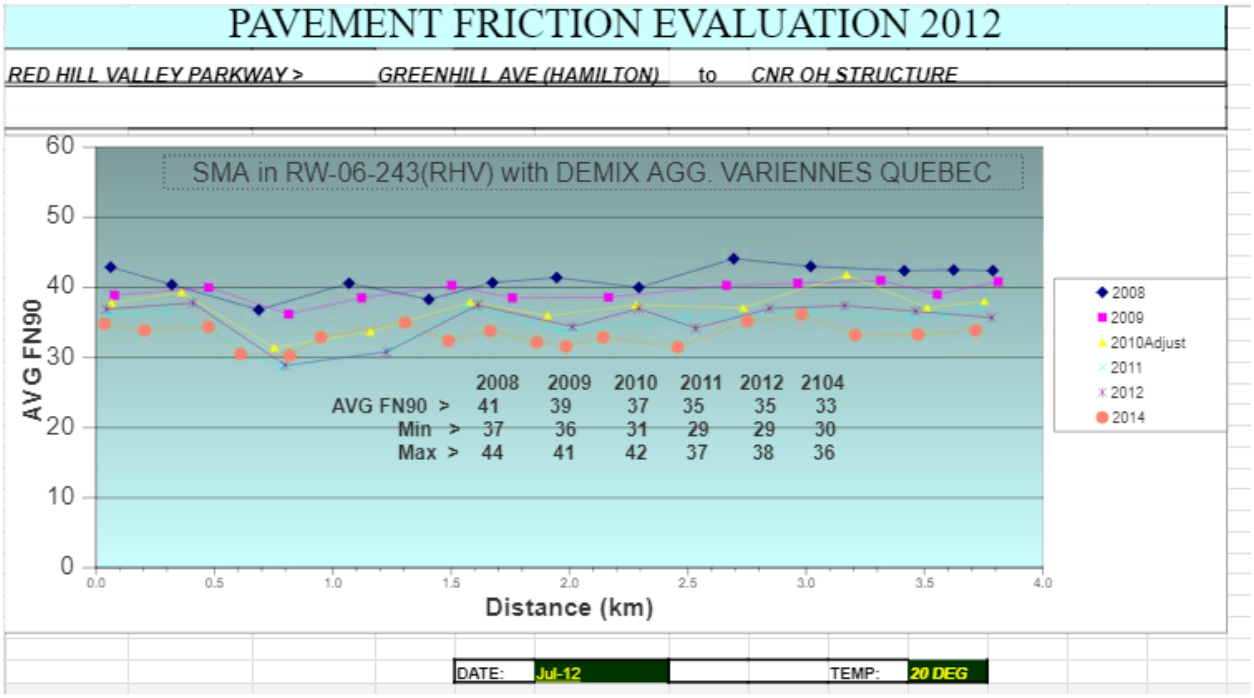
230. On July 25, 2014, Mr. Marciello emailed Mr. Senior (copying Mr. Gorman and Mr. Lee), attaching the RHVP friction results from July 12 and 23, 2014.[279] He wrote in his email:

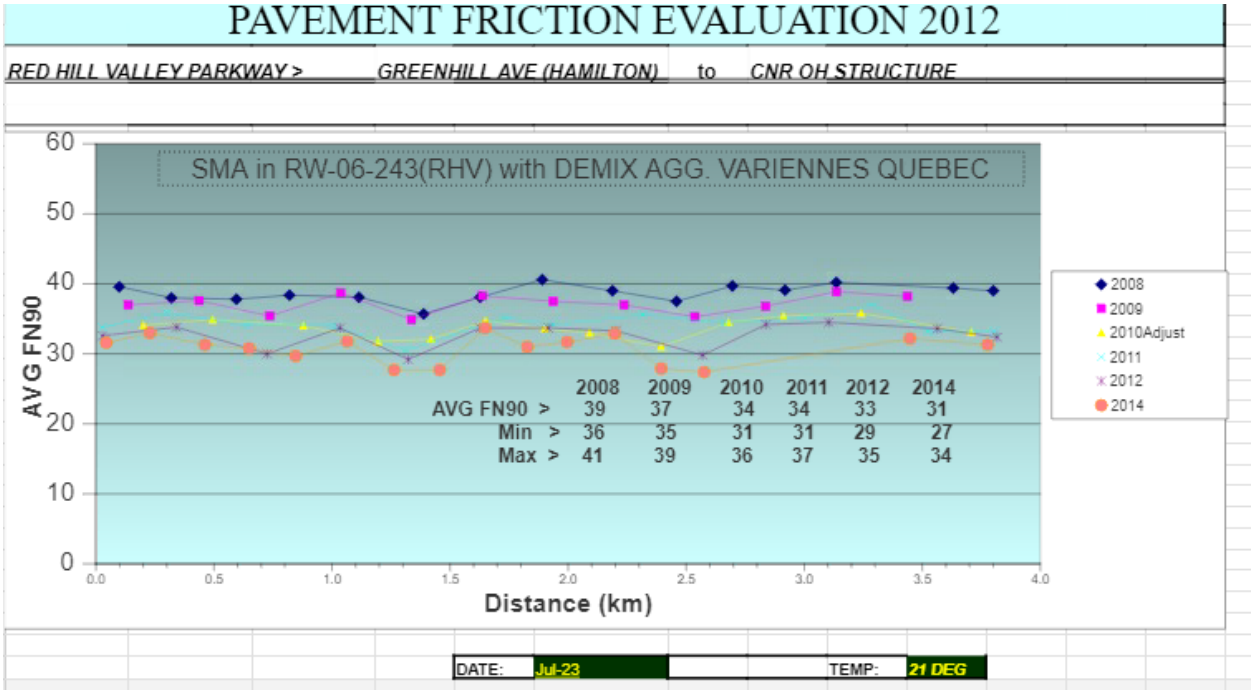
> Gentlemen
>
> 4 Lanes of the Parkway were tested a few days ago. Performance shows friction levels continuing to drop
>
> Quick Summary of average values in 2008 and in 2014

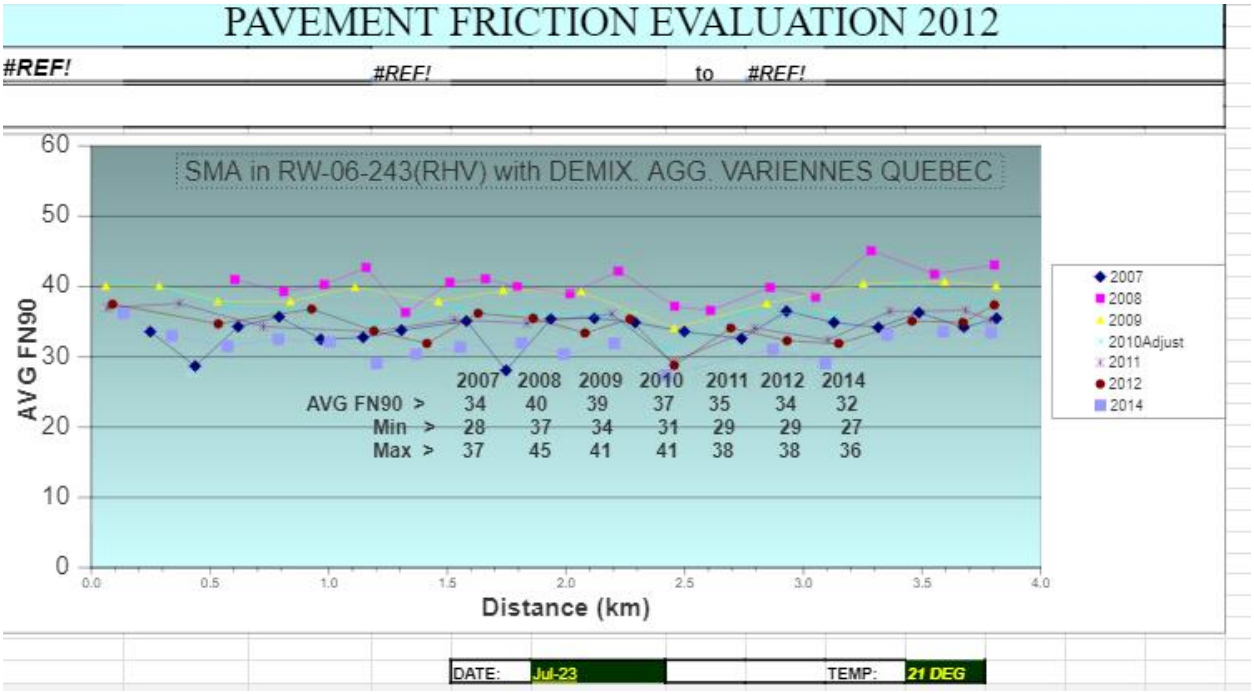
	NBL1	NBL2	SBL1	SBL2
2008	41	39	40	38
2014	33	31	32	31

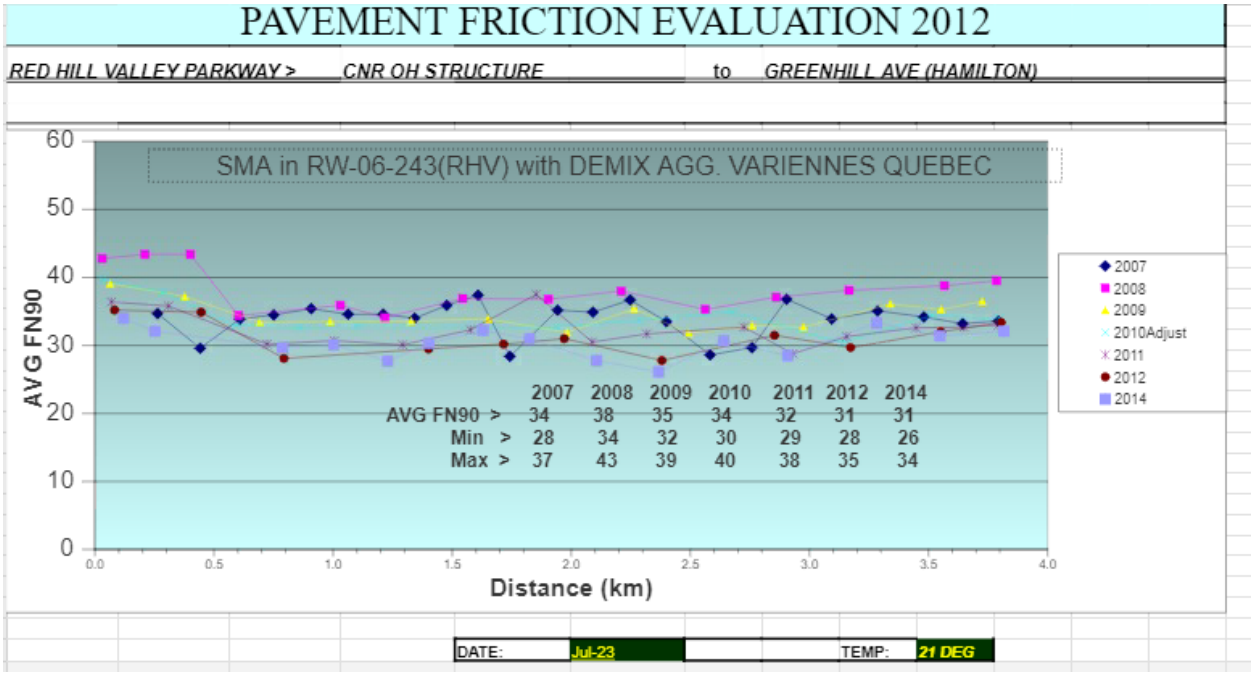
231. Mr. Marciello attached four documents reflecting the data collected from each lane tested.[280] The documents each included a chart outlining the friction testing done in 2007 (for the two southbound lanes only) 2008, 2009, 2010, 2011, 2012 and 2014. The charts identified the lanes as “NB1”, “NB2”, “SB1” and “SB2” have been reproduced below:

[277] MTO0022898
[278] MTO0022942 attaching MTO0022943, MTO0022944, MTO0022945 and MTO0022946
[279] MTO0022942 attaching MTO0022943, MTO0022944, MTO0022945 and MTO0022946
[280] MTO0022943, MTO0022944, MTO0022945 and MTO0022946


PAVEMENT FRICTION EVALUATION 2012
RED HILL VALLEY PARKWAY > GREENHILL AVE (HAMILTON) to CNR OH STRUCTURE
SMA in RW-06-243(RHV) with DEMIX AGG. VARIENNES QUEBEC
AVG FN90
Distance (km)
2008 2009 2010 2011 2012 2104
AVG FN90 > 41 39 37 35 35 33
Min > 37 36 31 29 29 30
Max > 44 41 42 37 38 36
2008
2009
2010Adjust
2011
2012
2014
DATE: Jul-12
TEMP: 20 DEG


PAVEMENT FRICTION EVALUATION 2012
RED HILL VALLEY PARKWAY > GREENHILL AVE (HAMILTON) to CNR OH STRUCTURE
SMA in RW-06-243(RHV) with DEMIX AGG. VARIENNES QUEBEC
AVG FN90
Distance (km)
2008 2009 2010 2011 2012 2014
AVG FN90 > 39 37 34 34 33 31
Min > 36 35 31 31 29 27
Max > 41 39 36 37 35 34
2008
2009
2010Adjust
2011
2012
2014
DATE: Jul-23
TEMP: 21 DEG


PAVEMENT FRICTION EVALUATION 2012
#REF! #REF! to #REF!
SMA in RW-06-243(RHV) with DEMIX AGG. VARIENNES QUEBEC
AVG FN90
Distance (km)
2007 2008 2009 2010 2011 2012 2014
AVG FN90 > 34 40 39 37 35 34 32
Min > 28 37 34 31 29 29 27
Max > 37 45 41 41 38 38 36
2007
2008
2009
2010Adjust
2011
2012
2014
DATE: Jul-23
TEMP: 21 DEG


PAVEMENT FRICTION EVALUATION 2012
RED HILL VALLEY PARKWAY > CNR OH STRUCTURE to GREENHILL AVE (HAMILTON)
SMA in RW-06-243(RHV) with DEMIX AGG. VARIENNES QUEBEC
AVG FN90
Distance (km)
2007 2008 2009 2010 2011 2012 2014
AVG FN90 > 34 38 35 34 32 31 31
Min > 28 34 32 30 29 28 26
Max > 37 43 39 40 38 35 34
2007
2008
2009
2010Adjust
2011
2012
2014
DATE: Jul-23
TEMP: 21 DEG

232. Mr. Gorman forwarded Mr. Senior the email from Mr. Marciello with the RHVP friction test results shortly after receiving it on July 25, 2014, stating: "I was hoping it would of stabilized at 35".[281]

233. On October 17, 2014, Mr. Gorman emailed Mr. Senior in response to a draft presentation respecting statistical parameters from the MTO's network friction testing conducted in 2013 (which issue will be discussed in more detail in a section below), but also mentioning the RHVP:

> 2 issues:
>
> > 1 Why so low in W region for FN vs pavement age? Maybe too much OTR in wearing course?
> >
> > 2 If you go to FN of 35 (100km/hr), some traps will have a problem with this from what I have seen based on data I have such as the Red Hill Ck xway[282]

(h) 2016

234. In August 2016, Demix Agrégats, Varennes Quarry, which had been listed as a source for 12.5FC1, 12.5FC2, HL1, and DFC, was removed from the DSM. The Varennes Quarry was removed from the DSM since Dufferin / Varennes did not pay the yearly fee for 2015 and then opted to be removed from the list in 2016.[283]

[281] MTO0022942 attaching MTO0022943, MTO0022944, MTO0022945 and MTO0022946
[282] MTO0022623
[283] MTO0017963, MTO0036617 and MTO0038646

2. Non-RHVP MTO friction testing, SMA pause continuation and early low friction remediation efforts, QEW/RHVP Interchange

(a) 2008 University of Waterloo Pavement friction/collision rate study

235. The February 26, 2008, minutes of the MTO Geotechnical Committee stated:

> Post-meeting note: status of Pavement Friction Study provided by Tom Klement. Pavement friction/collision rate study currently underway at University of Waterloo (PhD study). Target completion date of August 2008 remains. [284]

236. On February 27, 2008, Mr. Klement wrote internally at the MTO:

> On the subject of "Pavement Friction Study":
>
> The topic involves the examination of relationship (if any) between pavement friction and collisions. I have interrupted my research last year, to accommodate Mr. Amir Abd El Halim, currently with STANTEC, who has proposed to us to perform (at no cost to MTO) this research as a part of his PhD. candidature work, under the supervision of Prof. Susan Tighe, University of Waterloo.
>
> Some four months ago Li and I gave Amir all the required (pavement, friction survey and collision) data and I am told work is progressing well. Our key objective is to examine relationship between low friction road segments and collision incidence, so that we can electronically pre-screen collision data (manual scrutiny would demand resources that our Traffic colleagues do not have).
>
> Further progress hinges on finding a satisfactory screening mechanism. If pre-screening is feasible, we can then estimate the cost / benefit of different friction rehabilitation strategies and develop a mechanism to incorporate safety considerations as an integral component of our pavement management process.
>
> I suggest that you hold this topic in abeyance until Amir's research yields results. I would then notify you and arrange for a presentation to the committee. [285]

237. On April 11, 2008, Mr. Kazmierowski, emailed Mr. Chaput a number of work plans, including the 2008 / 2009 Work Plan for the Pavement and Foundations Section.[286] Item 6.2 in the 2008 / 2009 Work Plan identified Mr. Klement as the "Lead Name" responsible for:

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[284] MTO0000952 at image 6

[285] MTO0012326. Also see MTO0011291(October 25, 2007 emails between Tom Klement and Amir Abd El Halim)

[286] MTO0012692 attaching MTO0012699 and others

> 6.2) Pavements
> Pavement Safety
> Act as the primary MTO contact for a CPATT affiliated PhD thesis work that focuses on inter-relationship between pavement surface characteristics and safety.
>
> Based on the above results develop a screening mechanism for collision statistics so that screening can be employed to augment regional requests for site friction measurement. Also, once lower than desired friction values are obtained from field testing, the collision data sub-set can be used to establish site-specific benefit of friction restoration. This will enable prioritization of friction-related work.[287]

238. The MTO "Geotechnical Committee (GeoCom) 2008/2009 Workplan" referred to "Pavement Friction – Reducing wet pavement collision rate" with a target date of November 2008, stating:[288]

> Further development on hold pending results of collision/pavement friction correlation study by University of Waterloo.

(b) 2008

239. On January 7, 2008, Mr. Raymond submitted an abstract approval form for a paper on Low Early Age Friction with SMA Pavement, to Mr. Tam. [289] The abstract read as follows:

> A key component of road safety is pavement friction. Adequate hot mix pavement friction is typically promoted through the use of skid resistant aggregates and a suitable mix design procedure to ensure the appropriate asphalt cement content and good volumetric properties are achieved. Recently, many agencies including the Ontario Ministry of Transportation implemented the use of Stone Mastic Asphalt pavement as a cost effective long lasting hot mix technology. The use of Stone Mastic Asphalt has resulted in concerns related to low early age pavement friction, which is attributed to a thick asphalt mastic coating associated with SMA pavements, masking the aggregate surface. The Ontario Ministry of Transportation and other agencies have observed that new SMA pavements can exhibit low early age friction during the first months of service. This is of particular importance because new pavements are typically not tested for pavement friction and the traveling public can have higher performance expectations on new pavement surfaces. The friction of new SMA pavements does increase as traffic and weather remove the thick asphalt coating from the pavement surface and exposing the aggregate to provide skid resistance similar to that of a traditional dense graded hot mix constructed with the same aggregate type. This paper presents the Ontario's experience in dealing with early age friction, and observations including the development of friction over time from several

[287] MTO0012699 at image 10

[288] MTO0004809 at image 3, attached to MTO0004806. There are no documents in the database pertaining to completion of this study by the University of Waterloo

[289] MTO0000559 attached to MTO0000558

> SMA projects located in Ontario. Research from recent field trials to ensure adequate early age pavement friction in SMA pavements is also presented

240. On January 10, 2008, the SMA Task Group met.[290] Among other things, the minutes stated:

> 5. Three gritting options were discussed. 1. Intensive gritting between rollers, 2. light gritting application between rollers, and 3. light gritting application after all rolling similar to winter sanding with traffic kneading the grit into the pavement.
>
> 6. Tom will look into preparing a proposal for treatment on the QEW/RHCE project.

241. On January 11, 2008, Mr. Tam emailed Mr. Kazmierowski and Mr. Raymond the following with respect to MTO contract 2006-3034 and whether or not the MTO Southwest Region could use SMA on that contract.[291] He wrote:

> Tom, Below draft response to SWR. Kai
>
> With reference to the attached advisory provided earlier on by Kai, there are 2 options:
>
> 1. Determine the costs to switch to SP 12.5 FC2 (expect Ontario Trap aggregate would be cheaper than Marmora Trap).
>
> 2. If cost negotiations are unsuccessful, proceed per contract (using Ontario Trap SMA) but with posting advisory "Slippery When Wet" signing and advisory speed tabs to be in place upon opening to traffic. Advisory signing would be removed when FN=30 or greater are safely reached. Additional measures (e.g. Diamond grinding) would be required if an average FN below 20 is observed for a section of pavement. (In this case, the original Ontario Trap SMA should have the cost advantage because of the premium paid for the Marmora Trap SMA)
>
> Hope this help, and we are happy to discuss with you if there are further questions.

242. On January 15, 2008, Mr. Raymond wrote to Mr. Kazmierowski, Ms. Lane, and Mr. Tam, respecting a presentation given by John Emery (President and Principal Engineer, JEGEL) at a CTAA conference in late 2007.[292] He wrote:

> In response to Gerry's inquiry, the SMA committee has been examining the opportunities, which John Emery presented in his Early Life Friction in SMA presentation. Many of the

[290] MTO0000586

[291] MTO0015632

[292] MTO0000576, referring back to MTO0002966; and GOL0007392

> opportunities and issues are not new to the committee, which serves as validation that SMA committee is on the right track in examining all possible alternatives available. The SMA committee has discussed grit (or sand) applications to the SMA both during the compaction process and after compaction as a promising solution to the early age friction problem. Micro-incrustation is a term given to a newer grit application to the SMA used in France. The "skidabrador" was discussed but has not been pursued due to concerns with clogging. A promising variation of the skidabrador system, the blastrac system has been discussed and is being considered for demonstration in the spring. Micro-surfacing is not seen as a viable solution for early age friction due to its cost and lifespan which is shorter than hot mix.
>
> The SMA committee is also looking at the fillers used for SMA including their gradations, which is finer than our original filler requirements. The purpose of the filler is to stiffen the asphalt mortar but a filler of fine gradation can also act to extent the asphalt cement causing a rich mix.
>
> My CUPGA notes for John Emery's Early Age SMA Friction were as follows:
>
> > "John Emery (JEGEL) – Early Life Friction in SMA. The 1996 Ontario Safety Report indicates that 24 % of accidents occur in wet conditions. Micro-texture is measured by British Pendulum test. Macro-texture is measured with the sand patch test. The use of fine graded fillers with SMA was cautioned. A reference was given to a 1991 CTAA paper where the early age friction was presented. Two solutions are provided in the paper, which include the use of an asphalt cement pre-coated sand and hot sand application. The use of the “Skidabrador” and micro-surfacing were presented as other alternatives for providing early age friction along with a recent French process called micro-incrustation (Setra 2007)."

243. On January 22, 2008, Mr. Ponniah took over as the MTO’s SMA Task Group Coordinator from Mr. Raymond.[293]

244. On February 4, 2008, Mr. Raymond responded to an email from Mr. Bowers (of Blastrac), which Mr. Bowers had sent on November 27, 2007. [294] Mr. Raymond wrote:

> When we talked last fall, you indicated that you had a brochure (CD) specifically targeted at the Blastrac technology for applications such as our early age SMA issue. Would it be possible for you to send me a brochure.

[293] MTO0029644

[294] MTO0000628

245. Mr. Raymond then circulated information on Blastrac technology for treatment of early age SMA to a group of MTO employees.[295] That information was then further forwarded on to a broader MTO group,[296] which discussed the costs of the treatment.[297]

246. On March 6, 2008, Mr. Kazmierowski presented at the OHMPA Annual General Meeting. [298] One of the slides of his presentation stated:

> MTO has experienced concerns with low early friction
>
> Presently working with industry to optimize its use, capitalize its benefits and overcome the friction concerns.
>
> For the interim, MTO has paused the use of SMA until concerns with initial friction are resolved.
>
> > the result is contracts that meet the criteria for SMA are being designed with Superpave 12.5 FC2.

247. On March 12, 2008, in response to a query, Mr. Tam wrote to Brian Jansen (Jr. Editor/Writer, Road Talk, Resources and Planning Office, Division Services, Provincial Highways Management Division, MTO):

> I must have missed answering your previous email. Yes there is a moratorium on the use of SMA. However, there is also discretion of use on contracts already awarded base on individual cases. In the case of this quiet pavement, we will decide what to do when contractor informing us the aggregate they are going to use. So as far as the article goes, it is still correct to say using SMA. We do not say "moratorium" but "pause with discretion of use" under the direction of regional office in consultation with head office. [299]

248. On March 19, 2008, Mr. Virani circulated a document titled "MTO Superpave and SMA Guide" (March 2008). [300] That document contained the following excerpt:

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[295] MTO0000629 attaching MTO0000630 and MTO0000631
[296] MTO0012320 attaching MTO0012321 and MTO0012322
[297] MTO0013334 attaching MTO0013335, MTO0013336 and MTO0013337
[298] MTO0015684 at image 20
[299] MTO0029776
[300] MTO0001060 at image 24, attached to MTO0001059

> 8.5 Initial Friction Concerns
>
> By design, SMA mixes have high binder and filler contents that, together with fibres, result in a relatively thick asphalt film coating on the aggregates in comparison to dense graded mixes. This is an essential feature which makes SMA a high durability mix. However some SMA surfaces have been known to exhibit reduced friction properties immediately after paving and this is not desirable especially in wet weather. The frictional properties generally improve with trafficking.
>
> The exact cause of the problem is not known. The contribution, if any, of the aggregate and filler type, the binder type and content, the method of placement and compaction etc. are all being investigated. Until the study is completed, and measures put in place to deal effectively with the early friction concerns, MTO has temporarily paused the use of SMA mixes on future contracts. The regional geotechnical offices should be contacted to provide an update on this matter before specifying SMA in any design package.

249. On March 25, 2008, Mr. Rogers emailed Mr. Raymond, John Taylor (Regional Director, Northwestern Region, Provincial Highways Management Division, MTO), Sam Cheng (Manager, Contracts, MTO), and Dave Dundas (Senior Foundations Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) about pavement friction.[301] He said:

> I agree with Chris – it is critical to ensure sufficient pavement friction if we are interested in safety. By the time a problem is deteected using a frcition trailer it is often too late. (sic)

250. The SMA Main Task Group met on April 14, 2008. [302] The minutes record that Mr. Raymond provided an update on treatments to improve early age friction for SMA:

> 3. Chris provided an update of the different treatments available to improve early age friction of SMA mix. He said that Blastrac technology might not be suitable for SMA mix as it has the potential for gumming up the surface with removed SMA mortars. He recommended the water blast technology as a viable alternative to sand blasting for possible application. Both technologies are available for use on a trial basis. In response to Kai's question regarding the application of water blast technology for removing viscous material such as SMA mix, Chris said, that he had no knowledge of any issues associated with the use of this technology on SMA mix but intuitively speaking, this should not be a concern. Chris also said in response to Param Dhillon's question that removed material

[301] MTO0018620 attaching MTO0018621. Mr. Rogers was responding to an email from Mr. Raymond regarding Mr. Raymond's view that materials requirements/restrictions for pavements such as those involving aggregates are important.

[302] MTO0013349

> would be absorbed during operation. Kai suggested that the group submit the pros and cons analysis of the available four options **(sanding, Blastrac water jet?, modified roller)**. to assist the SMA task group for making an informed decision.

251. The SMA Main Task Group also met on May 28, 2008.[303]

252. On June 2, 2008, Mr. Marciello emailed Dave Morris (Coordinator, Geo Tech and Material Testing, City of Mississauga) (copying Mr. Klement and Mr. Dundas) about friction test results on Mississauga Road.[304] He stated:

> Mississauga Rd between Dundas St and Glen Oaks Blvd, in Mississauga, was friction tested on May 28, 2008. Texturization (micro grinding) of the pavement surface was completed in the Fall of 2007 and due to the cold temperatures, pavement conditions and equipment limitations with MTO's ASTM E274 Brakeforce Unit, friction surveys could not be completed at that time.
>
> Results from last week's surveys show a significant (positive) increase in friction levels throughout the texturized area. In MTO's experience, best results occur immediately after texturization activities have been completed, where both micro and micotexture enable high frictional performance. With already one winter gone by, including the abrasive conditions associated with snow plow, salt, sanding and traffic activities, pavement friction levels at this time do not pose a safety problem at the posted speed limit of 50km/h.

253. On June 3, 2008, Mr. Klement replied to Mr. Marciello.[305] , He wrote

> A friendly suggestion: If I were you, next time, when you do work in response to an external request, I would refrain from judgements on safety. It is “safer” for you (and MTO) to comment on how the measured friction values compare to those for other routes we have (for the same / similar posted speed / circumstances, or relative to higher posted speed).
>
> This way you are less likely to be dragged into a court-room should the frictional safety of a municipal road be ever the focus of a lawsuit.

254. On June 23, 2008, Mr. Marciello emailed May 2008 friction testing results on the 401 between Martingrove and Etobicoke Creek re Contract 2002-2000, for three year old SMA to Mr. Billings, Mr. Ponniah, Mr. Raymond, Mr. Kazmierowski, Mr. Dundas, Jim Vanbiesbrouk (Head, Claims, Central Region, Provincial Highways Management

[303] MTO0016179
[304] MTO0033141
[305] MTO0033141

Division, MTO), and Robert MacLean (Regional Contracts Engineer, Central Region, Provincial Highways Management Division, MTO).[306] The testing showed results in the low 30's average FN, with many individual results in the 20's. He also provided historical numbers from September 2005 to 2008 and a graph comparing each year in each lane. On June 24, 2008, Mr. Tam emailed Mr. Kazmierowski commenting on the results, stating: "Thanks. FN keeps pretty steady above 30."[307]

255. An MTO document titled "Early Age Friction of Stone Mastic Asphalt Pavement Task Group Update" dated June 25, 2008, provided an update on the work of the SMA Task Group.[308]

256. On July 18, 2008, Mr. Marciello emailed June 2008 SMA friction testing results on the 401 near London between Highbury and Dorchester re Contract 2006-3037, placed in 2006, to Mr. Ponniah and Mr. Raymond.[309] The testing showed results in the low to high 30's average FN, but one lane (WB3) had an average FN of 29.8. Also provided were historical numbers for 2006 to 2008 and a graph in each lane. On July 21, 2008, Mr. Raymond emailed the results to Ms. Lane.[310] He said:

> Here is an update on SMA placed in 2006. You should note the WBL3 numbers are less than would be expected at this age. Also of note is the higher levels in EBL1 and WBL1.

[306] MTO0012335 attaching MTO0012336, MTO0012337, MTO0012338, MTO0012339, MTO0012340, MTO0012341, MTO0012342, MTO0012343 and MTO0012344

[307] MTO0015752

[308] MTO0024198 attached to MTO0024197

[309] MTO0017123 attaching MTO0017124, MTO0017125, MTO0017126, MTO0017127, MTO0017128, MTO0017129 and MTO0017130

[310] MTO0013373

257. On July 7, 2008, Mr. Raymond emailed Ms. Lane, Mr. Ponniah, and Mr. Tam in respect of shotblasting to be done by Blastrac on Highways 41 and 115 (neither were SMA), stating:[311]

> FYI that Eastern Region has awarded to trial projects to do Blastrac technology to improve pavement friction. Note the cost comparison to micro-milling. Also note that a light Blastrac application has been proposed as a possible post construction solution for SMA early age friction.

258. Beginning on August 6-12, 2008, shotblasting took place on Highways 115 and 41.[312] The portion of Highway 41 where the shot blasting took place was "an old, worn (polished) asphalt pavement".[313] On August 14, 2008, Mr. Tam wrote internally at the MTO after having visited the shotblasting site on Highway 41:[314]

> I agree that larger size shots will help to produce more desirable micro textures on the coarse aggregates, and the water blasting process holds more promise for treating SMA as mentioned in my earlier email below.

259. On August 26, 2008, Mr. Marciello reported that "Both affected areas on Hwy 115 and 41 have experienced a significant increase in surface friction since the shotblast texturing activities."[315]

260. On August 29, 2008, Mr. Marciello emailed Joshua Li (Pavement Design Evaluation Office, Pavements West, Geotechnical Engineering, Central Region, Provincial Highways Management Division, MTO) in response to an inquiry from Mr. Li about "the current criteria used for the skid resistance evaluation", stating "Sorry for the delay Joshua. Attached presentations and video should give you an in depth knowledge

311 MTO0030748
312 MTO0020912 attaching MTO0020913
313 MTO0024045
314 MTO0030095
315 MTO0020921

of ASTM Friction Management in Ontario."[316] The attached slide deck presentation was dated November 2004, and is described in detail above.

261. Commencing October 3, 2008, the MTO water blasted newly laid SMA on Highway 401.[317] On October 7, 2008, Mr. Marciello emailed friction test results taken after the water blasting to Mr. Billings, Ms. Lane, Mr. Ponniah, and Mr. Raymond, stating:[318]

> Friction surveys were conducted on the freshly texturized SMA between Stevenson Rd and Harmony Rd and the adjacent untextured SMA to Courtice Rd. All 3 eastbound lanes were tested at the posted speed limit of 100km/h. Performance charts with the detailed data from October 6 are attached. Although overall increases in friction occurred in the majority of locations, it's interesting to note the insignificant changes in FN in Lane 2 at approx 1.5-2km.

262. On October 16, 2008, Mr. Tam sent a memo to MTO Regional Managers and Regional Heads respecting the SMA low early age skid resistance problem, noting that "the initial attempt to resolve this issue by the selective use of premium aggregates did not adequately address this problem", describing the consequent formation of the SMA Task Group, and making an "urgent request for SMA trial sections, which are necessary to evaluate the SMA mix toward a possible solution to the low age friction issue."[319]

263. The MTO, not Hamilton, was responsible for the design and construction of the RHVP/QEW Interchange, where the RHVP was to connect at its north end with the QEW.[320]

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316 MTO0033716 attaching MTO0033717, MTO0033718 and MTO0033719
317 MTO0020951; MTO0020955; and MTO0020957
318 MTO0020984 attaching MTO0020985, MTO0020986, and MTO0020987
319 MTO0000130 and MTO0000131
320 MTO0000086

264. On December 5, 2008, Mr. Rollings emailed Mr. Tam, Mr. Billings, Mr. Costantino, Terry Pearson (CCO, Quality Assurance Section, Contracts Office, Central Region, Provincial Highways Management Division, MTO), John McGonigal (Quality Assurance Officer (Bituminous), Quality Assurance Section, Contracts Office, Central Region, Provincial Highways Management Division, MTO), and Mr. Verok regarding the SMA mix design for the RHVP/QEW Interchange (MTO contract 2005-2008). He forwarded a December 4, 2007, email from the general contractor AECOM and attached a Mix Design Report prepared for the paving subcontractor Dufferin by Trow. [321] Mr. Rollings stated:

> Dennis/Kai
>
> On Contract 2005-2008, it calls for SMA to be placed. Previously when the SMA "issue" came up we asked the Contractor for a price to use FC2 instead and he came back with a $2/t credit (Joe can correct me if I am wrong). This piddly credit was offered even though there was already an FC2 price on the contract which was significantly lower than the SMA ($15-20 or so – again Joe can correct). No decision was made at the time because we were a long way away from using SMA. They will be placing surface next year so now we need to revisit this.
>
> They were asked to provide their aggregate source for the SMA and they have provided the so called "intended" mix design attached. This mix uses Ontario Trap Rock. I put the "intended" in quotes because it is not a given that this is true. The mix design was from a 401 contract which was actually produced and placed by another Contractor (Dufferin was the prime but didn't do the asphalt). The other thing is that the FC2 that Dufferin was using contained Dolomitic Sandstone and it would seem more likely they would also use that for the SMA. This is conjecture on my part but I think Dufferin may be playing a game as they know that Ontario Trap may not be acceptable for SMA and that we will then be forced to pay them an unreasonable premium to use FC2. If they told us they were using Dolomitic sandstone we would say fine go ahead and place SMA at the tender price.
>
> That is the background for your information. We need your input into placing of SMA using their "intended" Ontario Trap Rock mix design – what is the Ministry current position on its use given your addition work etc on the SMA friction issues.?
>
> Joe – feel free to add any questions/concerns you may have from the Contract perspective

[321] MTO0012404 attaching MTO0012405

265. On December 9, 2008, Mr. Tam replied to Mr. Billings and Mr. Ponniah respecting MTO contract 2005-2008 RHVP/QEW Interchange and the AECOM proposal to use Ontario Trap Rock for aggregates in the SMA. [322] He wrote:

> My suggestion is:
>
> 1) Looking at the trial perspective, there are two areas we need to do: (a) use of water blasting on new surface (if OTR is used, there may be a need to use the water blasting) and (b) using the revised specs for SMA. Do you think we could incorporate these in this contract?
>
> 2) In the contract perspective, and if over all cost is the main issue – with game playing is a concern, going for FC2 at least is the lower cost option. But we lose out $ 15 or so per ton in real cost of the surface course.
>
> 3) Other option could be let them pave with ORT, and ministry get water blasting contractor to be on stand-by if skid test showed low numbers, and to run through the surface. This option could test the future viability of SMA in Ontario.
>
> What do you think?

266. Mr. Ponniah replied to Mr. Tam and Mr. Billings the same day. [323] He wrote:

> It appears that Rob wants input based on the additional work done by SMA TG. Thus, from SMA TG perspective, I recommend option # 3 with modified SMA mix if feasible. As well, consider gritting using manufactured sand in addition to water blasting as discussed in the last TG meeting.

(c) 2009

267. On January 7, 2009, Mr. Tam emailed several employees at the MTO to discuss a recommendation to the GeoCom regarding SMA as a result of the work of the SMA Task Group.[324] He stated:

> Industry's position is to have a full reinstatement on the use of SMA in all contracts where it is warranted. Their key argument is that, with the successful trial of the water blasting method to improve on early age friction of SMA, there is assurance that this method will be available to mitigate cases where low early friction is still a problem. In addition, specs revision with new limits may also help to reduce the risk of low friction.

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[322] MTO0012446
[323] MTO0012446
[324] MTO0012407

> So, the proposal could be that:
>
> (a) Allow use of SMA in all contracts per surface course directive using aggregates as per DSL, with provision of using water-blasting in case of low early friction is still obtained.
>
> (b) Conduct field trials (one trial for each of the DSL listed aggregates) using the proposed spec limits (Pass 75 um from 8-12% to 8-11% for 9.5 mm and from 8-12% to 6-9% for 12.5 mm SMA mix; VMA from 17% min to 16.5% with a max of 18%; %AC reduce by 0.3%, and filler by 2% for the 12.5 mm SMA mix, 9.5 mm mix remains the same as existing spec).
>
> (c) Continue to conduct trials with other surface treatment methods and study of the pass 20 um filler and macrotexture properties[.]

268. On January 26, 2009, the GeoCom endorsed conducting field trials using designated aggregates (option b in Mr. Tam's January 7, 2009, email).[325]

269. On January 29, 2009, Mr. Tam updated the MTO Quality Assurance Committee Meeting on the work of the SMA Task Group as follows:[326]

> KT is looking for opportunities to try out the new specs on some trial contracts.
>
> Central Region is working on a trial using a 12.5 mix but it has not yet been constructed.
>
> Aggregate restrictions are still in effect but MERO is open to trials using any aggregates.

270. In February 2009, the American Association of State Highway and Transportation Officials released AASHTO's Guide for Pavement Friction, 1st Edition,[327] which was circulated to MTO staff.[328]

271. On February 10, 2009, Mr. Rollings emailed Mr. Senior and Mr. Gorman with the subject line "SMA Aggregates Red Hill".[329] He wrote:

> We are having some "discussions" about SMA versus FC2 and appropriate credits etc with the Contractor on our QEW Contract at Red Hill. We are going to be visiting the plant were

[325] MTO0021058 at image 6
[326] MTO0004815 at image 3
[327] MTO0012499 (this guide is circulated numerous times – this appears to be the first time it was circulated)
[328] MTO0012498
[329] MTO0004895

> apparently the Ont Trap rock for the SMA is stockpiled. I asked Bob G if he would go with my QAO and a CA rep to review the stockpiles and get some samples and he was agreeable.
>
> Are you OK with Bob G assisting us for this? – the plan is to go Thursday

272. Mr. Senior replied the same day: "Pls go ahead" and followed up with "I would also recommend sending Carole Anne MacDonald along with MERO EDPs Muraya and Milos as well."[330]

273. On February 19, 2009, the SMA Task Group met to discuss next steps regarding construction of trial sections with SMA. There was consensus among the members of the SMA Task Group that this field investigation should be carried out in partnership with the OHMPA.[331] According to revised minutes, it was agreed that Ontario Trap Rock would be included in the proposed field trial section to determine its impact on early age friction of SMA mix, and that the DSM list would be updated to include Ontario Trap Rock, if the results were favourable.[332]

274. On February 27, 2009, Ms. Lane emailed Mr. Marciello to obtain friction testing results for premium aggregates (not for SMA) over time as part of the consideration of performance criteria for Minimum Oversight (usually referred to as "MinO") requirements. Mr. Marciello provided the MTO friction database to her.[333]

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[330] MTO0005138; and MTO0005141. The database contains no report regarding this visit.

[331] MTO0013604 at image 2, attached to MTO0013603. See also MTO0021507

[332] MTO0013607; and MTO0030400

[333] MTO0017013 attaching MTO0017014. See also MTO0034508 which is a version of the MTO friction database circulated in 2011 which includes the 2007 and 2008 RHVP friction testing results, and MTO0017442, a differently formatted version of the MTO friction database circulated in January 2013 which includes the 2007, 2008 and 2011 RHVP friction testing results

275. On February 26, 2009, Mr. Rollings emailed Mr. Tam and others internally at the MTO with respect to Contract 2005-2008, QEW / RHVP Interchange, for which Dufferin was the paving contractor.[334] He wrote:

> There has been a number of previous e-mails and discussions etc regarding the direction on SMA use for Cont 2005-2008 on QEW at Red Hill. I will summarize the pertinent points:
>
> - Contract call for SMA to be placed.
> - Approximately 12,000 t of 12.5 SMA to be placed this spring
> - Contractor offered a credit of $2/t to use FC2 instead (not the approx $20 credit it should be)
> - Their SMA mix design calls for use of Ontario Trap Rock (OTR).
> - We have verified that they do have OTR at the plant
> - In previous e-mails you indicated that a suggested option would be to put down SMA with the OTR but using the revised gradation etc.
>
> Dennis indicated that he was OK with putting down the SMA with the revised specification if there was confirmation from your office that this was acceptable. The Contractor needs direction on this so he can get lined up for spring paving, so we would ask for a quick response.
>
> If this is acceptable to you please confirm also the revised spec limits that we received from you previously:
>
> - Pass 75 um – 6 to 9%
> - VMA – 16.5 to 18%
> - AC reduced by 0.3% - is this reduced from the minimums in Table 5 of OPSS 1151?
> - Filler reduced by 2% - reduced from what?

276. MTO elected to use this contract (Contract 2005-2008 QEW / RHVP Interchange) for the SMA trial, based on Special Provision 111F10M.[335]

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[334] MTO0004926

[335] MTO0021211 attaching MTO0021212

277. On February 27, 2009, Mr. Billings identified three contracts in the MTO Central Region where there would be SMA paving in 2009, for possible use in the SMA trial, and sought input from MTO's Regional Contracts Office on their suitability for the proposed SMA trial.[336] The three contracts were:

(a) Contract 2005-2014, Hwy 401 (Contractor – BOT; Paving Sub – Miller) (partially paved).

(b) Contract 2005-2008, QEW / RHVP Interchange (Contractor – AECON; Paving Sub was Dufferin though not listed in the email) (not yet paved). Mr. Billings stated with respect to this contract:

> As you are aware, a decision has been reached in the last several days to stay with the SMA item on this Contract, use the contractor's mix design that calls for Ontario Trap Rock aggregates and also use this Contract to trial demonstrate the revised specification for 12.5 SMA.

(c) Contract 2007-2028, Hwy 427 (QEW to Highway 401 Southbound Express Lanes) (Contractor – Dufferin; Paving Sub – Fermar) (partially paved)

278. On March 5, 2009, Mr. Kazmierowski presented an "MTO Report" to the OHMPA 35th Annual General Meeting. He reported that MTO had experienced concerns with low early age friction and had paused the use of SMA until concerns with initial friction were resolved. He further reported that contracts that meet the criteria for SMA were being designed with Superpave 12.5 FC2. He further reported that the MTO formed a task group

[336] MTO0021292 attaching MTO0021293 and MTO0021294

with representatives from OHMPA, and industry to address the low early age friction concerns, including the construction of trial sections of a modified SMA mix.[337]

279. On March 6, 2009, Mr. Tam circulated an update for internal circulation entitled "Low Early Age Friction of Stone Mastic Asphalt Pavement – Update" dated March 5, 2009.[338] It stated:

> A joint MTO/Industry SMA Task Group (TG) meeting was held on February 19, 2009 to discuss next steps for implementing the task group recommendations (update June 25, 2008) to address the early age friction of SMA.
>
> As part of implementing the recommendations, TG identified the need to build trial sections in partnership with OHMPA for evaluating the effectiveness of the proposed changes to SMA specifications to provide the anticipated early age friction.
>
> At the GeoCom meeting on Tuesday, February 24, 2008, the Committee discussed the TG recommendations and identified the need for construction of trial sections and subsequent evaluation of the early age friction of the modified SMA mix before incorporating the change in the existing SMA specification. The Geotechnical Section Heads of Eastern, Central and Southwest regions agreed to assist MERO in identifying contracts suitable for building the proposed SMA trial sections (see attached for details).
>
> MERO is currently working with the regions to secure trial sections from regional contracts. The proposed trials consist of 7 SMA test sections with different aggregates including Onatrio Trap Rock (OTR) as described in the Appendix. At present, the Central Region has identified the following three SMA carry over projects.
>
> Contract 2005-2014, Hwy 401 (Contractor – BOT; Paving Sub – Miller)
>
> Contract 2005-2008, QEW/RHCE (Contractor – AECON)
>
> Contract 2007-2028, Hwy 427 (Contractor – Dufferin; Paving Sub – Fermar)
>
> The regional Contracts Office is currently reviewing the requirements for the trial sections as specified in the Appendix and will subsequently determine the suitability of incorporating them in the above contracts in due course.

280. On March 15, 2009, Mr. Tam delivered a presentation at the AAPT Workshop on March 17, 2009, titled "SMA Early Age Friction and Mix Characteristics –Ontario Study." The presentation set out the evaluation matrix used for the Ontario trap rock aggregate

[337] MTO0030109 at images 17-18, attached to MTO0030108

[338] MTO0004934 attached to MTO0004933; also sent to Mr. Chaput MTO0021848

trials, influence of fillers on film thickness and air voids, British Pendulum test results on film thickness, and discussed surface treatment including skid resistance testing before and after water blasting.[339]

281. On April 20, 2009, at the meeting of the ORBA/MTO Hot Mix Technical Committee, the attendees discussed performance specifications.[340] The minutes stated:

> Performance contract for Highway 404 has a requirement for a minimum skid number of 40. Concerns were raised as to the limited information in industry as to what skid numbers can be achieved and how to get them. Asked if information on what aggregates will provide this can be provided. This requirement is not designed to change what is currently done. Can the data that was used to establish these criteria be shared?
>
> Post meeting note: MERO Report 005, Skid Resistant Aggregates in Ontario, was forwarded to Rob Bradford April 21st. Action: Phil Hutton to take these concerns back to the MTO group working on this.

282. On April 21, 2009, in the context of Highway 407 and friction performance on concrete surface roads, Mr. Klement emailed Mr. Raymond, Ms. Lane, and Mr. Marciello, to prepare information for a presentation regarding the MTO's friction testing processes to those who manage Highway 407 under the MTO/407ETR management structure. Embedded within Mr. Klement's email was a proposal from Ms. Lane that the presentation include: "Our practices - for example, if friction >30 no problem, if < 30 we investigate, if <25 (?) we react" and "SMA implementation was paused because of low initial friction numbers." In response, Mr. Klement stated:

> I suggest that we do not even mention SMA, unless Hwy. 407 has SMA segments. Too controversial and would support an argument that FN = 30 (or close to it) is not universally upheld by MTO, considering that on certain SMA segments, on high speed-high volume freeways, we "lived with" for relatively long periods with FN's well below 30. [341]

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[339] MTO0030386

[340] MTO0030295 at images 2-3

[341] MTO0025395 attaching MTO0025396

283. On May 4, 2009, Mr. Ponniah asked Mr. Gorman to review aggregate types included in the SMA trial sections.[342] Ms. Chan prepared a spreadsheet of historical friction numbers for premium aggregate setting out average FN by aggregate type.[343]

284. On June 16, 2009, Mr. Rollings requested that Mr. Billings arrange for friction testing on the SMA trial on pavement placed on the QEW at Burlington Street Bridge (MTO contract 2005-2008 [QEW/RHVP Interchange]), prior to opening the road to traffic.[344] Mr. Billings agreed. In making the request, Mr. Rollings stated:

> The aggregate for the SMA is Ontario Trap Rock and the mix was to be as per the modified requirements for gradation, AC content etc as per Bituminous Section. The left shoulder and lane 1 are currently behind barrels and would be a good opportunity to check both mixes for really early skid number.

285. As noted above, Dufferin was the paving contractor on MTO contract 2005-2008 (QEW/RHVP Interchange). An MTO Quality Assurance Officer Report dated June 17, 2009, reported that Dufferin had placed SMA earlier that week.[345]

286. On June 29, 2009, the MTO conducted friction testing on the SMA placed by Dufferin in MTO contract 2005-2008, QEW/RHVP Interchange. On June 30, 2009, Mr. Marciello emailed Bruce Turner (Senior Contract Administrator, MTO Contract #2005-2008, Aecom), Mr. Billings, Mr. Rollings, Ms. Lane, Anthony Di Lorenzo (Senior Project Manager, Area 2 – Traffic Office, Engineering Program Delivery Central, Design & Engineering Branch, Transportation Infrastructure Management Division, MTO), and Mr.

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342 MTO0013635
343 MTO0022754 attaching MTO0022755
344 MTO0012547
345 MTO0030889

Ponniah and advised that "As preliminary results indicate, Average Friction Numbers throughout all lanes ranged from 32-36."[346]

287. On July 3, 2009, Mr. Turner emailed Mr. Ponniah enclosing the Dufferin mix design for the SMA in MTO contract 2005-2008, QEW/RHVP Interchange.[347] Ontario Trap Rock and EC King filler were used.[348] On July 6, 2009, Mr. Ponniah expressed concern regarding the value if the SMA trial using EC King filler, as opposed to Carmeuse filler. Mr. Tam responded that the evaluations would provide confidence in the new specifications.[349]

288. On July 17, 2009, Ministry Directive PHM-C-001, The Use of Surface Course Types on Provincial Highways was finalized and was intended to replace Directive PLNG-C-003.[350] The Directive was circulated within the MTO in December 1, 2009.[351] Directive PHM-C-001 directed that:

> the use of SMA has been paused to resolve technical concerns[352]
>
> ***
>
> the use of carbonate aggregates (e.g. limestone and/or dolostone), is restricted in surface courses based on the following requirements[353]
>
> ***

[346] MTO0024473

[347] MTO0024328 attaching MTO0024329, MTO0024330, MTO0024331, MTO0024332, MTO0024333, MTO0024334, MTO0024335, MTO0024336, MTO0024337 and MTO0024338

[348] MTO0024329 at image 4

[349] MTO0015919

[350] MTO0000054

[351] MTO0025275 attaching MTO0025276

[352] MTO0000054 at image 3

[353] MTO0000054 at image 5

> Superpave 12.5 FC1, Superpave 12.5 FC2 and SMA require aggregates to come from the DSM.[354]

289. On July 23, 2009, Mr. Marciello emailed Ms. Lane, Joseph Della Mora, and Mr. Raymond with the friction testing results for SMA trial on pavement placed on the QEW in MTO contract 2005-2008, QEW/RHVP Interchange, conducted on June 29, 2009, with a comment: "Early friction appears to be improving". The results showed the average FN of each of five lanes tested ranging between 33.0 and 35.4, with only one test location in one lane falling below 30 (29.8).[355]

290. In late July 2009, Mr. Raymond assumed the role of acting Head, Bituminous Section, Materials Engineering Research Office, replacing Mr. Tam.[356]

291. Mr. Ponniah prepared a September 2009, slide deck titled "Progress Report For The MTO-OHMPA SMA Task Group."[357] It presented an update on the SMA trials including some friction test results, and indicated the following with respect to Task Group membership:

> Kai Tam replaced by Chris Raymond (co-chair), Bituminous Section
> Chris Raymond replaced by Joseph Ponniah, Pavements and Foundation Section
> Dennis Billings replaced by Stephen Lee, (Central Region)
> Tom Kazmierowski (P&F Rep) replaced by Chris Raymond/Joseph Ponniah
> Chris Rogers replaced by Steve Senior (Soils and Aggregates Section
>
> Ontario Hot Mix Producers Association - Sandy Brown (Co-Chair)
> AECON - Tom Dziedziejko
> DBA Engineering - Param Dhillon
> Miller Paving Group - Joe Bunting

[354] MTO0000054 at image 5
[355] MTO0014876 attaching MTO0014877, MTO0014878, MTO0014879, MTO0014880 and MTO0014881
[356] MTO0013965
[357] MTO0013711 at image 6, attached to MTO0013710

292. On October 14, 2009, Mr. Raymond spoke at the MTO/OHMPA Senior Managers Meeting to provide the results of the SMA trial.[358] The minutes stated:

> The friction results from a recent SMA test section using revised requirements to promote a lower asphalt cement content and lower filler content were encouraging (SN=34). MTO would rather solve the problem through mix design changes than look at remedial solutions like water blasting or sand application. It is suggested that Ontario Trap Rock be put back on the approved aggregates list as film thickness, not the particular coarse aggregate seems to have a great affect on initial friction. Chris Raymond suggested that the committee should make that decision and that a committee meeting should be held before the end of the year so that trail SMA projects can be planned for 2010.
>
> Action: Chris Raymond will schedule a meeting of the SMA low friction task group before the end of the year to finalize the committee's position on reinstating SMA in Ontario and decide whether to put Ontario Trap Rock back on the DSM list for SMA.

293. Mr. Ponniah, Mr. Tam, Param Dhillon (President, DBA Engineering Ltd.), Mr. Dziedziejko, and Mr. Brown, co-wrote a paper entitled "Addressing the Early Age Low Skid Resistance of Stone Mastic Asphalt Pavement in Ontario" which was submitted to and presented at the CTAA November 16-18, 2009 conference.[359]

294. Mr. Raymond prepared an update to HST (the Highway Standards Management Team) on the SMA trials to date to be delivered on December 2, 2009, which contained the following next steps:[360]

- Continue to work with the regions to build further field trials and monitor the early age friction.
- If the results are favorable:
    1. Update the Designated Sources for 1.Materials (DSM) list for aggregates to include OTR aggregates.
    2. Recommend removing the temporary pause on the use of SMA

[358] MTO0014008 at image 3
[359] MTO0030446 attached to MTO0030445; and MTO0014086 attached to MTO0014082
[360] MTO0021863 at image 11

295. On November 27, 2009, Mr. Chaput reviewed the draft presentation to HST and asked Mr. Raymond about the cautious approach to complete more trials. Mr. Raymond responded as follows:[361]

> The SMA committee has taken a cautious approach over the last two years for a number of reasons
>
> 1. to ensure safety to the travelling public,
>
> 2. because the committee's first recommendation to address the issue of restricting some premium aggregates was not effective, and
>
> 3. because there was frustration in the regions due to the challenges and costs of negoiating changes to active contracts and that the issue was not solved with the first recommendation.
>
> Over the last year, industry and the ministry have done considerable research to address the issue. We have looked at several alternatives although the main thrust of the research has been to reduce the film thickness in the SMA by modifying the mix properities to provide greater early age friciton. The work has been centred around laboratory testing. We now need to verify that what we found in the lab also happens in the field. We have done one field trial with the new SMA requirements and that was a success, FN=34. However, the committee is not yet comfortable removing the "pause" until a few more field trials are complete to ensure that positive results are obtained in the field with both filler products and a range of aggregates. Note: the single trial used the (EC King) filler that has historically shown better early age friction and the (Ontario Trap Rock - OTR) aggregate that had been prone to lower early age friciton. To accelerate getting a cross-section of friction results from different fillers and aggregates, we have proposed a trial that requires several test sections. Central region is onboard with finding such as trial. We have also been pushing the regions for further trials but there has been no uptake from other than Central Region. Should our trials be successful, the pause will be removed.

296. Mr. Raymond reviewed and revised minutes from the December 2, 2009, HST meeting.[362] They read, in part:

> Item 3: Stone Mastic Asphalt (SMA) Update – Chris Raymond
>
> - Low early age friction is a possible safety concern for some SMA pavements
> - Further investigation has shown that it is not solely related to aggregate type but is also related to other factors such as mix design properties and possibly construction practices
> - The concern is limited to the early age of the pavement, over time, the friction levels increase

[361] MTO0021607

[362] MTO0014107

- MERO has revised the existing specification to allow the reduction of AC by 0.3% and the filler content by 2% from the current design values
- HST Questions: are you recommending reduction in filler and AC content for all SMA?
- We are recommending a trial contract with several test sections to valid the laboratory results will be obtained under field conditions. If validated, we will recommend the use of the revised SMA specification for all future SMA projects
- Industry is anxious, they feel if the pause goes on much longer they will lose their experience with SMA
- They have invested a lot in lab work in search of removing the ministry's pause
- 3 possible projects in mind for a trial in Central Region

297. On December 16, 2009, Mr. Ponniah presented a Progress Update to the SMA Task Group.[363] The MTO identified the following next steps:

> Work with the regions to build more field trials as proposed and monitor the early age friction
>
> If the results are favorable
>
> 1. Update the aggregates Designated Source List (DSL) to include OTR aggregates
>
> 2. Recommend the use of SMA mix in the future contracts.

(d) 2010

298. As of February 26, 2010, the permitted SMA aggregate source list was contained in Special Provision No.110S12, Amendment to OPSS 1003, November 2004, which listed the following aggregate sources: [364]

> For SMA, coarse and fine aggregates shall be produced from crushed bedrock material supplied from sources named in the following list:
>
> Ottawa Quarry Aecon Construction and Materials Limited O05-072
> Marmora Quarry Aecon Construction and Materials Limited C01-058
> Boyce Quarry Dibblee Paving and Materials Limited O05-070
> Brockville Quarry Lafarge Canada Incorporated B15-039
> Hawthorne Quarry Lafarge Canada Incorporated O05-155
> Bruce Mines Quarry Ontario Trap Rock – Bruce Mines Limited B22-072
> Rideau Road Quarry R.W. Tomlinson Limited O05-067
> Methuen Township Quarry MRT Aggregate Incorporated B02-071

[363] MTO0013780 (presentation); and MTO0000154 (minutes)

[364] MTO0022324 attached to MTO0022322. The list remained the same in July 2010 (MTO0006659)

> Both the coarse and fine aggregate for SMA shall be obtained from the same source. Aggregate derived from RST may be from a source different than the rest of the aggregates for the SMA.

299. On August 31, 2010, Mr. Virani reported on the SMA trial to the Senior Engineers Meeting (Mr. Raymond, Mr. Virani, Ms. Marks, Mr. Tabib). [365] The minutes recorded:

> Anil advised that two trials were planned to assess the early friction characteristics of SMA, and design documents were prepared for one contract in WR (Hwy. 401 Cambridge) and one in CR (Hwy. 400, N/B from Hwy. 407 to Bass Pro Drive). Each trial was designed to incorporate three aggregate sources and two filler types. The trial in West Region is a "non award" due to high bid prices. The CR trial is now completed.
>
> First round of friction testing on Hwy. 400 conducted just after construction gave friction numbers in mid 20's and second round of friction testing done after a few days of trafficking indicated that friction numbers are now starting to approach 30. Another round of measurements will be arranged in 2-3 weeks time. Some areas are exhibiting flushing and referee testing is underway for disputed voids results. Some removal may be warranted. The friction results will be presented to MTO Geotechnical Sections and discussed with the SMA Task group.

300. On November 22, 2010, the MTO Senior Engineers Meeting occurred (Attendees: Present: C. Raymond, A. Virani, P. Marks, S. Tabib).[366] The minutes state that Mr. Virani reported the following with respect to SMA and friction testing:

- Work on SMA is still continuing and friction numbers from the SMA trials will be included in up coming updates to Steve Cripps.
- AMEC is doing mix verification for some of the mix designs.
- Aecon asked about information on friction numbers for their SMA jobs. Chris advised that friction numbers should not be shared with contractors. Contractor's requiring friction information to assist with meeting performance contract requirements, should contact Becca Lane.
- The friction results of the SMA trials will be discussed with the SMA Task Group.

301. On December 6, 2010, Mr. Raymond presented a Bituminous Section Update to Steve Cripps (Director and Chief Engineer, Highway Standards Branch, Provincial

[365] MTO0026177 at image 2

[366] MTO0026215

Highways Management Division, MTO).[367] This update provided background to and an update on the SMA trials:

(a) In the slideshow itself he noted that "OHMPA has invested considerable money in recent lab testing and plant modifications. They want SMA back."[368]

(b) In the speaking notes to that slide he indicated that the "Task Group does not consider the issue to be aggregate related [.] However as discussed with industry in December, trials are needed which should incorporate different aggregate types and the two fillers commonly used in Ontario for side by side comparison [.] MTO is pursing a 2010 trial contract to confirm laboratory results in the field [.] To that end, we are consulting with the regions for suitable candidates and a number of these have been proposed. Our preference is for 2010 construction." [369]

(c) In the slideshow itself he noted that the Highway 400 Trial early friction "preliminary results are not encouraging" and should be discussed with industry.[370]

(e) 2011

302. On January 5, 2011, Mr. Raymond emailed Mr. Kazmierowski, attaching a draft presentation for an update to HST regarding SMA. Mr. Raymond stated that the MTO had

[367] MTO0014399 attached to MTO0014398
[368] MTO0014399 at image 8
[369] MTO0014399 at image 8 (speaking notes, hidden content)
[370] MTO0014399 at image 9

to discuss the results with the SMA Task Group and that the 2010 results did not support removing the pause on SMA.[371] The presentation contained friction results from SMA trials.

303. On March 3, 2011, Mr. Kazmierowski presented the MTO Report at the OHMPA's annual general meeting. He summarized the 2009 and 2010 SMA trials, noted that "Friction results did not meet expectations!", reported that the SMA pause would continue, and that the MTO was considering grit embedment on already-tendered projects.[372]

304. On April 18, 2011, Mr. Virani emailed Mr. Raymond a presentation titled: "SMA Update" for the "Task Group Meeting April 18, 2011". The presentation concluded that the SMA pause could not be lifted based on the trials conducted.[373]

305. On June 16, 2011, the MTO received a media inquiry about the SMA placed on the QEW, the use of SMA generally, skid resistance, and the SMA pause, from Nathan Medcalf (Editor, Equipment Journal). Mr. Medcalf's questions were detailed and specific. In the same email chain, Mr. Kazmierowski stated to Mr. Raymond:

> I am concerned with these types of media conversations regarding frictional resistance and safety of our highway surfaces. I would prefer we avoid any discussion of actual skid numbers/values/thresholds and keep the conversation on a more generic level. The sensitivity associated with this issue is high. [374]

306. Mr. Virani sought input on a draft response from legal counsel and from Ms. Lane, Mr. Raymond, Brenda Liegler (Contract Innovations Engineer, Contract Innovation Office,

[371] MTO0014478 attaching MTO0014479
[372] MTO0026297 at images 16-18
[373] MTO0026340 at image 16, attached to MTO0026339
[374] MTO0026567

Contract Management & Operations Branch, Provincial Highways Management Division, MTO), Heather Kamp (Communications Branch, MTO), and Greg Godin, (Executive Assistant, Office of the Assistant Deputy Minister, MTO).[375] Mr. Godin provided the following comments:

> Friction numbers have always been a controversial issue. We need to be cautious on the language we use. I thought we had a template of phrases that we drew from when referencing friction measurements.
>
> With regard to the last sentence; Should we base our decision on only one trial? Perhaps we should keep the door open in the event that we want more trials to make a final decision.[376]

307. On August 5, 2011, Mr. Virani responded to Mr. Medcalf's June 16, 2011 email with the following email (which had been approved by the office of the Assistant Deputy Minister[377]):

> Thank you for your inquiry regarding our Stone Mastic Asphalt (SMA) gritting trial on the QEW East Bound Lanes between Burloak Drive and Bronte Road. This trial is one of many innovations the ministry is exploring to improve the quality of our highway infrastructure. The purpose of the trial is to evaluate the potential of rolling a sand grit into the SMA pavement as part of the compaction process to improve the surface characteristics of the pavement. Gritting is performed on some European roads but is not the typical practice in North America.
>
> SMA is a premium heavy duty gap graded hot mix asphalt with a large proportion of stones and a high amount of mastic-stabilized asphalt cement. The aggregate skeleton provides stone-on-stone contact for superior rutting resistance and the ability to withstand damage due to heavy truck loads. The high amount of asphalt binder provides increased durability and resistance to aging and cracking in the mix. The expected service life of a newly constructed SMA pavement is 21 years versus standard pavement that has an expected service life of 19 years. In addition to extended life, SMA is also reported to have better noise properties and less spray in wet conditions. Because of the high binder content and the fact that SMA is used on some high speed 400 series highways, gritting of the freshly laid surface is being assessed on a trial basis as a possible means to enhance the surface properties of SMA.
>
> The ministry learned that Dynapac had gritting equipment in Canada from a presentation at the 2010 Ontario Hot Mix Producers Association Fall Seminar. MTO then inquired as to

[375] MTO0016290; and MTO0031157

[376] MTO0031157 at image 1

[377] MTO0016299

> the availability of this equipment to conduct a gritting demonstration in Ontario. To our knowledge this is the first trial of its kind in North America.
>
> The ministry plans to monitor this trial to assess the surface characteristics in the short term and over the next several years.
>
> We will review the results of the trial in detail before making a decision to continue using SMA.
>
> With regards to the comments from Mr. Wilcox, please refer to my response.
>
> FYI..Ontario has the safest roads in North America, according to our latest road safety statistics (for 2008).
>
> http://www.mto.gov.on.ca/english/safety/orsar/orsar08/overview.shtml [378]

308. On June 23, 2011, the MTO received an inquiry from the email address "nick.bokalo@torontopolice.on.ca" in response to a "Road Talk link" as follows: "I would like to know if there are any publications that cover hot rolled asphalt compositions and friction coefficients for the hot rolled asphalts used in highways and roads in Ontario." Mr. Raymond emailed Mr. Kazmierowski and Ms. Lane that he would prepare a response and that "I will work with Becca to prepare a response noting that I am concerned with this type of judicial inquiry regarding frictional resistance and safety of our highway surfaces. I would prefer we avoid any discussion of actual skid numbers/values/thresholds and keep the conversation on a more generic level. The sensitivity associated with this issue is high."[379]

309. Mr. Raymond and Mr. Virani sent the following in response to Nick Bokalo (Police Collision Reconstructionist, Toronto Police Service) on August 3, 2011:[380]

[378] MTO0032375
[379] MTO0026365
[380] MTO0026385

> Thank you for your inquiry. I am responding on behalf of the Ministry of Transportation. Please find two attached documents and the link to a third document that address your inquiry.
>
> The MTO Pavement Design and Rehabilitation Manual covers the hot mix asphalt types used in 1990 (see page 31) and friction testing (see page 252). This document is too large to attach but it can be downloaded from our MTO library using the library catalogue search to conduct a search by title. The mto library can be found at the following link.
>
> http://www.mto.gov.on.ca/english/transrd/index.shtml
>
> The Superpave and SMA Guide (attached) covers the hot mix asphalt types used today.
>
> The Skid Resistant Aggregates in Ontario document (attached)covers hot mix asphalt types and friction.

310. A July 11, 2011, Monthly Report Memorandum from the MTO to Premier Kathleen Wynne (Premier of Ontario) and Deputy Minister Carol Layton (Deputy Minister, MTO) stated, among other things:

> 11. Embedded Grit Trials of Stone Mastic Asphalt Proving Successful
>
> A joint MTO/Industry Task Group has conducted several trials to cost-effectively improve the lower friction of freshly paved Stone Mastic Asphalt (SMA).
>
> While SMA is a durable, rut resistant, noise and wheel spray reducing pavement, its higher asphalt content and thicker film initially lowers friction. Field research for solutions including diamond grinding, shot blasting and water blasting found the limited availability of equipment the biggest drawback to coordinating work within the time window.
>
> In early June 2011, a method developed in Germany for rolling gritting sand into the SMA as part of conventional hot mix rolling was trialed on the North Service Road in Burlington, and the results were positive, showing a pavement with better friction. Equipment and material for applying this technique is readily available and relatively inexpensive.
>
> A subsequent trial in the SMA sections of the QEW in the vicinity of Burloak Drive revealed friction measures in the high 40s to lower 50s when gritted (the Ministry performance target is 30), well above the high 20s to low 30s without gritting.
>
> The positive results indicate the method will be adopted as a cost effective tool for increasing friction when paving with SMA. [381]

[381] MTO0007055 at image 7. MEO staff were not pleased with the publication of friction numbers, followed up and learned that the website was only available to MTO staff: MTO0014503

311. Mr. Raymond wrote a summary of the MTO/OHMPA Senior Managers Meeting held on September 27, 2011. Mr. Raymond noted:

> SMA - MTO wants to bring SMA back. SMA projects that were built several years ago are meeting our performance expectations. Two gritted trials were constructed this year with encouraging results. The trials used a specialized roller to roll grit into the hot pavement as part of the compaction process. Sand coated with a small amount of asphalt cement seems to work better than uncoated sand. The coating on the sand is light and hardly noticeable but reduces dust and roller pick up. May also help embedment into SMA. Initial friction concerns seem resolved. Some issues to be discussed such as not gritting locations for pavement markings, but overabulll gritting looks promising. Also need to review if we should be using the leaner SMA used for 2010 trials, or if the original SMA mix requirements should be used in conjunction with gritting.[382]

312. On November 22, 2011, Ms. Lane emailed Kane Erickson (Engineer in Training (EIT), Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) in respect of a wet/dry collision extraction algorithm:

> As part of the Network Friction Analysis Study, we asked Laura Kingston in Head Office Traffic to develop a wet/dry collision extraction algorithm. The concept is that if an area has many more accidents in wet conditions than in dry conditions, it may be an indication that the pavement friction has deteriorated. We would then sort the data based on highest to lowest wet/dry ratio and compare Friction Trailer / ARAN macrotexture at these locations to look for correlation.
>
> Tom Klement used the interim information provided by Laura to identify priority sites for friction testing in each region. Unfortunately, none of the sites were tested this year with the Friction Trailer - but they will have been tested with the ARAN.
>
> Please follow up with Laura so that we can start to analyse the collision data and extract the wet/dry collision statistics from the database. [383]

313. On December 1, 2011, the MTO Geotechnical Committee met by teleconference. Mr. Virani presented on the 2011 SMA gritting trials. [384] At the conclusion of his slide show

[382] MTO0014470 at image 3, attached to MTO0014469

[383] MTO0033599

[384] MTO0007446 at image 23, attached to MTO0007445

prepared for the meeting, Mr. Virani set out recommendations under the heading "Next Steps":

- Propose:
  - Reinstate SMA use (incremental, 5 contracts?), requiring gritting with hot, coated sand
  - Revert to the original SMA specification?
- Develop construction specification for gritting
  - Gradation, temperature
  - Application rate, lane markings
  - Clean -up.

(f) 2012

314. The January 2012 version of DSM 3.05.25 twenty-three sources for SP12.5 FC2, including Demix Agrégats, Varennes Quarry, and fourteen sources for SP 12.5 FC1.[385] It did not list sources for SMA, which were still listed in Special Provision No.110S12.

315. On January 27, 2012, Mr. Virani, in response to an inquiry from MTO staff about the possibility of submitting a paper abstract to CTAA regarding SMA gritting trials, stated: "We cannot present a paper on gritting without getting into friction numbers, which I understand is a very sensitive issue legally. So please consider this carefully before sending an abstract." Mr. Raymond replied: "I encourage staff to submit papers for technical forums and I am willing to present at CTAA although for this topic, I do not support publishing on such a legally sensitive topic."[386]

[385] MTO0007477 attached to MTO0007476
[386] MTO0026702

316. On February 2, 2012, David Dyer, a fourth year engineering student at Queen's University, emailed Ms. Marks.[387] He asked about standards for road friction in Ontario and testing devices:

> I was hoping you could help me with a few things. First, I am interested in the Ontario government standards for friction. Could you point me to where I could find them. Second, I am interested in the method used to measure road friction. I know there a variety of testing devices, and I was wondering which is used by the Ministry of Transportation. I have seen that they use trailer mounted units, but are there any more portable devices in use?

317. Ms. Bennett replied for Ms. Marks (copying Ms. Marks and Mr. Senior) with background information on the MTO's locked wheel ASTM 274 skid tester, the Dynamic Friction Tester, the British Pendulum Method, and resources on pavement friction. [388] There was no response on MTO friction standards.

318. On March 2, 2012, Mr. Kazmierowski presented a "Bituminous Report" at the OHMPA Annual General Meeting.[389] The slideshow included an update on the SMA gritting trials and advised that the next steps were to reconvene the SMA Task Group, to consider reinstating SMA use (incrementally) requiring gritting with hot, coated sand, and reverting to the original SMA specification (possibly with more asphalt cement), and to develop a construction specification for gritting.

319. A draft of OPSS.PROV 1003 dated March 5, 2012 contained the same permitted SMA aggregate source list as the July 2010 Special Provision No.110S12, Amendment to OPSS 1003, November 2004. It listed the same eight aggregate sources as in 2010

[387] MTO0019393
[388] MTO0019393
[389] MTO0016667 attached to MTO0016666

and continued to require both the course and fine aggregate for SMA to be obtained from the same source.[390]

320. On May 31, 2012, Mr. Dziedziejko emailed Mr. Gorman regarding the use of SMA on an upcoming contract.[391] He wrote:

> I am following up on the voice message I just left on your phone.
>
> We would like to be able to use material from our Mountain Lake quarry for SMA. A contract that is out for tender, 2012-3012, which closes on June 7th does not list the mountain lake material as an acceptable material for use in SMA. I have been exchanging messages with Anil Virani and from what I can understand from his voice message to me is that there is no official SMA designated sources list for SMA and an aggregate that is acceptable for FC2 should be OK for use. From this I assume that the listing of acceptable sources in the current contract out for tender is in effect a throw back to address the initial skid resistance issue that has now been resolved with the use of grit. I would appreciate it if you could discuss this internally with Steve, Anil and anyone else that needs to be involved to confirm that the Mountain Lake aggregate can be used for SMA and to send out an addendum to the contract to that effect.

321. Mr. Gorman replied the same day: "I knew I would not make retirement before this issue came up. You are not the only one either."[392]

322. An article dated June 1, 2012, titled "Sand gritting paves the way to perpetual pavement", in "On-Site", described as "Canada's Construction Magazine", described the MTO pause on SMA due to skid resistance issues, mentioned the RHVP, and focused on the SMA gritting trial in MTO contract 2007-2026 (on the QEW).[393] Included in the article were the following statements:

> For several years now, the Ministry of Transportation of Ontario (MTO) has had its sights set on perpetual pavement—highways that will last, if not eternally, at least for the foreseeable future. One of the keys to realizing this dream seemed to be using durable, stone mastic asphalt (SMA) as the surface course. That was, until issues with skid

[390] MTO0022495 (OPSS.PROV 1003 at s. 1003.05.01 (Table 1) March 2012); and MTO0006659 (SP110S12 at s. 1003.05.01, July 2010)

[391] MTO0012905

[392] MTO0012905

[393] MTO0014602 attached to MTO0014601

resistance emerged that put the process on hold. Lately, one Canadian roadbuilder seems to have solved the problem.

The notion of “perpetual” pavements started to gain currency in Ontario in about 2003. “The intent is to build the pavement thick, with an elastic layer on the bottom. That way, there is enough material to flex when traffic runs on it. If it cracks, it only cracks at the surface, so it can be repaired easily,” explains Tom Dziedziejko, general manager, AME Materials Engineering, Toronto.

***

In 2006, the first full-service perpetual pavement highway using SMA as the surface-course mix in Ontario was built: the Red Hill Valley Parkway.

***

Precise compaction is an important concern with SMA; the mix cools rather quickly, and drum rollers must be used to prevent working the binder material to the surface and ruts.

However, of greater concern than compaction was skid resistance. Questions about SMA’s capabilities in this regard have been asked internationally.

“The issue is that there was quite a bit of AC coating the aggregate,” says Bernal. That tended to reduce friction noticeably, compared to conventional asphalt. The effect only lasts for a couple of weeks or so after exposure to traffic.

***

The rubber hit the road with Ontario tender 2007-2026, covering grading, drainage, granular base, hot mix paving, illumination, traffic signals, structures and an Advanced Traffic Management System on the Queen Elizabeth Way (QEW) from Burloak Dr. to Third Line. The total value was $88.7 million, according to the tender.

***

The MTO put out a non-standard special provision for safe construction with a specification for gritting of stone mastic asphalt, according to Bernal. This was going to be a pioneering project; it had never been tried before in Ontario, he adds.

***

The gritting “did amazing things,” says Dziedziejko. “The initial numbers on the trial section were significantly higher than they were without it—way above the minimum.”

“The MTO checked the skid resistance, and at our last committee meeting everyone was happy with the skid resistance,” says Dziedziejko. “They plan to recommend to the MTO that they lift the pause on SMA as long as gritting is part of the job.”

***

The MTO was satisfied with the results and has allowed SMA back into the specifications with the added gritting specification, notes Bernal. This procedure will probably become the standard in Ontario.

323. A Highway Standards Branch 90-day plan, dated July 6, 2012, referenced the reintroduction of SMA under the heading “Support (Green) Hot Mix Trials for 2012-13”. It noted: “Arrange for the reintroduction of SMA into trial contracts through consultation with stakeholders”.[394]

324. The Fall 2012 edition of the MTO’s “Road Talk” publication contained the article on SMA early friction issues and the embedded gritting trials conducted by the MTO.[395] The article contained the following statements:

> The Ontario Ministry of Transportation (MTO) is always looking for innovative technologies to enhance highway safety and improve highway performance. Stone Mastic Asphalt (SMA) was adopted by MTO as a premium surface course mix due to its excellent proven performance. One concern that the ministry has encountered with newly placed SMA is that it exhibits lower initial frictional properties that improves over a short period of time. Similar findings have been reported by other agencies in USA, Europe and Australia. To obtain enhanced friction immediately after construction, the ministry trialed the use of embedded gritting sand on the SMA surface during paving. This embedded gritting technology is new to Canada and the ministry’s trials in Burlington, Ontario, in 2011, were the first ever conducted on a provincial highway. [396]
>
> ***
>
> Macrotexture of the SMA mix provides improved surface drainage (reduced splash), good frictional resistance and surface texture characteristics with superior noise reduction compared to conventional dense graded HMA.[397]
>
> ***
>
> Enhanced initial early age friction on SMA surface is desired right after construction and before opening to traffic. The need to enhance initial early age friction of SMA motivated the ministry to suspend the use of SMA while investigating different methods to enhance initial early age friction. In the interim, the ministry specifies Superpave 12.5FC 2 in place of SMA. To address the surface friction issues of SMA, the ministry formed a joint SMA Task Group to investigate different methods (mix design and construction) to improve the initial early age friction of SMA. The SMA Task Group comprised of ministry staff, the industry, including the Ontario Hot Mix Producers Association, consultants and contractors.

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394 MTO0023797

395 MTO0000197. Input on drafts of the article was provided by: Imran Bashir, Tom Kazmierowski, Anil Virani, Stephen Lee, and Kristin MacIntosh: see MTO0031243; MTO0016364; MTO0016369; MTO0016373; and MTO0016380

396 MTO0000197 at image 1

397 MTO0000197 at image 1

> The SMA Task Group reviewed current specifications and oversaw extensive laboratory testing resulting in a revised SMA specification.
>
> In 2009, the ministry conducted its first trail using the revised SMA specification on a section of the Queen Elizabeth Way at Red Hill Creek, with encouraging results. Subsequently, in 2010, the ministry carried out trials on a section of Highway 400 north bound lanes between Highway 407 and Bass Pro Drive featuring three aggregate sources and two fillers. These trials on Highway 400 also included the assessment of a light application of gritting sand on the compacted SMA surface with the intent to accelerate abrasion of the asphalt binder film of coated aggregates from the fresh SMA finish surface.
>
> The results of the ministry's Highway 400 trials indicated that use of post-construction gritting sand was not effective in improving the initial early age friction of SMA surface; the ministry then trialed the embedded gritting sand to improve initial early age friction.[398]
>
> ***
>
> Friction surveys of these trials found that embedded gritting has been successful in improving the initial early age frictional resistance of SMA. Initial early age friction of SMA tested just after construction (within one to two days) for both coated/ uncoated gritting materials improved by 26 to 59 percent at various application rates. Friction measured after six to eight weeks after construction still indicate slightly higher frictional resistance (2 to 11 per cent) compared to control sections. The ministry will continue to monitor and evaluate the performance of these trials.
>
> Based on the results, it is evident that the embedded uncoated/ coated grit can significantly improve the initial early age friction of SMA surface. These trials also confirm that embedded hot gritting material using a specialized gritting roller is feasible and removal of excess coated grit was not necessary when coated gritting was used.
>
> Following the success of the two trials, the ministry plans to reinstate SMA use on its high volume highways using the new specification that includes embedded grit. This will be done through consultation with the MTO/industry SMA Task Group and will be implemented on an incremental basis. Embedded coated gritting sand with one percent asphalt binder and 1.0 kg/m2 application rate has proven to be an effective method to enhance initial early age friction of SMA surface.[399]

325. On November 2, 2012, Ms. Marks emailed draft minutes from an ORBA-MTO Hot Mix Technical Committee to Mr. Raymond. Item 5 related to SMA status, and noted "MTO wants to build on the successes last year and are planning two trials for 2013". A post meeting note was included below Item 5: "Construction stared in October on a West Region contract utilizing SMA with gritting".[400]

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[398] MTO0000197 at images 1-2

[399] MTO0000197 at image 4

[400] MTO0026936 at images 1-2, attached to MTO0026935

(g) 2013 MTO network friction testing

326. In January 2013, the MTO developed a program for network friction testing of pavement sections throughout the province in 2013.[401]

327. By March 2013, the MTO identified 194 sections to be tested using the MTO's brake-force trailer.[402] Despite initial concerns about the MTO's resources to complete network testing internally, Mr. Marciello was assigned to complete the testing.[403]

328. The MTO completed friction testing in the summer of 2013.[404]

329. The MTO analysed the friction data collected during the 2013 network testing and testing conducted in 2012 (including testing on the RHVP).[405] In November 2013, Sam Cui (Pavement Management Analyst, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) sent Mr. Lee a presentation and spreadsheet of his analysis in which he concluded that there seemed to be no significant correlation between friction number and pavement age, but that there was evidence that friction number had a relationship with pavement type.[406] The presentation noted that, based on the limited testing numbers, SMA appeared to have lower FN than average AC while Portland Cement Concrete had high FN.[407]

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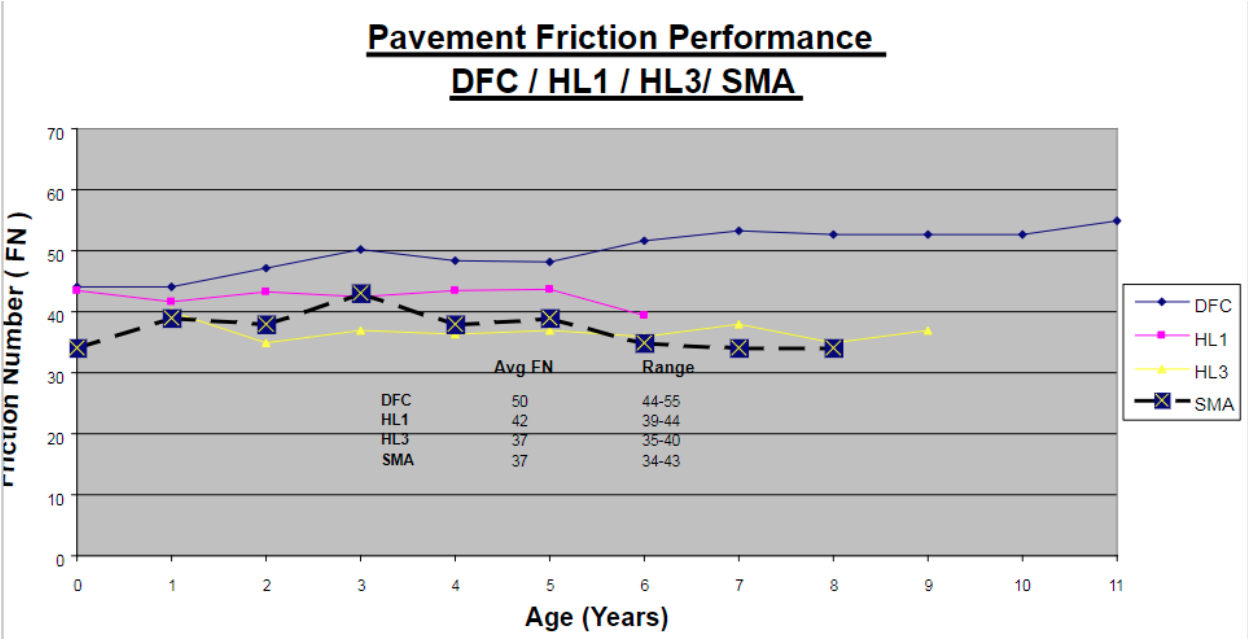
401 MTO0034863
402 MTO0008458
403 MTO0034863; MTO0008476; MTO0017010. See also MTO0016999
404 MTO0011758
405 MTO0023430 attached to MTO0023428
406 MTO0023428. See also MTO0017083 attaching MTO0017084
407 MTO0023429 at image 9

330. The MTO created a spreadsheet with the 2013 network testing results as well as some roads testing in 2012 (including the RHVP).[408]

(h) 2013

331. On January 11, 2013, Mr. Marciello emailed Mr. Lee, attaching a presentation with graphs comparing historical pavement friction performance over time of SMA, DFC, HL1 and HL3.[409] The last graph[410] contained a comparison of all four types:



332. On January 22, 2013, Mr. Marciello emailed Li Ningyuan (Senior Pavement Management Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) two spreadsheets with friction data, one of which was titled "Friction Database

[408] MTO0009385 attached to MTO0009384
[409] MTO0034867 attaching MTO0034868
[410] MTO0034868 at image 9

March 2012", writing "This is the most recent file".[411] Both attachments included friction data for numerous provincial roads, including roads identifying the pavement type as SMA with notes regarding mix design or gritting, from the early 1990's to 2011. The documents also included RHVP friction data from testing conducted in 2008 and 2011 (but not the other years MTO testing was conducted).

333. On January 29, 2013, Ms. Smith emailed Peter Freure (Project Soils Engineer, Eastern Region, Highway Standards Branch, Provincial Highways Management Division, MTO), copying Mr. Rollings regarding items to be discussed at the next Geotechnical Committee meeting, writing:

> • What is the status of the spec for SMA with gritting (Bituminous Section)? The spec is needed for upcoming demonstration projects.
>
> • Can Bituminous Section present updated friction values for SMA trial projects. This is needed regionally for our decision-making as to which projects we might risk as demonstration projects for SMA.
>
> Not sure if these are coming up in QA Committee this week, but I will check with Rob Rollings. [412]

334. Mr. Rollings replied on January 30, 2013, stating that it was not "on our current agenda but certainly should be on the next joint meeting – I have made a note". The same day, Ms. Smith forwarded the response to Ms. Marks and Mr. Lee, writing:

> Please see below, we are looking for the new spec for SMA with gritting and would also like to see friction data from projects and trials (400, QEW). There is still some reluctance to move forward with SMA in critical areas, so this will aid in the decision-making, and hopefully we can get a few demonstration projects out in 2013.

[411] MTO0017440 attaching MTO0017441 and MTO0017442

[412] MTO0037016

> While I've asked for it to be tabled at the next GeoCom at the end of February, and Rob Rollings will be putting it on the next joint QAC/GeoCom agenda, it would be appreciated if we could see something sooner.[413]

335. Ms. Marks forwarded the email to Mr. Virani 10 minutes later, asking him if he could address the inquiry at the meeting the following day.[414]

336. On January 31, 2013, Mr. Virani sent an email providing SMA friction data in response to Ms. Smith's request.[415] The attached slide deck included graphs with friction testing results, including comparisons of friction numbers between ungritted and gritted pavements. The first chart included friction testing results for four mix types. Underneath the chart, it was written "Initial friction results did not meet expectations. Consider grit embedment."

337. Ms. Smith replied that afternoon, writing:

> Thanks Anil. Do you have any comparisons with other surface courses such as a Superpave 12 FC2? Just wondering what frictional properties on our most popular surface course would be, and how SMA compares to that.
>
> Also, is there any multi-year data on the SMA trials? It looks like the friction results are all from a single season. How does it perform in years 2, 3…[416]

338. On January 30, 2013, Karolina Krol (Engineer in Training (EIT), Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) emailed Mr. Virani, attaching friction data for gritted SMA surfaces, writing:

> Please see sheet 1 in the attached doc.

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413 MTO0037016
414 MTO0037016
415 MTO0032575 attaching MTO0032576
416 MTO0031391

> Note the 3 columns of data points represent the 3 testing dates (Oct.18, 25, and Nov.15). (I couldn't figure out how to change the x-axis to display just those dates.)
>
> Please let me know if this is sufficient for the telecom. Another thought is to compare NB and SB friction data. I can work on that first thing tomorrow if you'd like that info? [417]

339. The attached document included friction data from tests on gritted SMA conducted between October 18, 2012 and November 15, 2012, on four pavement sections which appear to be on Highway 6 in Guelph, ON. The average friction numbers included in the document ranged from 38.4 to 51.5.[418]

340. The minutes of the MTO Quality Assurance Committee teleconference on January 31, 2013 indicated the following was discussed regarding SMA, listing Ms. Smith as the having submitted the topic:

> AV showed that the trials on the 400 did not provide the frictional properties needed.
>
> Friction starts out in the order of 25 – unacceptable and it takes several weeks to increase to acceptable friction values.
>
> Other trials showed embedding the grit right after paving works better with uncoated than with coated.
>
> Another SMA trial in WR. There were some issues because of the echelon paving - larger areas to grit, spread rated, and wind made it difficult.
>
> There were no values in the 25 range. Ranged from 38-50. This spring investigation will be done on friction properties and reviewed.
>
> Spec is ready. AV is comfortable to use this on a full contract. If there is a contract suitable it could be used now for where SMA is warranted.
>
> Move forward with SMA as long as the gritting is used.
>
> **Action: Regions to identify suitable contracts for SMA gritting to AV.** [419]

[417] MTO0031389

[418] MTO0031390 attached to MTO0031389

[419] MTO0008444 at images 13-14, attached to MTO0008443

341. The MTO Geotechnical Committee met by teleconference on February 20, 2013[420] and Mr. Bashir made a presentation regarding the SMA gritting trials prepared by Mr. Virani. [421] The minutes noted the following discussion respecting SMA, with Ms. Smith and Ms. Marks listed as the proponents:

> What is the status of the Spec for SMA with Gritting (Bituminous Section)? The spec is needed for upcoming demonstration projects.
>
> - Imran Bashir presented SMA Gritting prepared by Anil Virani
> - Initial results did not match expectations so decided to do Grit Embedment trial.
> - Both coated (hot sand w/ Asphalt applied hot) and uncoated grit worked well, but some issues with application of uncoated
> - Will continue to collect data as paving is completed
> - Have been focusing on the early friction, which has been historically a concern with SMA
> - Spec is not ready yet, so a place holder will be used with Superpave and SMA will be added into contracts if Spec is ready in time.
> - Going back to the original SMZ spec (not the reduced AC) with the addition of grit
>
> Can Bituminous Section present updated friction values for SMA trial projects. This is needed regionally for our decision-making as to which projects we might risk as demonstration projects for SMA. [422]

342. In March 2013, the MTO published the "Pavement Design and Rehabilitation Manual", 2d edition.[423]

343. On March 1, 2013, Mr. Virani emailed Frank Pinder (Head, Quality Assurance Section, Eastern Region, Provincial Highways Management Division, MTO), Mr. Rollings and Mr. Smith regarding SMA specifications, writing:

> FYI: The SMA design tables in our NSSP were from OPSS 1151. As you are aware, these were amended to reduce the min. AC content and the VMA requirements. We have inserted these revisions into our NSSP - Much as I would have liked to go back to the original SMA specs, this might come across as a "change".

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[420] MTO0008456

[421] MTO0018067 attached to MTO0018066

[422] MTO0008457 at images 2-3

[423] MTO0038658

> Also Karolina has re-numbered the last few Tables (one was missing). [424]

344. Mr. Rollings replied approximately five minutes later, stating:[425]

> I think this is one that should be pursued further as the reduction of the AC content was only to try and deal with the friction issue and it didn't work. We now have the gritting solution and we should go back to the technically correct decision.
>
> My thoughts

345. On March 5, 2013, Mr. Bashir emailed Ms. Marks (Mr. Virani copied), attaching a slide with notes for the OHMPA 2013 Annual General Meeting.[426] The notes included the following:

> Most of you are aware that MTO paused the use of SMA due to early age friction issues – we reverted back to FC 2 mix.
>
> The MTO Industry SMA TG that was established to resolve this came up with mix design modifications.
>
> In 2010, a large scale trial was constructed on Hwy. 400 that incorporated 3 aggregate sources and 2 fillers, and one of these sections also used a grit that was applied after compaction. None of these test cells yielded acceptable initial friction.
>
> So MTO decided to explore the use of embedded grit, which had not initially found favour with the TG.
>
> In 2011, MERO targeted two CR contracts on the QEW in the Oakville Burlington area to try the embedded gritting technology. Both uncoated and coated grit were tried on the Aecon contract, but pick up and dust was encountered with the uncoated grit. MTO only used coated grit on the Dufferin contract. Both trials were constructed under change orders, and the gritting roller equipment was rented by the contractors from Dynapac.
>
> In 2012, MTO Contract 2012-3012, Hwy 6 Hanlon Expressway (8.7 km length) is being constructed using embedded coated grit. The project is 40% complete, This is the first full scale trial of SMA embedded coated grit. Coco Paving is the contractor.
>
> The QEW trials and Hwy 6 project have demonstrated that coated gritting of SMA during compaction is very feasible. Within about 6 to 8 weeks, the friction properties of the ungritted and gritted sections are about the same, and friction is no longer a concern. MTO will continue monitoring these sections for friction.

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[424] MTO0031437

[425] MTO0031437

[426] MTO0035920 attaching MTO0035921

> Embedded coated grit with about 1% AC has proven to be an effective method to significantly improve early age friction.
>
> Moving forward with additional contracts for 2013

346. On March 15, 2013, Mireya Hidalgo (Project Engineer, Development, Operations, Contract Management & Operations, Provincial Highways Management Division, MTO) emailed Mr. Marciello regarding concerns regarding friction during wet pavement conditions:

> Following my voice message, the head office / regional traffic office / OPP expressed some concerns with respect to friction concerns during wet conditions at the Highway 406 and QEW SW ramp. We have evidence of most collisions occurring during wet conditions and although we have records that the friction levels are adequate in dry conditions, would you know if the MERO equipment would be able to pick up recent friction levels of pavements during wet conditions?
>
> This ramp will be resurfaced in 2014; however it would be beneficial for us to have this information as we are hoping to add some traffic safety improvements at the ramp and it would be good to have this information available. [427]

347. On March 18, 2013, Mr. Marciello replied to Ms. Hidalgo's emails regarding wet condition friction concerns from March 15, 2013, which related to a particular ramp on Highway 406. He attached two spreadsheets with friction data, and wrote:

> This ramp was initially requested for wet friction survey by Central Region's geotechnical office in 2006 and 2011. Records in 2008 showed over 125 accidents on that ramp from 2000 and 2008. It was an SP12.5FC2 at that time.
>
> If you have a look at the data, trends and FN levels were similar for both lanes in both years.
>
> The large differences in friction show a drop in properties in 2 areas immediately after the QEW centreline. These differences may be what contribute to some accidents as speeding vehicles transition from the areas of high friction to the areas of much lower friction in wet pavement conditions. Side forces are acting on these vehicles trying to manoeuvre through the curve, possibly contributing to these events.[428]

[427] MTO0033347

[428] MTO0034890 attaching MTO0034891 and MTO0034892

348. On March 25, 2013, Jamie Stacey (Quality Assurance Engineer, Provincial Highways Management Division, MTO) emailed Ms. Marks, copying Mr. Virani, regarding the agenda for an upcoming meeting. Ms. Marks had previously requested that an update regarding SMA be added as an item to the agenda (to be presented by Mr. Virani). Jamie Stacey replied:

> Will do. Could the following also be updated in Anil's time.
>
> > Updated friction values for SMA trial projects. This is needed regionally for our decision-making as to which projects we might risk as demonstration projects for SMA.[429]

349. On March 27, 2013, Ms. Krol sent Mr. Bashir and Mr. Virani an email with the subject line "Hwy 6 - Gritted SMA - bar chart", attaching a document titled "AVG FN Data Summary_bar chart_Karolina".[430]

350. On March 27, 2013, Mr. Virani emailed Ms. Smith regarding SMA costs, writing:[431]

> Concerns regarding the premium for SMA are understandable, especially now that we have a gritting requirement to deal with early friction issues. The cost estimates are more suspect because at MTO there has not been recently the "critical mass" to reliably put a fair dollar value to the item. The decision to use or not use SMA is further compounded by the fact that the increase in life expectancy is theoretical – we started to use SMA around 2002 and suspended its use in 2007, so a full life cycle has not happened.
>
> Published literature [1] from the U.S. indicates a premium of about 20-25% for their SMA, and there is no gritting requirement included in this. My guesstimate is that the gritting may add a maximum of 5% to this, so I am estimating the SMA premium for a good size contract to be in the order of 30%. Of course if contractors have to gear up again with equipment to add fibre and an extra silo for fines, we may see a bit more.
>
> This is about the best I can contribute to this. I could be way off.
>
> Anil

[429] MTO0031459
[430] MTO0016435 attaching MTO0016436
[431] MTO0033123

> [1] Designing and Constructing SMA Mixtures – State-of-the-Practice, NAPA Quality Improvement Series 122

351. The April 4, 2013 joint Geotechnical Committee/Quality Assurance Committee meeting included updates on SMA and friction.[432] The meeting minutes noted:

> AV provided a presentation on the SMA update.
>
> Gritting was successful in providing increased initial friction. After the initial period the friction tends to come back to a level that is the same as ungritted SMA after the asphalt film has worn off.
>
> Status and future plans are contained in the attached slide deck.
>
> **Action Closed.**

352. The presentation attached to this item was titled "SMA Gritting Update Friction Data" and was prepared by Mr. Virani.[433] The presentation was dated in March 2013. It included several charts outlining friction results for gritted and ungritted pavement sections, as well as photographs of MTO gritting operations. The final slide noted the following:

> Status/Future Plans
>
> • Additional testing on QEW trials
>
> • WR contract is a carry-over
>
> • Continue measurements
>
> • CR: Same specification proposed for Hwy. 401
>
> contract
>
> • Reconvene TG to suggest we revert to "higher AC"
>
> spec

[432] MTO0008310 attaching MTO0008311

[433] The attachment is not part of the family of documents in the Inquiry database. It can be accessed by opening MTO0008311 in native format and clicking on the link.

• Initial feedback not positive

353. On May 7, 2013, Ms. Lane emailed Ms. Marks and Mr. Virani, advising that "Dino is supportive of the SMA trial with original spec. His only request is that we discuss with Sandy before proceeding. I have attached the revised Info Note for your information."[434] The attached note, dated May 6, 2013, stated:

> **Issue/Question:**
>
> Central Region has requested that they be allowed to specify SMA mix according to the original SMA mix design requirements, on one of two currently advertised contracts on Highway 401. The original specifications required higher asphalt cement (AC) content to enhance mix durability.
>
> While MERO is supportive of a return to the original SMA mix designs, there is a concern that there is not sufficient time to carry out full consultation with industry.
>
> **Recommendation:**
>
> **The ministry should proceed with issuing an addendum to one of the advertised contracts, requiring that SMA be designed in accordance with the original SMA specification. Gritting of the SMA has been demonstrated to improve the early friction properties of SMA, and would continue to be specified.**
>
> **Both the Ontario Road Builders Association (ORBA) and the MTO-Industry Task Group formed to deal with the SMA early friction issue should be advised of this trial, however given that the Central Region contracts are already advertised, there would not be enough time for meetings and discussion.**

354. On May 15, 2013, Mr. Virani presented an update regarding SMA gritting to the SMA Task Group.[435] On May 16, 2013, Mr. Bashir emailed Mr. Raymond and provided a summary of the discussion from the May 15, 2013 meeting.[436] He wrote:

> Here is the summary of what was agreed in MTO/SMA Industry Task Group meeting held at ORBA Boardroom on May 15, 2013. The meeting was attended by Sandy Brown, Kevin Martin, Tom Dziedziejko, Anil Virani, Pamela Marks and myself.
>
> The SMA task group was updated on friction data for SMA gritting trials and also some friction data from Highway 6 job was presented. For the Highway 6 project, about 40

[434] MTO0031512 attaching MTO0031513
[435] MTO0000204
[436] MTO0014691

> percent of SMA with gritting was completed and rest of the SMA paving with gritting will be done this year.
>
> In Central Region, the following two contracts are going for SMA with gritting and closing date is June 5, 2013.
>
> • 2013-2014 Hwy.401 EB Collector from Dufferin Street to Avenue Road
>
> • 2013-2015 Hwy. 401 EB and WB Express and Collector lanes from Renforth Drive to Hwy. 410
>
> It was agreed by the Task Group to revert back to the **original SMA specification with gritting** as per OPSS 1151 dated 2007 and the following minor deviations from the original spec were also agreed by the task group.
>
> 5. Reverting back to original AC content as per Table 1 of OPSS 1151 2007 (0.3% increase in AC content from the revised spec)
>
> 6. VMA requirement to return to original i.e., minimum of 17% (16.5 to 18% revised spec)
>
> 7. Dust content (passing 0.075 mm sieve) 7-11% (original spec 8-11% for SMA 12.5 mm)
>
> 8. Cellulose fibre dosage a range of 0.3 to 0.4 % (original spec 0.3%)
>
> It was agreed that SMA original spec with the above mentioned changes will be utilized on both of these CR contracts and an NSSP will be issued as an addendum for these two contracts. The findings (friction data) from these two SMA with gritting projects will be presented to the SMA task group in future.
>
> Hopefully this is sufficient for your immediate needs.

355. Mr. Raymond replied, making minor changes to Mr. Bashir's email.[437] Mr. Virani commented on Mr. Bashir's email on May 17, 2013, writing to Mr. Raymond (cc'ing Mr. Bashir):[438]

> This is a good summary of what was discussed as far as the CR contracts go. Kevin asked if we would consider allowing RAP in SMA, and Sandy was quite informative in that he emphasized how much more control of gradation was required for SMA, and what would have to be done to the RAP to make it happen successfully. We did not pursue this too much, but if a contractor wants to put in a change proposal, we may entertain it.
>
> As discussed with you after the meeting, OHMPA would like to be part of any "Friction TG" that the ministry may have to discuss, among other things:
>
> - the appropriateness of the speed at which friction is measured

[437] MTO0014691

[438] MTO0014692

- other devices that could be used (grip tester)

- whether early life friction should be measured for SMA (Sandy thinks not – we disagreed)

All in all, I think we accomplished what we were after and now can give CR the modified SP for the 2 contracts

356. On May 28, 2013, Robert Vandenberg (Project Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO) emailed Ms. Hidalgo, attaching a PowerPoint titled "Friction Numbers".[439] Mr. Vandenberg wrote:

As Seyed promised I've attached a few slides showing that SP 12.5 FC2 provides the most consistently high friction numbers compared to open graded, gap graded, and SMA mixes.

Additionally, I've been told that Rob Kohlberger has spoken with Bob Gorman of Soils & Aggregates regarding friction results for Dolomitic Sandstone aggregates.

357. The attached presentation included various charts with friction numbers for Highway 405, Highway 115 and the QEW, and included the following notes referencing SMA:[440]

[Hwy 405]

- Very consistent results for SP 12.5 FC2
- Inconsistent results for OFC, ROFC, and SMA
- Low early age friction for OFC, ROFC, and SMA

[QEW]

- High early age friction numbers for Gritted SMA
- After 3 months friction numbers similar for Non-Gritted and Gritted SMA

358. A presentation by Ms. Marks given on June 3, 2013 (though dated March 7, 2013), stated regarding SMA use going forward:

[439] MTO0035976 attaching MTO0035977

[440] MTO0035977 at images 1 and 3

- A temporary pause was placed on use of SMA due to concerns with early age friction
- Investigation resulted in construction of several test sections
- Based on trials to date, a grit coated with asphalt cement (1%), embedded on the SMA surface has proven to be an effective method to significantly improve early age friction
- MTO will continue monitoring these sections
- Moving forward with additional contracts for 2013[441]

359. The minutes of the ORBA / MTO Hot Mix Technical Committee meeting on October 28, 2013 noted the following with respect to SMA:

> Two contracts with SMA were awarded in 2013. One large contract had some minor issues noted during paving including consistency of gritting and tracking of tack coat reducing effectiveness of grit. Initial Skid numbers are good. The second contract will not be paved until 2014. There are no new SMA contracts currently identified for 2014. Post Meeting Note: While MTO is not aware of any new contracts for 2014, MTO is continuing to seek suitable SMA projects. [442]

360. The MTO Geotechnical Committee met on December 18, 2013.[443] The meeting minutes noted the following with respect to SMA and the lifting of the pause on its use:

> SMA
>
> Pause was lifted after positive results of gritting trials; gritting is now standard SMA procedure. One SMA job in West Region Hwy 6 Guelph this year – adjacent job planned for next year. ER has been advancing use on 401 Expansion through Port Hope. (Post Meeting Note – planned Tender Award Oct 2014; 195 Working Days… SMA to be placed either 2015/2016). Geocom does not endorse initiatives that would trend towards less AC in SMA.
>
> Revisit LCC assumptions considering performance of SMA on ministry projects to date; not clear whether making projections of 30% more life on either new construction or rehab. Putnam to Dorchester in West Region offered as an example where SMA rehab is tracking towards 13 or 14 years. Geocom agrees worthwhile to revisit LCC assumptions for SMA.
>
> **Action: Advance candidates for SMA as appropriate.**
>
> **Action: Compile SMA Performance to Date on Ministry Projects**

[441] MTO0037156 at image 5, attached to MTO0037155
[442] MTO0037246 at image 3, attached to MTO0037245
[443] MTO0008865 at image 5, attached to MTO0008864

(a) 2014

361. By January 2014, the number of DSM aggregate sources had increased to twenty-nine for SP12.5 FC2 (including Demix Agrégats, Varennes Quarry), and twenty-one for SP12.5 FC1.[444]

362. On January 9, 2014, Ms. Marks emailed Mr. Virani, asking whether they could prepare "a list of contracts SMA has been placed on" for Warren Lee (Pavement Design Engineer, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division, MTO).[445]

363. On January 13, 2014, Mr. Marciello emailed Mr. Warren Lee with the subject line "List of sections that have been friction surveyed". Attached to the email was a document titled "SMA List" appearing to list all SMA road segments the MTO had friction tested (including the RHVP).[446]

364. On January 17, 2014, Mr. Gorman circulated an updated DSM list of aggregate sources and a map, showing 29 skid-resistant aggregate sources for SP12.5FC2, and 21 for SP12.5FC1.[447]

365. On March 6, 2014, Mr. English emailed Mr. Lee, Mr. Blair, Mr. Senior, and Mr. Raymond, attaching notes from a meeting with ORBA on March 4, 2014.[448] The slide deck for the meeting was titled "MTO Network Friction Analysis", and included slides

[444] MTO0036643 attached to MTO0036642
[445] MTO0037249
[446] MTO0017550 attaching MTO0017551
[447] MTO0022877 attaching MTO0022878
[448] MTO0014810

comparing friction numbers and age of the pavement, compared by surface type, including SMA.[449]

366. On March 10, 2014, Ms. Bennett circulated draft meeting minutes from a Geotechnical Committee meeting on February 26, 2014.[450] The following was noted regarding SMA (the minutes note Mr. Lee was the proponent):

> 2013 SMA Results
>
> - Circulate or post to SharePoint
> - Based on generally good performance of SMA mixes in the Regions there is agreement that the ban on use of SMA should be lifted and the information related to senior management
> - Bituminous Section to prepare information update for HST and OMT
> - HIIFP– List of approved projects distributed to members
> - Longitudinal Joint Specification– there are both performance and method based specifications that cover joint requirements In order to get a sense of what versions of the specification are being used, Geotechnical Heads are requested to forward their versions to PM

367. On March 26, 2014, Mr. Blair emailed Mr. Gorman regarding updates to the DSM.[451] He wrote:

> As you know, each time a different lithology is added to the DSM, we have to update Table 3 (i.e. physical properties of the Superpave coarse aggregates) in OPSS.PROV 1003 to accommodate these changes.
>
> So, as we agreed, it's probably more efficient to modify the DSM to include Categories such as (G) for gravel, (D) for dolomitic Sandstone, (T) for traprock, diabase, andesite & quartzite and (M) for meta-arkose, metagabbro, gneiss & granite etc. Carole Anne you may wish to comment on the best letter designations to use for this?
>
> I'm asking if you could please modify the DSM to include the designations that you and Carole Anne think would be the most appropriate and also include the appropriate note.
>
> I'm thinking that you could probably input the letter designations beside each lithology in the "Product Name" column. As an example, "Red granite (M) from Mississauga Landing Quarry" or "Dolomitic Sandstone (D) from Ottawa quarry".

[449] MTO0014811 at images 5 and 13, attached to MTO0014810
[450] MTO0008993 attaching MTO0008994
[451] MTO0009005

> The note could be added under "NOTES" (or in the "Product Name" cell). If you do it under "NOTES", it could read something like "Letter designations shown in brackets beside each lithology in the "Product Name" column are used to specify physical property requirements for specific aggregate types - see Table 3 of OPSS.PROV 1003 and SSP 110S12."

368. One of the attachments, "AMENDMENT TO OPSS 1003, NOVEMBER 2004Special Provision No. 110S12April 2014" included a table outlining acceptable aggregate sources for SMA.[452] Those sources were:

Table 1
SMA Surface Courses - Coarse and Fine Aggregate Sources

Source Name	Inventory Number	Owner
Methuen Township Quarry	B02-071	MRT Aggregate Incorporated
Brockville Quarry	B15-039	Lafarge Canada Incorporated
Rosewarne Quarry	B17-013	Fowler Construction Company Limited
Bruce Mines Quarry	B22-072	Ontario Trap Rock – Bruce Mines Limited
Havelock Quarry	C01-054	Drain Brothers Excavating Limited
Marmora Quarry	C01-058	Aecon Construction and Materials Limited
Rideau Road Quarry	O05-067	R.W. Tomlinson Limited
Boyce Quarry	O05-070	Dibblee Paving and Materials Limited
Ottawa Quarry	O05-072	Aecon Construction and Materials Limited
Hawthorne Quarry	O05-155	Lafarge Canada Incorporated

369. The meeting minutes from the Geotechnical Committee held on April 30, 2014 stated the following regarding SMA and the lifting of the pause:

> SMA ban lift – requires HST endorsement – Refer to Item 6 Bituminous Update
>
> ***
>
> SMA
>
> - Each Section Head to discuss removal of SMA ban with their respective Mgr's of Engineering

[452] MTO0009007

- Surface Course directive will need to be updated, including new maps and incorporation of AB criteria, and revisions presented to HSTAV to prepare presentation to HST on changes; P&F will provide revised surface course maps[453]

370. On June 24, 2014, Ms. Marks sent Ms. Lane a presentation for HST titled "SMA Reinstatement", writing:[454]

> Becca, attached is the long awaited presentation for HST on lifting the pause on the use of SMA. Are you okay with me forwarding it on for Neil to put on their agenda or did you want to forward it?

371. On October 20, 2014, Ms. Marks circulated a memorandum and gritting specifications related to the lifting of the SMA pause.[455] She wrote in her email:

> Attached is a memo regarding the reinstated Stone Mastic Asphalt (SMA) for use as a premium surface mix and the NSSP requiring gritting of the SMA that must be used with the item.

372. The attached memorandum stated:

> Based on the successful completion and assessment of the Stone Mastic Asphalt (SMA) gritting trials and the full scale SMA paving contacts with gritting, the pause on the use of SMA as premium surface course mix has been lifted. The Geotechnical Committee, Quality Assurance Committee, and Highway Standards Management Team (HST) have endorsed the re-instatement of Stone Mastic Asphalt (SMA) as premium surface course mix.
>
> All SMA placed requires the application of a hot grit coated with asphalt cement (about 1 %) during mix placement. The enclosed NSSP for the grit application is to be included in all contracts specifying SMA mixtures. The NSSP is not yet posted in CPS.
>
> SMA is to be used where traffic levels warrant its use according to the current SurfaceCourse Directive, although other surface mixes should be considered if the mix is for temporary detours. Note that an updated Surface Course Directive is expected this fall or winter.[456]

373. On October 29, 2014, Ms. Marks forwarded the memorandum and gritting specifications to Mr. Smith.[457] Mr. Smith replied the same day, writing:

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[453] MTO0009049 at images 1 and 4, attached to MTO0009048
[454] MTO0031784 attaching MTO0031785
[455] MTO0009219 attaching MTO0009220 and MTO0009221
[456] MTO0009221
[457] MTO0037470

> Thanks Pam…. I'm going to hold off on removing the prohibition on the use of SMA with pavement performance specs until a friction performance measure is established. Not comfortable that we will get adequate friction for SMA without this performance measure, unless the prescriptive gritting requirement is included in the pavement performance specs (which may lead to warranty issues).

374. Ms. Marks replied "Agree".[458]

375. On October 31, 2014, Mr. Raymond emailed Geoff Wilkinson (Executive Director/Chief Operating Officer, ORBA) regarding the lifting of the SMA pause:

> Please be advised that after successful completion and assessment of Stone Mastic Asphalt (SMA) gritting trials and full scale SMA paving contacts with gritting, the ministry has removed its pause on the use of SMA.
>
> SMA requires the application of a hot grit coated with asphalt cement (about 1%) during mix placement. The attached Non Standard Special Provision for the grit application accompanies all contracts specifying SMA mixtures.
>
> SMA is used on high traffic applications in accordance with the ministry's Surface Course Directive. [459]

376. On December 12, 2014, the MTO's Surface Course Directive was revised to reinstate the use of SMA.[460]

(b) 2015

377. On February 5, 2015, Mr. Bashir sent an email to Geotechnical heads, stating:

> To All Heads of Geotech:
>
> This is to inform you that Head Office NSSP BITU0007 has been implemented in CPS for use with NSTI 9999-9059 Gritting of Stone Mastic Asphalt effective February 3, 2015. This NSSP is required for SMA tender items. [461]

378. On April 17, 2015, Anne Holt (Senior Bituminous Engineer, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial

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[458] MTO0037470
[459] MTO0027603
[460] MTO0000055
[461] MTO0017797

Highways Management Division, MTO) emailed all Bituminous Referee Lab Project Managers, writing: “Please be advised that for contracts tendered in 2015, most will involve the new special provisions SP103F1 and SP111F11, which replace OPS 313 and 1151 in their entirety.”[462]

379. On May 6, 2015, Ms. Marks sent an email to George Vayali (Bridges and Structures, Transportation Infrastructure, City of Calgary), attaching (among other things) a presentation titled “MTO vs Municipal Specifications”.[463] She wrote:

> Attached are some copies of the SPs we discussed and a presentation that highlights high level differences between the provincial and municipal hot mix specs. John Blair in the Soils and Aggregates Section is the person to contact for more information on the aggregate specifications.

380. In December 23, 2015, the MTO considered the protocol for adding SMA sources to the DSM.[464]

381. In the June 2016 version of the DSM, eleven sources were included for use in SMA 9.5 and SMA 12.5:

(a) Aecon Construction and Materials Limited, Ottawa Quarry (O05-072)
(b) Aecon Construction and Materials Limited, Marmora (C01-058)
(c) Danford Construction Ltd, Tweed (K01-106)
(d) Drain Bros. Excavating Ltd, Havelock (C01-054)
(e) Fowler Construction Company Ltd., Rosewarne (B17-013)
(f) Lafarge Canada Inc, East'n Cdn Aggr, Brockville (B15-039)
(g) Lafarge Construction, Boyce (O05-070)
(h) Lafarge Construction, Hawthorne (O05-155)
(i) MRT Aggregate Inc., Methuen (B02-071)
(j) Ontario Trap Rock, Bruce Mines (B22-072)
(k) R.W. Tomlinson, Rideau Rd (O05-067) [465]

[462] MTO0036549 attaching MTO0036550
[463] MTO0018193 attaching MTO0018198
[464] MTO0018027 attaching MTO0018028
[465] MTO0017922 attached to MTO0017920

382. In September 2016, SP110S12 was revised to remove the list of specified SMA aggregate sources and to instead include the following (referring to the DSM where permitted SMA aggregate sources now resided):

> For SMA surface courses, both the coarse and fine aggregates shall be produced from crushed bedrock supplied from sources shown in DSM #3.05.25. Both the coarse and fine aggregates shall be obtained from the same source except where aggregate is derived from RST.[466]

383. On December 1, 2016, Ms. Marks delivered a slideshow presentation to OHMPA titled "Update on Stone Mastic Asphalt" summarizing the history of SMA, the concerns about it, the MTO pause and SMA Task Group, the trials, the reinstatement, and the specifications going forward.[467]

3. 2012-2013: Municipal requests for friction testing

(a) City of Kingston, 2012

384. On October 16, 2012, Mr. Freure emailed Mr. Marciello:[468]

> Just got a call from a Matthew Scanlan at Genivar here in Kingston enquiring about how to get Friction Testing done on a municipal road. I didn't think that we normally get into lending our equipment out, but I'm also not aware of any private firms that do that testing. Do you have any thoughts on any firms that might do that sort of work?

385. On October 17, 2012, Mr. Pinder of the MTO received an email from Mark Campbell (Construction Manager, City of Kingston), requesting MTO assistance with friction testing:

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[466] MTO0036977 at image 3, attached to MTO0036972
[467] MTO0038028 attached to MTO0038027
[468] MTO0033338

> As discussed, we have flushing on the recently placed asphalt on Bath Rd between Queen Mary and Centennail. The contractor has agreed to replace it but we would like to have this work completed next year to ensure we have suitable weather conditions.
>
> We are concerned with the loss of friction and were wondering if the MTO's skid trailer would be available to assist in determining skid resistance. This would assist in us determining appropriate remedial options.
>
> Given the time of year we are in a time crunch and would most likely need to have this work completed by October 26th. I am aware that this is a very tight timeline but we did not believe there was any harm in asking.
>
> Thanks for the email on Superpave - I will most likely find time to speak with you further about this.
>
> On a separate issue were you able to find anything with respect to the water blasting. [469]

386. After passing on the request to Mr. Marciello, he conducted the Kingston-requested friction testing on October 22, 2012. On October 24, 2012, Mr. Marciello emailed Mr. Pinder, Mr. Freure, Frank Vanderlaan (Head, Geotechnical, Eastern Region, Provincial Highways Management Division, MTO), Ms. Bennett and Mr. Dundas, attaching the Kingston friction testing results.[470] Regarding the testing, he wrote:

> The HL1, placed by Genivar, on Bath Road between Centennial Dr and Queen Mary Rd in Kingston, was friction tested on Oct 22. Attached below are the .pdf files showing friction levels on all 4 lanes, in detailed and graphical formats.
>
> Testing conformed to ASTM E274 and ASTM E501, occurred during simulated wet pavement conditions at the posted speed limit of 60km/h.
>
> Typically, premium pavements will produce high frictional values at highway speeds. Due to some flushing, early pavement life assessment shows a few areas which produced low frictional properties in the westbound lanes and in the eastbound lane 1. Westbound lane 2 was the most consistent.
>
> Please review and forward to Mark Campbell of the City of Kingston
>
> There was also a friction survey conducted on the 4 lanes of the micro-surface on Taylor-Kidd Blvd, placed this past summer. I will process and FW that data soon.

[469] MTO0017426

[470] MTO0017426 attaching MTO0017427, MTO0017428, MTO0017429, MTO0017430, MTO0017431, MTO0017432, MTO0017433 and MTO0017434

387. Mr. Pinder replied the same day:[471]

> Thanks Frank. I reviewed and sent the reports. I'm surprised the numbers are as high as they are considering the visual appearance. Were you able to run through the intersections, where the flushing is worst? Also, from your experience, what would happen to the results if tested at 80 km per hour?

388. Mr. Marciello responded the following day:[472]

> Intersections that were of concern were covered in the survey.
>
> Depending on the mix, friction numbers would decline at the rate of 1 to 2.5 FN for every 10km/h change in speed. Could possibly be a higher decline when flushing is prevalent. That would roughly be a 2 to 5 FN decline in friction.
>
> Curious to see what the values look like in Summer / Fall 2013

(b) Region of York, 2013

389. On July 24, 2013, Madison Kennedy (Geotechnical Co-op Student, Golder) emailed Mr. Lee on behalf of Vimy Henderson (Pavement and Materials Engineer, Golder), requesting "a small amount of friction testing required in the Region of York, as was discussed last week".[473]

390. Mr. Lee forwarded the request to Mr. Marciello to coordinate the testing with Golder (which was "engaged by Region of York for overall engineering of the intersection"). Mr. Marciello replied on July 26, 2013, that "normally, municipal requests are considered a last priority", but that he may be able to accommodate the request the following week, and asked "Is there an issue with accidents?" Mr. Lee replied the same day: "[y]es I believe accident rate is high is why friction testing assistance requested".[474]

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[471] MTO0034779 (the email by which Mr. Pinder sent the results to the City of Kingston is not in the Inquiry database)
[472] MTO0034779
[473] MTO0017520
[474] MTO0017520

391. Mr. Marciello conducted the Region of York friction testing on July 29, 2013, and emailed the results to Golder (Dr. Henderson and Ms. Kennedy) on August 1, 2013.[475] Mr. Marciello reported:

> Both lanes at York Region's Bathurst St and Green Lane West intersection were friction surveyed last Monday. Testing was possible, with no traffic protection, due to the low traffic volumes. Various speeds were used to simulate the regular traffic flow. ASTM E274 and ASTM E501 were used to collect friction numbers during simulated wet pavement conditions.
>
> The northbound to eastbound directions included a right turn ramp. Data was collected prior to and a good distance after the end of the ramp. Speeds ranged from 38km/h (ramp) to over 80km/h. Friction in the mid 20's occurred prior to ramp entry and improved throughout the ramp, tested at lower speeds.
>
> The westbound to southbound directions included a left turn configuration. Data was again collected prior to the start of the left turn lane and a good distance after the left turn was completed. Most Friction Numbers prior to the intersection were found to be in the 20's, including the left turn lane. Friction improved in the southbound direction.
>
> If any questions arise, please do not hesitate to call this office

PART II. MTO CONSIDERATION OF FRICTION NUMBER STANDARDS OR SPECIFICTIONS

392. From as early as 2005 through to 2015, the MTO considered various approaches to the use of and development of a friction number value as a performance requirement and/or a repair requirement in its pavement contracts, in addition to or in lieu of the use of pre-approved aggregate sources from the DSM.

[475] MTO0017520 attaching MTO0017521 and MTO0017522

A. Initial Development and Use of Performance Requirements - 2006 to 2009

393. In 2006, the MTO required a surface friction skid number "that exceeded SN = 30" at the posted speed as a seven-year unconditional warranty for certain pavements contracts on low-volume roadways.[476]

394. The requirement in paving contracts of a 7-year warranty requiring FN = 30 was presented at the OHMPA/MTO Senior Managers Meeting on September 26, 2006.[477] In an email to Mr. Tam, Mr. Chaput, Mr. Todd, and Mr. Cautillo on September 20, 2006 in advance of the OHMPA/MTO Senior Managers Meeting, Mr. Kazmierowski described 7-year warranty projects as follows:

> o How will skid resistance be treated in 7-year warranty contracts?
>
> The 7-year pavement warranty projects require that contractors design the pavement and select all the materials to be used in the pavement structure. Contractors are not required to use MTO material specifications. Since the contractor is responsible for pavement design, materials selection and construction, performance requirements were developed to address issues of ride (roughness), rutting, and distresses during the 7-year warranty period. In addition, a performance requirement for friction was selected because of the short-term nature of the warranty. Since the warranty only covers the first 7 years of the pavement life, a performance requirement of >FN 30 at the posted speed was implemented. If the pavement friction decreased to FN 30 or less over this short time frame, it would certainly be an indication of a pavement friction problem occurring during the 15-18 years expected life.
>
> o Why not in LCC equations too?
>
> The MTO LCC model is for high traffic volume freeways (1 M ESALs >), which may be premium hot mix or concrete. According to MTO policy, high volume HMA pavements require the use of skid resistant aggregates. MTO has taken a proactive approach to skid resistance, where aggregates in premium surface course mixes are selected to ensure good friction resistance over the life of the pavement. The aggregates are tested in the laboratory (PSV, AAV) and in the field (500 m test section on high volume facility) to ensure high friction values. Aggregates meeting MTO requirements are put on the DSM. Selecting

[476] MTO0028305 at image 41; MTO0020010 at image 13; MTO0028351 at image 15; MTO0028722 at image 15; MTO0028723; and MTO0028724

[477] MTO0028908 attaching MTO0028909 at image 2

> high quality, skid resistant aggregate for the surface course means that annual friction testing is unnecessary and certainly not cost-effective.[478]

395. From 2008 to 2015, the MTO developed three types of performance contracts: Type A (Minimum Oversight), Type B (Resurfacing), and Type C (7-year Warranties). These categories were described in an April 2009 document reproduced in its entirely immediately below (it is important to note, however, that while the categories were fixed over time, the "Friction Number during the Warranty Period" column in the document below was a proposal at that point in time).[479]

April 2, 2009

Project Selection Guideline for Performance Contract Trials

Performance Contract Type	Typical Project Description (Selection of Contract Type for a particular project is at the Region's discretion)	Materials and Mix Type	Friction Number during the Warranty Period
Type A (Low Risk, Low Complexity, Low Value) (also Known as MinO)	• HM Patch(s), Single Overlay, or mill one lift, pave one lift • Typically less than $1 M • Small quantity; multiple short length patches, several long patches up to 1 kilometre in length, or combination of short and long lengths • Non Freeways • Expected service life of up to approximately 5 years (Service life is time to rehabilitation or reconstruction)	• Ministry does not specify HMA mix type. • Contractor selects the aggregate sources • Ministry specifies prohibited aggregates	Shall Exceed 30 (3 year warranty)

Type B
 	
(Selective Resurfacing)
	• Single Overlay or mill one lift, pave one lift, but may apply to 2 lifts
	• Typically less than $3 M
	• Large quantities, longer section lengths, up to 5 km
	• All Highways and Freeways
	• Expected service life of up to 10 years (Service life is time to rehabilitation or construction)
	• May include padding and cross-fall correction.
		• Contractor selects the aggregate sources, except
		  • if the AADT is greater than 2500 per lane then the ministry specifies that the coarse aggregates shall only be supplied from sources named on the MTO DSM 3.05.25.
		  • if the AADT is greater than 5000 per lane then the ministry specifies that the coarse and fine aggregate shall only be supplied from sources named on the MTO DSM 3.05.25.
		• Ministry specifies prohibited aggregates and aggregate constraints based on traffic volumes
		
		• For further trial purposes on 40% of the Type B contracts
		  • HMA mix type is specified as shown in the specification or better in accordance with MTO surface course Directive PLNG-C-003, and
		  • Gradation requirements are specified by the ministry for HMA in surface courses.
			Shall Exceed 30
			(for highways with < 2500 AADT/ lane)
			
			Shall Exceed 35
			(for highways with 2500 to 5000 AADT/ lane)
			
			Shall Exceed 40
			(for highways with > 5000 AADT/ lane)
			
			(3 year warranty)

Type C (also known as 7 year Warranty)	• Reconstruction or rehabilitation of existing HMA pavements • Expected service life of up to 20 years. • 2 lane and 4 lane highways with less than 5000 AADT/design lane or less than 1M ESAL's/lane/year • Uniform pavement performance without extensive problematic soils/swamp conditions left untreated • May include other work: bridge rehab, culvert replacements, intersection improvements, but no new truck climbing or passing lanes	• HMA mix type is specified as shown in the specification or better in accordance with MTO surface course Directive PLNG-C-003. • Coarse Aggregates for Superpave 12.5FC1, and coarse and fine aggregates for Superpave 12.5FC2, shall only be supplied from sources named on the MTO DSM list. • Ministry specifies prohibited aggregates and aggregate constraints based on traffic volumes • Gradation requirements are specified by the ministry for HMA in surface courses.	Shall Exceed 30 (for highways with < 2500 AADT/ lane) Shall Exceed 35 (for highways with 2500 to 5000 AADT/ lane) Shall Exceed 40 (for highways with > 5000 AADT/ lane) (7 year warranty)

[478] MTO0015273

[479] MTO0025392

396. In 2008, drafts of the 7-year pavement warranty specifications and Minimum Oversight Contract specifications circulated internally at the MTO included a surface friction number exceeding FN = 30 at posted speed.[480]

397. From 2008, MTO staff responsible for the development of specifications for Minimum Oversight and 7-year Warranty contracts sought information and input from MTO staff in the Geotechnical department regarding a friction performance requirement for use in these specifications. In April 2008, Mr. Rogers and Mr. Raymond advised Mr. Todd (who was involved in warranty development) and Mr. Taylor (involved in development of Minimum Oversight contracts) that the MTO could not complete an assessment of current friction levels because it did not conduct network level friction testing, and noted:

> As you know the ministry ensures pavement friction through a combination of our materials specifications, DSM, and Surface Course Directive, which have evolved through 20+ years of development, monitoring, and experience. The development of performance measures for friction to replace our existing requirements would have a significant impact on safety and should only be done if supported with considerable research, analysis and discussion to resolve critical issues …[481]

398. The Geotechnical Committee ultimately recommended to the HST that the friction performance requirement be deleted in its entirety,[482] although early drafts of the memorandum and discussions about the memorandum considered the following recommendations: a friction number that "exceeded FN = 40?"[483], or the use of a

[480] MTO0024947 at image 21; and MTO0024977

[481] MTO0011255 attaching MTO0011256. See also a similar response focusing on the DSM regarding a performance-based contract in York Region from Ms. Lane and Mr. Billings, after which Mr. Chaput provided a friction number of 35 for use in that contract: MTO0021010

[482] MTO0004806 attaching MTO0004807

[483] MTO0004794 attaching MTO0004796

minimum average friction value of 42 and no single spot friction value less than 37 or 38 at the end of the 3 year warranty.[484] In its January 5, 2009, memorandum entitled "Aggregate Quality/Pavement Skid Resistance Minimum Oversight Performance Specifications", the Geotechnical Committee stated:

> The Geotechnical Committee supports the development of performance specifications as an integral component of the smart sourcing initiative, and indeed, considers performance specifications an effective means for delivering pavement preservation treatments. The Committee has had discussions regarding the new minimum oversight specifications, particularly related to the risk associated with pavement friction, the performance criteria, and appropriate project selection.
>
> For Hot Mix Asphalt (HMA) pavements, the majority of transportation agencies enforce surface course aggregate quality at the outset ie. at the time of material production. This is due to the importance of providing superior pavement friction throughout the service life of the pavement surface, and the practical difficulties of in-service friction testing. In Ontario, aggregates that meet minimum frictional properties are identified through detailed investigations and field trials. Deviations from MTO aggregate quality requirements have resulted in known incidences of high collision rates (eg. Highway 401 Windsor, Highway 403 Hamilton). The relevance of pavement friction to highway safety cannot be understated.
>
> In-service pavement friction (FN) values for HMA pavements typically range from 35 to 50, and pavements with FN below 30 are subject to monitoring and remedial action if necessary. The in-service FN is a function of many factors, but primarily aggregate quality, traffic speed, and traffic volume. Contractors are not knowledgeable of the relationship between FN, aggregate quality, and traffic volume/composition, increasing the risk of an unfavourable outcome.
>
> It is understood that the performance specification Hot Mix Asphalt, Surface Course is intended for pavement holding strategy treatments (ie. selective resurfacing). Holding strategies are intended to carry the pavement condition for a period of 3-5+ years, prior to implementation of the preferred rehabilitation strategy. However, it is commonly the case that holding strategy treatments are in-service for 10 years or more. As a result, in the Committee's opinion, the pavement friction requirements of minimum oversight performance specifications should be based on an anticipated service life of ~10 years.
>
> The industry response to the new specification is uncertain. There is a potential for the use of inappropriate materials on high speed, high volume facilities such as Highway 401, particularly given the poor or non-existent local availability of appropriate aggregates, with respect to pavement frictional and durability, along most of the Highway 401 corridor.
>
> There is only one ASTM E 274 skid testing trailer currently available in Ontario. The single MTO trailer is already in heavy demand in response to MTO regional testing requests. The efficiency of in-service friction testing of localized holding strategy treatments is questionable. The cost of carrying out pavement friction testing, monitoring performance,

[484] MTO0019045 attaching MTO0019046

and enforcing warranty requirements, for localized holding strategy treatments will, in many cases eliminate any savings from reduced contract oversight.

In consideration of the above issues, the Performance Requirement – Hot Mix Asphalt, Surface Course dated May 2, 2008 has been reviewed and the following is proposed:

Revise 2202.05, Project Specific Requirements, to read:

For Pavements with AADT less than 2500 per lane. The use of carbonate aggregate, such as limestone and dolostone, in the hot mix asphalt coarse aggregate is prohibited. Up to 20% by mass reclaimed asphalt pavement (RAP) is permitted in the hot mix asphalt.

For Pavements with AADT less than 2500 per lane, and hot mix surface courses less than 35 mm thick. The use of carbonate aggregate, such as limestone and dolostone, in the hot mix asphalt coarse and fine aggregate is prohibited. Up to 20% by mass reclaimed asphalt pavement (RAP) is permitted in the hot mix asphalt.

For Pavements with AADT greater than 2500 per lane. The use of carbonate aggregate, such as limestone and dolostone, in the hot mix asphalt fine aggregate is prohibited. The coarse aggregate for the hot mix asphalt shall only be supplied from sources named on the MTO Designated Sources for Materials (DSM) list. The use of reclaimed asphalt pavement (RAP) in the hot mix asphalt is prohibited.

For Pavements with AADT greater than 5000 per lane. Both the coarse and fine aggregate for the hot mix asphalt shall only be supplied from sources named on the MTO Designated Sources for Materials (DSM) list. The use of reclaimed asphalt pavement (RAP) in the hot mix asphalt is prohibited.

Revise 2202.07.01.01, by deletion of the Surface Course Friction requirements.

In conjunction with the above revisions to 2202.05, the References section of the specification must include "MTO Designated Sources for Materials List", and the Definitions section must include the definitions for coarse and fine aggregate and reclaimed asphalt pavement. These definitions may be obtained from SP 110F12.[485]

399. The accompanying Decision Note stated:

Amendment is proposed in order to specify what is considered to be a minimum level of assurance of adequate pavement friction, in the Geotechnical Committee's opinion.[486]

400. On January 23, 2009, members of the Geotechnical Committee, the Contract Management Office, and the Contract Innovations Office met to discuss the Geotechnical

[485] MTO0019061 attaching MTO0019062 and MTO0019063 (Decision Note entitled "Minimum Oversight Specifications – Geotechnical Recommendations for presentation at HST [Highway Standards Team]).
[486] MTO0019061 attaching MTO0019062 and MTO0019063.

Committee's concerns with the current Minimum Oversight specification. In respect of friction, the minutes of this meeting stated:

> GeoCom disagreed with using a Friction Number (FN) as a performance specification and suggested manipulating wording in specification that ensures the MTO receives an aggregate that meets or is equivalent to the quality of aggregate in an approved DSM source.
>
> The Contract Innovations Office remains of the position that the use of the Friction Number performance measure is appropriate, noting that the current FN could be revised if supported by historical information provided by MERO.
>
> The Contract Management Office led discussions on the fundamental principles of performance specifications and the basic concept that the owner does not specify the materials to be used under a performance specification.
>
> GeoCom agreed to review the specification and recommend wording that will reduce the risk of receiving a poor quality aggregate. [487]

401. In March 2009, after significant discussion within the Geotechnical Committee,[488] the Geotechnical Committee recommended the following:

> (a) Minimum Oversight specification:
>
> GeoCom/MERO recommends the use of an average target number plus a minimum. In addition, GeoCom/MERO proposes for Type A and C, to use a minimum of 30 with an average 35. For Type B, GeoCom/MERO proposes a minimum of 35 with an average of 40. CMOB [the Contract Management and Operations Branch] proposes to use only the minimum numbers proposed (which are the same as what was used in 2008).[489]
>
> (b) 7-year Warranty Specification Friction Requirements:
>
> The Warranty Steering Committee has reviewed the information provided by the P&F section and the following recommended thresholds were agreed to:
>
> - Minimum SN of 30 for highways with <2500 AADT/lane (corresponds to warrants for HL3, HL4, and Superpave 12.5 mixes)
> - Minimum SN of 35 for highways with 2500 AADT/lane to 5000 AADT/lane (corresponds to warrants for HL1 and Superpave 12.5 FC1 mixes)

[487] MTO0021151 at image 2
[488] MTO0021209; MTO0021215; MTO0021216; and MTO0019068
[489] MTO0012702 at image 3

- Minimum SN of 40 for highways with > 5000 AADT/lane (corresponds to warrants for DFC and Superpave 12.5 FC2 mixes)

> Subsequent discussion ensued regarding friction testing frequency and all members agreed that our current testing unit is incapable of performing the amount of testing being specified. Testing within the first two years of the service life is recommended and subsequent follow up testing at the end of the warranty is preferable. DS [Dale Smith] suggested that if the frequency of testing warrants, an additional friction testing unit and personnel may be required.[490]

402. In the spring of 2009, the MTO discussed with ORBA, OHMPA, and OSSGA (Ontario Stone, Sand & Gravel Association) the tendered Highway 400 Minimum Oversight contract that included a performance requirement of FN = 40.[491]

403. Thereafter, the MTO decided to reduce the friction number to 30 as an interim solution,[492] to consult with industry, to reconsider friction numbers for 2010 projects (including whether FN = 30 was a failure criteria or a performance requirement[493]), and to begin providing aggregate producers their friction data to allow them to become knowledgeable and lower the risk that is built into bid prices.[494]

B. MTO Consideration of a Friction Number Performance Requirement to Replace the DSM – 2009 to 2011

404. On January 19, 2010, Mr. Raymond emailed Mr. English, Darwyn Sproule (Head, Geotechnical Engineering Section, Eastern Region, Provincial Highways Management Division, MTO), Mr. Smith, and Mr. Kazmierowski in respect of his attendance at the Minimum Oversight meeting on January 14, 2010. He advised, among other things, that

[490] MTO0012529 at image 3
[491] MTO0030281 attaching MTO0030282; and MTO0019135 attaching MTO0019139
[492] MTO0019135 attaching MTO0019139; and MTO0027883
[493] MTO0014044
[494] MTO0019149

"Moving forward – CIO would like to replace the aggregate DSM requirements with performance requirements."[495]

405. Following a general discussion about friction at the February 23, 2010, meeting of the Geotechnical Committee, on February 26, 2010, Mr. Smith sent the following email to members of the Geotechnical Committee:

> To follow-up last week's meeting and specifically whether we should have a policy on action to be taken if the in-service friction drops below 30.
>
> With multiple contracts (likely 40-50 in total provincial wide by the end of this year) being tendered specifying a minimum friction value and requiring resurfacing if the value drops below 30, it would be difficult to tolerate an in-service value of below 30 without a supporting policy document. There is a real risk of serious personal and professional impact, for example if there is a coroner's inquest into a multiple fatality. In the mid-1990's there was an inquest into a multiple (6) fatality related to severe flushing on Hwy 11 near New Liskeard.
>
> IMO, we really need a friction policy document[496]

406. In response the same day, Dan Schutte (Head, Geotechnical Engineering Section, Northwestern Region, Provincial Highways Management Division, MTO) framed the issue as "Does the MTO wish to transition to a performance measure for pavement friction?" and noted:

> This is a difficult question to resolve as there are several pros, cons, risks, benefits and disbenefits. Perhaps GeoCom should prepare a short summary document/decision note, develop a recommendation, and ask HST, CIO, PHMT for direction. HST and PHMT may wish to pull in traffic and legal into the decision making process.
>
> As a backgrounder, GeoCom/MERO may need to develop some historical friction numbers. I was thinking that perhaps each region should be measuring friction on the superpave monitoring sections each year, or ever 2nd year to establish a reasonable regional or provincial target.[497]

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[495] MTO0025927 attaching MTO0025928

[496] MTO0038452. Sent to: Alkins, Andrew; Curtis, Calvin; Gilbert, Nick; Kazmierowski, Tom; Lane, Becca; Lee, Stephen; Marks, Pamela; Raymond, Chris; Schutte, Dan; Senior, Stephen; Skinner, Sonya; Smith, Dale; Sproule, Darwyn; VanAsseldonk, Kevin. All recipients were MTO employees.

[497] MTO0038452

407. Mr. Lee also responded that day, concurring with Mr. Schutte that the MTO was "transitioning into pavement friction performance by virtue of increasing number of warranty/performance contracts being called" and noted:

> Development of a policy on how to handle pavement with below target friction number (with historic regional information) in combination with the other contributing factors will provide for more consistent approach in addressing low friction number pavement and mitigate some of the legal exposures. [498]

408. Ms. Lane noted in a reply email on March 2, 2010, that "MERO has already sought legal advice on this issue and I would be happy to share the discussion at our next GeoCom meeting."[499] The minutes of the March 30, 2010 of the Geotechnical Committee state that Ms. Lane provided "some history on friction testing" and that there was "a discussion on the factors that were considered when picking a specific friction number to include in contract documents." The minutes also state:

> There was a discussion regarding the creation of a friction number policy/decision note and do we need to create one?
>
> Action: BL will create a recommendation memo for HST regarding GeoCom concerns with specifying a friction number.[500]

409. On May 11, 2010, Mr. Schutte emailed Mr. Sproule and others to recommend that the Geotechnical Committee prepare a memorandum in response to the Contract Innovations Office's revised draft Minimum Oversight performance requirements. In respect of friction, he stated:

> At our March 30, 2010, meeting with legal services, CIO and GeoCom; legal services expressed concerns with specifying a friction number. The memo should recommend that CIO obtain a legal opinion of the potential liability issues with specifying a friction number. Further to the CIO follow up with legal services on their concerns, CIO should process a PHM decision note on whether the ministry should proceed with contracts that

[498] MTO0038452
[499] MTO0038452
[500] MTO0022330 at image 3

> specify a performance standard for friction. Alternatively, the PERF specifications may wish to adopt a system with core material requirements that result in an appropriate friction level.[501]

410. In June and July, 2010, the MTO staff participated in meetings with the ORBA/MTO Hot Mix Technical Committee and attended the OHMPA/MTO Senior Managers Meeting. The MTO reported to ORBA and the OHMPA that the friction requirement of FN = 30 would continue to be in effect for Minimum Oversight and Pavement with Warranty contracts awarded in 2010,[502] and invited ORBA and OHMPA are invited to list the information about skid resistance that industry would like to have provided to "intelligently bid on these types of contracts".[503]

411. In the first quarter of 2011, the MTO prepared draft performance specifications ("PERFs") for Minimum Oversight and resurfacing projects (Contract Types A and B1 and 2). None of these specifications permitted the use of SMA (Type C contracts). All of the drafts included the following: "The surface friction number shall exceed FN = 30 at posted speed, as measured by the Owner using a brakeforce trailer conforming to ASTM E-274 and E-501."[504] The Geotechnical Committee and the Quality Assurance Committee provided revisions to these draft that removed the friction number from these PERFs.[505]

412. In March 2011, Ms. Lane prepared a draft memorandum and presentation for HST regarding the concerns and views of the Geotechnical and Quality Assurance

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[501] MTO0038456. The others emailed were: VanAsseldonk, Kevin, Smith, Dale, Gilbert, Nick, Kazmierowski, Tom, Lane, Becca, Lee, Stephen, Raymond, Chris, Senior, Stephen and Curtis, Calvin.
[502] MTO0006351 at image 1; and MTO0014239 at image 1
[503] MTO0025888 at image 2
[504] See MTO0014482 at image 20; and MTO0006780 at image 11
[505] MTO0026281

Committees."[506] The presentation noted that these committees had "no concern removing FN performance requirement" from Type A and B contracts.[507] The presentation included the following comments regarding using friction as a performance measure:

- The use of FN as a performance measure is intended to replace MTO's current practice of assessing the frictional properties of aggregates in the laboratory, comparing performance in the field, and listing acceptable aggregates sources on a DSM to be used in conjunction with the Surface Course Directive.[508]
- GeoCom is concerned that use of FN as a performance measure will increase MTO's liability, especially where checks and balances in place to ensure pavement friction are replaced with rarely measured performance targets based on failure criteria.[509]
- Friction testing has been carried out by MTO for decades. Friction testing is carried out to support the DSM, to address issues of flushing and polishing, and in response to Regional site specific requests.[510]
- MTO does not carry out network level friction testing.[511]
- FN on it's own does not relate directly to safety - other factors such as geometrics, site lines, traffic patterns, traffic volumes, stops and starts, driver expectations, weather etc. also play a significant role. Note: At some value, FN on its own does become a safety –concern.[512]
    - GeoCom is concerned about the liability of specifying FN in contracts.[513]
    - Friction is a public safety issue.[514]
    - Most highway agencies do not publish friction numbers for liability reasons[515].
    - There is concern that widespread use of FN as a failure criteria in performance contracts will lead to ministry wide evaluation of the highway network.[516]

[506] MTO0019280; MTO0007156. Comments on draft: MTO0038459
[507] MTO0011556 at image 12
[508] MTO0011556 at image 3
[509] MTO0011556 at image 3
[510] MTO0011556 at image 4
[511] MTO0011556 at image 4
[512] MTO0011556 at image 4
[513] MTO0011556 at image 5
[514] MTO0011556 at image 5
[515] MTO0011556 at image 5
[516] MTO0011556 at image 6

- MTO does not have the resources to carry out network level friction testing.[517]
- The specified performance measure for FN in current MinO and AMC contracts is based on a failure criteria, i.e., the lowest acceptable value which would trigger a response to the frictional performance of a pavement[518]
- MinO contracts include a 3 year warranty.[519]
- The use of a failure criteria in short term contracts does not guarantee that acceptable frictional performance will be maintained over the life of the pavement.[520]
- Is FN > 30 an appropriate performance measure?[521]
- Friction testing does not evaluate aggregate quality.[522]
- FN is an indicator of frictional resistance of the pavement surface (microtexture, macrotexture)[523]
- Aggregate quality is assessed through laboratory tests that measure physical durability, e.g. MDA abrasion, FT durability, AAV as well as resistance to polishing.[524]
- Aggregates with acceptable friction in the short term are not necessarily durable over time.[525]
- Requiring a FN >30 will not ensure quality, longevity or value[526]

413. The Geotechnical Committee's presentation included several options in lieu of specifying a friction number as a performance requirement:

> remove FN performance measure and propose an alternative performance measure (noting that some poor friction aggregates are prohibited and some contracts already require aggregates from DSM)
>
> allow contractors to opt out of DSM: if they opt in, no friction requirement

[517] MTO0011556 at image 6
[518] MTO0011556 at image 7
[519] MTO0011556 at image 7
[520] MTO0011556 at image 7
[521] MTO0011556 at image 7
[522] MTO0011556 at image 8
[523] MTO0011556 at image 8
[524] MTO0011556 at image 8
[525] MTO0011556 at image 8
[526] MTO0011556 at image 8

> instead of a failure criteria, monitor net change annually, based on a percentage reduction in friction; implement a monitoring program to ensure performance requirements are being met
>
> if FN is retained as a performance measure, implement a monitoring program.[527]

414. On March 8, 2011, the Geotechnical Committee revised the draft PERFs prepared by the Minimum Oversight Steering Committee to remove all references to a friction number as a performance specification in Type A and B projects (which are divided into B1 and B2 projects).[528] Thereafter, the Geotechnical Committee, the Minimum Oversight Steering Committee, and the Performance Specification Steering Committee had further discussions on whether to include a friction number as a performance specification and if so, at what number.[529]

415. At Mr. Cripps' request, the Geotechnical Committee revised the draft performance specifications prepared by the Minimum Oversight Steering Committee to permit a contractor to opt-out of the DSM and meet a friction performance requirement.[530]

416. On March 24, 2011, the Minimum Oversight Steering Committee team sent ORBA draft PERFs with friction performance requirements. Type A included a friction requirement of FN=30. For Type B contracts, the PERFs indicated:

> In cases where aggregates are to be supplied from the MTO Designated Sources of Materials (DSM) List #3.05.25, the Contractor may supply aggregates from alternate sources by warranting that the surface friction number shall exceed FN = 40 for pavements with speeds posted at 100 km/h and exceed FN = 35 for all other pavements, for the

[527] MTO0011556 at images 9-11 (paraphrased). The MTO productions do not contain a final version of the presentation nor the minutes of the HST when it was presented.

[528] MTO0007129 attaching special provisions (MTO0007130, MTO0007132, MTO0007133, MTO0007134, MTO0007135 and MTO0007136) and a document entitled "Comments Pertaining to More than One of the Draft MinO Performance Specifications, March 7th, 2011" (MTO0007131)

[529] MTO0019288; MTO0019289; and MTO0011577

[530] MTO0038462

> complete warranty period, as measured by the Owner using a brakeforce trailer conforming to ASTM E-274 and E-501.[531]

417. In April 2011, all references to friction numbers as a performance requirement were removed from the draft PERFs.[532]

418. In April 2011, the HST directed the Geotechnical Committee that the "DSM [was] meant to be a transition to a performance measure" and to "develop a plan to move forwards with the development and implementation of performance measure and report back to HST".[533]

419. On June 7, 2011, Mr. Klement prepared a presentation entitled "Proposed Friction Management Initiatives" for Mr. Kazmierowski to present to Mr. Cripps, recommending a friction testing initiative with the following:

> "Black-spot testing" will incorporate the existing testing practice, specifically: regional requests based on visual observations, external (i.e. OPP) requests; DSM testing of new aggregate sources and research testing of new materials and construction methods.
>
> "Core testing" will involve testing around 30 representative segments on Hwy. 400-series and Trans-Canada contracts. This (initial) testing frequency will provide two tests per pavement lifetime.
>
> "Warranty testing" will provide ad-hoc compliance verification.
>
> "Secondary testing" will comprise annually about 20 secondary roads segments where the regions suspect low friction (based on collision history, macro-texture, "unexpected" road features or with borderline friction characteristic of similar segments [developed through Klement's macro-texture study].[534]

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[531] See MTO0026306 at image 4 and MTO0026308 at image 4, attached to MTO0026305

[532] See for example MTO0014417 attaching MTO0014418, MTO0014419, MTO0014420, MTO0014421, MTO0014422, MTO0014423, MTO0014424, and MTO0014425; MTO0006294 attaching MTO0006295, MTO0006296, MTO0006297, and MTO0006298; and MTO0014429 attaching MTO0014430

[533] MTO0011559.

[534] MTO0033577 attaching MTO0033578; and MTO0033582 at image 4

420. On September 27, 2011, at the MTO/OHMPA Senior Managers Meeting, Mr. Todd advised ORBA that the MTO would move away from the DSM, slowly, but that municipalities were not likely to. Ms. Lane noted that the 2011 Minimum Oversight PERFs did not include friction numbers.[535]

421. On April 18, 2012, Mr. Blair emailed Mr. Rollings, Mr. Senior, Cindy Brown (Head, Corridor Management, Northwestern Region, Provincial Highways Management Division, MTO), Mr. English, Mr. Pinder, and Ataur Rahman (Senior Structural Engineer, Provincial Highways Management Division, MTO) to discuss revisions to the draft Minimum Oversight PERFs in respect of aggregate types. He said:

> However, I'm not sure that the statements about prohibiting limestone and dolostone in the coarse aggregates for AADT's > 500 and fine aggregates for surface layers less than 35 mm is really enough. My recollection is that carbonates have shown up before. So I think we still need assurance against frictional concerns in the following areas:
>
> 1) For the fine aggregates for roads with < 5000 AADT's and RAP is not involved
>
> 2) For the coarse aggregates for roads with < 2500 AADT's whether or not RAP is involved.
>
> 3) We still need the insoluble residue test for the fine aggregate for <2500 AADT's whether or not RAP is involved..[536]

422. In the same email exchange, in response to a comment from Ms. Brown about using a friction number, Mr. Blair replied:

> With regards to your last comment, I completely agree that a friction number is preferable to all of this but we had nothing to do with that decision.
>
> As far as your first comment goes, maybe you've had no friction concerns in your Region so far because we currently have petrographic and insoluble residue requirements for the aggregates used in hot mix.

[535] MTO0026450 at image 6; and MTO0026452 at image 7

[536] MTO0007835 attaching MTO0007836

> You're right in saying that the MinO specification prohibits limestone and dolostone but, as I said in my last e-mail, you take a risk in not ensuring that this is the case. Also note that it's not just carbonates that can be a problem[537]

423. Mr. Blair forwarded Mr. Senior draft Minimum Oversight PERFs with revisions to the hot mix requirements to address "frictional concerns" on April 25, 2012.[538]

C. Development of Friction Number Performance Requirement – 2012 to 2015

424. On October 9, 2012, the ORBA/MTO Hot Mix Technical Committee met.[539] The MTO advised ORBA/OHMPA attendees (Ashton Martin (Vice-President, Fermar Ltd.) (co-chair, along with Dave McColl (Manager, Operations, Northwestern Region, Provincial Highways Management Division, MTO)), Mr. Wilkinson, Chris Ledsdal, Mr. Magisano, Steve Smith (Vice President, Construction, Coco Paving Inc., Coco Group of Companies), Mr. Brown, Mr. Dziedziejko and James McVeety (Director, Infrastructure, Coco Group of Companies) that:

> **1 – Performance Specification (Skid Number):**
>
> Performance specification task groups have been focusing on developing a framework and have not yet discussed pavement friction numbers. Task group is also aware of the issues and are considering other options. There is no point in discussing the issues if they will not be used. Once draft is review, we will determine if a group or groups need to be put together to discuss the criteria selected. [540]

425. On December 7, 2012, Mr. Senior emailed James Gordon (Materials Manager, Fowler; OSSGA) an update for the OSSGA Specification Committee which noted in relation to requirements for aggregate frictional testing:

- Requirements for 85% DSM retained on the 2.36mm sieve for FC1:
- marginal relationship between the % of DSM aggregate retained on the 2.36 mm sieve and FN at 3 years.

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[537] MTO0007835

[538] MTO0007711 attaching MTO0007712

[539] MTO0026909

[540] MTO0026912 at image 1

- will look at the pavements where reduction in FN was highest or FN< 40 (in yr 3)
- compare with other physical properties to determine better indicator of FN
- no change in current requirement[541]

426. In December 2012, the MTO considered whether to use macrotexture or microtexture measurements to replace skid testing as an indicator of wet-pavement safety.[542]

427. As described in detail above in the section titled "2013 MTO Network Friction Testing", in January 2013, the MTO decided to conduct friction testing across a large number of its road network, which testing was completed during 2013.

428. Throughout January 2013, the MTO took steps to revise some of its specifications, including for OPSS 313 "Construction Specification for Hot Mix Asphalt – Performance Based"[543] and OPSS 1151 "Material Specification for Superpave and Stone Mastic Asphalt Mixtures."[544] The revised draft specifications adopted a performance-based model, but did not include a friction number performance requirement.[545] Ultimately, neither OPSS 313 nor OPSS 1151 were implemented as performance-based specifications by MTO.[546]

429. On March 20, 2013, Mr. Smith presented a memorandum regarding aggregate durability and skid resistance to the Highway Standards Branch. It stated in part:

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[541] MTO0008527 attaching MTO0008528 at image 1
[542] MTO0027053; MTO0027663; and MTO0027665
[543] MTO0031371 attached to MTO0031370
[544] MTO0016406
[545] MTO0031433 attaching MTO0031434, MTO0031435 and MTO0031436; and MTO0028039 attaching MTO0028040, MTO0028041, and MTO0028042
[546] MTO0038712 at image 23

> MTO has consistently used a "front end" approach to obtain adequate pavement friction, by specifying aggregate properties as a function of mix type and/or traffic level, and testing the aggregate for compliance prior to production and placement. This approach has been very effective, with few pavement friction problems occurring. In general, problems due to inadequate pavement friction have historically either been a result of mix instability and flushing, or of not complying with the surface course directive on mix type, (e.g., using a lower quality mix type for maintenance).
>
> A change to a "back end" approach, where pavement friction measurements are taken post-completion introduces a number of risks, the primary ones being:
>
> - increased risk of pavement friction problems, in part due to limited contractor knowledge or inability to properly evaluate candidate materials for appropriate frictional properties
> - introduction of a time lag in detecting/reacting to pavement friction issues (reactive, rather than proactive)
> - lack of standard testing conditions/environment leading to and poor repeatability with -increased risk of dispute
> - lack of agreement with respect to established limits or ranges for friction values
> - reduced testing repeatability with increased risk of dispute
> - higher costs due to:
>   - limited contractor knowledge/experience
>   - use of performance measures inappropriate for the project specific situations (ie. lower numbers than required for some situations and higher numbers than required in others)
>   - increased testing costs (laboratory testing vs. field testing)
> - higher legal costs due to potential lawsuits if performance standards are challenged[547]

430. The memorandum listed nine possible alternatives for the evaluation of alternative approaches to aggregate durability and pavement friction in pavement performance specifications, loosely characterized as the material sampling and laboratory testing, contractual limitations, and field performance testing.[548] The memorandum recommended the use of reduced physical properties testing of aggregates (reduced from the then-current model using the DSM) as an interim approach until a pavement friction performance measure was developed, based on the input from eleven senior MTO staff members.[549]

[547] MTO0011701 at images 4-5
[548] MTO0011701 starting at image 6
[549] MTO0011701 at images 11-12. See also an accompanying presentation: MTO0011702

431. Mr. Smith advised members of the Geotechnical Committee that this recommendation would be presented to the Steering Committee, and that once the MTO completed network wide friction testing, validated friction testing methodology, and developed pavement friction performance measures, the DSM will be replaced by a pavement friction performance measure, which Mr. Smith noted was at least 10 years away.[550]

432. After internal discussion,[551] Mr. Smith prepared two slide decks for presentation to the Highway Standards Branch on May 13, 2013. One presentation recommended the removal of friction number as a performance requirement for Type B1 and B2 contracts (now called “RW contracts”).[552] The other presentation, in summary, proposed a staged process to move to a friction performance requirement, noting that the decision on Interim Stage 2 implementation would be deferred until friction data collected and analysed:

(a) Interim Stage 1

(i) Use of DSM and Reduced Material Testing

(ii) Complete network testing and analysis (including correlation of network testing to mix design, aggregate properties and ARAN textual measures), to be completed in February 2014

(b) Interim Stage 2 – March 2014

[550] MTO0011706 attaching MTO0011707, MTO0011708 and MTO0011709
[551] MTO0019702; MTO0019701; MTO0027171; and MTO0028090
[552] MTO0011744 at images 8-9

(i) Use of Pavement Friction Performance Measure and Reduced Material Testing

(ii) Research deflectometer equipment and monitor deflection change

(c) Final - 2023 or sooner pending further research

(i) Pavement Friction Performance Measure

(ii) Structural Capacity Performance Measure

(iii) Minimal Material Testing[553]

433. On July 24, 2013, Mr. Raymond circulated an email to Alain Beaulieu (Head, Engineering Standards and Specification Management, Provincial Highways Management Division, MTO) and Tony Tuinstra (Contract Innovation Engineer, Construction Contracts, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division, MTO) (copying Mr. English and John Garrett (Construction Officer, Construction Contracts, Contract Management Office, Contract Management & Operations, Provincial Highways Management Division, MTO)) with links to a recent TRB newsletter that addressed "Legal Aspects for Performance-Based Specifications for Highway Construction and Maintenance Contracts".[554]

[553] MTO0011745 at images 5, 7 and 8-9
[554] MTO0027729

434. At ORBA / OHMPA's request,[555] on December 16, 2013, the MTO presented Mr. Brown with friction data collected from 110 sections across the province from 400 series Highways and 2 lane Highways with various mix types including SP 12.5, SP 12.5 FC1 and FC2 and SMA. Mr. English's notes of the meeting stated:

> Attendees:
>
> Sandy Brown, OHMPA, Stephen Lee, Betty Bennett, John Blair, Dale Smith, Kevin English
>
> Moreen Miller from OSSGA was invited but she did not get back to Kevin
>
> Discussion:
>
> MTO presented initial friction data collected from 110 sections across the province from 400 series Highways and 2 lane Highways with various mix types including SP 12.5, SP 12.5 FC1 and FC2 and SMA. Very little analysis has been completed on the data yet. MTO is currently collecting mix design information and wants to include it before completing a detailed analysis. Sandy agreed that incorporating the mix design information is key to doing a complete analysis.
>
> All the data was collected with a friction trailer following the ASTM standard (65 km/hr) with some also collected at the posted speed to see the correlation between ASTM and posted speeds.
>
> MTO has not determined if we will be going with one friction # for all highways or friction #'s for different classifications or highway types. I.e. One friction # for 400 series highways and one for 2 lane highways. MTO will wait until the analysis is complete before the details are worked out.
>
> MTO has received the majority of the mix design information, just missing some of the older contract mix designs. Sandy offered to help get mix design information from contractors. He would need to know some details including the contractors who constructed the contracts.
>
> Sandy asked if MTO considered other ways of collecting friction data besides using the friction trailer which is expensive to purchase and which is not readily available for contractors to rent/use. He also wondered if the friction trailer is the right tool considering the changes to motor vehicles. I.e. Anti-lock brakes. An example of another friction tester is the "Grip" tester which is used by other agencies including Transport Canada, who use it for measuring runway friction. The Grip tester would be a lot cheaper for contractors to purchase or even rent as there are more of them available. The cost to purchase a Grip Tester would be approximately $65,000 compared to $375,000 for a skid trailer.
>
> MTO is currently not considering using a Grip tester but is considering using the ARAN to collect Macro/Micro texture measurements as another way to determine friction. Sandy

[555] MTO0017634 at image 1

> noted that while the ARAN could collect macro texture data it likely could not get good micro texture data.
>
> Sandy suggested correlating various friction testers so contractors can get their own (i.e. a cheaper grip tester). MTO noted that from a review, it seems that correlation between different testers is pretty difficult.
>
> MTO has already proposed the official Friction kick off meeting for Feb 11, 14 or 18 to Geoff Wilkinson at ORBA. Kevin is waiting to hear back with ORBA's preferred date. Kevin will propose meeting time from 10am to 2 pm at ORBA's office once a date is chosen.
>
> Sandy stated that he is happy with the direction so far and would be happy to help in any way he can. He also noted that he plans to update OHMPA after today's meeting so they understand where MTO is going with the friction study. MTO said that Sandy is welcome to forward any questions/suggestions from OHMPA members to MTO for consideration and MTO will look at sharing data (sanitized) after some of the analysis is completed in mid-January. [556]

435. On December 18, 2013, the Geotechnical Committee discussed use of friction number in performance specifications and decided to put on hold its endorsement of the use of a friction number as a performance measure in MTO contracts pending "findings of analysis" by Mr. Smith.[557]

436. In the first quarter of 2014, MTO staff continued to analyze the results of the 2012 and 2013 friction data and its relationship to pavement age and surface type[558] and correlation to retained aggregate for aggregates on the DSM.[559] Throughout 2014, the MTO also researched friction evaluation approaches in other jurisdictions.[560]

437. On March 4, 2014, the MTO presented an MTO Network Friction Analysis to ORBA (Mr. Magisano, Mr. Brown, and Mr. Dziedziejko) at the first MTO/ORBA Friction Group

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[556] MTO0008965

[557] MTO0008865 at image 2

[558] MTO0023431 attaching MTO0023432 and MTO0023433

[559] MTO0019804

[560] MTO0019916. Note: some of the presentation is written in white text on a white background. By highlighting the text electronically, with a cursor or by "selecting all", the full text of the presentation is visible. MTO0013297; MTO0013244; MTO0014825 attaching MTO0014826 and MTO0014827; MTO0023668 attaching MTO0023669 and MTO0023670; MTO0013243; and MTO0013297

meeting. The minutes of this meeting noted that "MTO is looking to move towards friction as a performance measure in place of the current aggregate requirements. … The friction analysis has just begun and no decisions have been made. ORBA and MTO will continue to work together to develop a performance measure that ensures adequate friction and safety."[561] The presentation summarized the MTO's analysis of its network testing data as follows:

> Preliminary findings of study:
> - Data suggested that friction remains fairly constant or decreases very minimally over time
> - Higher friction values achieved for test speed of 65 km per hour compared to 100 km per hour
> - Incorporating macro texture (IFI) revealed similar friction results over time
> - Results from this study, will be used to develop additional testing for 2014 season to supplement gaps in data[562]

438. At this meeting, ORBA advocated for the selection of a friction number that was the minimum friction needed to ensure safe roads. It also expressed concerns about MTO's use of a skid trailer, as industry did not have ready access to complete its own testing using a skid trailer, and suggested the use of a grip tester.[563]

439. The March 2014 drafts of the Minimum Oversight PERFs for Type B1 and B2 contracts did not contain a friction number as a performance requirement.[564]

440. On March 27, 2014, Dino Bagnariol (Director, Highway Standards Branch, Provincial Highways Management Division, MTO) delivered a presentation to the OHMPA annual general meeting.[565] The presentation noted a "new approach" to performance

[561] MTO0031743 at image 1, attached to MTO0031742. See also MTO0014868 and MTO0027291
[562] MTO0014811 at image 11
[563] MTO0008991, MTO0014811
[564] MTO0014757 attaching MTO0014758, MTO0014759, MTO0014760
[565] MTO0037362 at image 15-16 and 18

specifications, including “the use of material testing where performance measures don’t exist” and “the use of pre-approved materials lists during transition period”, which would be discussed a multi-stakeholder workshop in the Spring/Summer of 2014.[566]

441. On July 10, 2014, Susan Tighe (Professor, Department of Civil Engineering, University of Waterloo) sent a draft proposal to Guy Tremblay (Head, Pavement Laboratory Division, Ministere des Transports du Quebec) and Mr. Lee titled “Evaluation of Surface Texture and Associated Skid Resistance for Concrete and Asphalt Pavement – MTO and MTQ”, in which the University of Waterloo proposed a collaboration of MTQ and MTO for testing various concrete and asphalt pavement sections for skid resistance.[567] She sent a follow-up email in September 2014.[568] There is no evidence of a reply in the documents produced by the MTO.

442. On October 17, 2014, Mr. Lee circulated a document titled “Draft Friction Recommendations for AC Pavement”, dated October 15, 2014.[569] This presentation set out Mr. Lee’s assessment of FN statistical parameters based on network level test data by age and region, traffic, and speed. It used statistical characteristics of the FN data to establish pavement friction limits/criteria tested at 65km/h and 100 km/h.[570] The presentation contained the following summary and recommendations:

> Results indicate FN values remain fairly constant or decrease very minimally over time.

[566] There are no documents in the Inquiry database indicating that this occurred.
[567] MTO0023472
[568] MTO0023531
[569] MTO0022621 attaching MTO0022622
[570] MTO0022622 at image 4

…

Recommended HMA frictional requirement:

FN@65km/h = 40 (FN@100km/h = 35) (Value selected is about 98% Confidence Level)

Fall back position:

–Use DSM Materials OR FN@65km/h = 40 (FN@100km/h = 35)[571]

443. On October 17, 2014, Mr. Gorman emailed in response to the draft presentation:

2 issues:

1 Why so low in W region for FN vs pavement age? Maybe too much OTR in wearing course?

2 If you go to FN of 35 (100km/hr), some traps will have a problem with this from what I have seen based on data I have such as the Red Hill Ck xway[572]

444. On the same day, Mr. Senior replied to Mr. Gorman:

Thanks. Yes, there is no correlation with aggregate type and no specific data dealing with 400 series highways. It appears to apply to all highways for all traffic categories, which I would say is too simplistic. In addition the data is not normally distributed. This is somewhat expected since a bias is introduced as a result of using DSM materials and because of regional applications, e.g., high frequency use of trap rock in WR 400 series. [573]

445. On November 4, 2014, Mr. English, Mr. Lee, Mr. Smith, Mr. Blair, Mr. Virani, Ms. Bennett, Mr. Senior and Mr. Raymond discussed the presentation and draft recommendation.[574] The attendees agreed to revise the presentation, and present a recommendation to the Performance Specifications Implementation Committee that a friction requirement be used to replace DSM on a 7-year performance contract on a trial basis.[575]

[571] MTO0022622 at images 15-16
[572] MTO0022623
[573] MTO0022623
[574] MTO0023821
[575] MTO0019866 attaching MTO0019867

446. After discussion,[576] on November 14, 2014, Mr. Lee circulated a revised presentation with the following recommendations:

- FN testing shall be carried out per ASTM E-274requirements. FN results carried out at other posted speed to be converted to FN65 equivalent.
- Recommended expected level of friction number performance management for each 500 m lot:
    - FN65 >= 40 (acceptable)
    - FN65>=30 to <40 (accident rate assessment and annual friction monitoring, remedial required prior to hand over)
    - FN65 <30 (remedial action within 1 month)
- Target a selective number of 7 year warranty projects for initial trial with friction criteria.[577]

447. Between November 14, 2014 and November 25, 2014, MTO staff engaged in further discussion about the continued use of the DSM, the application of a friction requirement to 400 series highways, the possible use of price adjustments to remove and replace based on friction testing, the use of FN65 = 30 or 35 for assessment, and MTO liability exposure for personal injuries.[578]

448. On November 25, 2014, the Geotechnical Committee met. At that meeting, Mr. Lee presented on "Status of Performance Specifications – Standing Item". The minutes state:

Friction Criteria Update
- [Redacted by the MTO for privilege]
- [Redacted by the MTO for privilege]
- Friction number implies certain level of safety

[576] MTO0019852; MTO0019865; MTO0023583; MTO0023593; and MTO0013245
[577] MTO0019861 attaching MTO0019862 at image 13; and MTO0014829
[578] MTO0019868; MTO0019974; MTO0009395; MTO0019952 attaching MTO0019953 and MTO0019954; and MTO0019870

- Recommendation to continue with current friction mgmt.. plan
- GeoCom [redacted by the MTO for privilege] do not recommend publishing a friction number
- Perf 2271 still includes reference to friction – need to remove friction from DB specs[579]

449. On November 26, 2014, Mr. Lee circulated the presentation slides, noting that "Legal and Geocom comments/opinions [were] not included" [580] for the presentation on December 1, 2014, to the Performance Specifications Implementation Committee.[581]

450. On December 10, 2014, Mr. Smith emailed Mr. Beaulieu and Mr. Raymond:

> With the decision that FN will not be included in performance specs (could be reversed by steering committee however), we still need to engage and wrap this up with the industry members of the task group. With Kevin going to Windsor, and Chris to Oz, concerned this will fall through the cracks. Who/how do we wrap this up with industry? [582]

451. Mr. Raymond sent an email on December 12, 2014, asking for confirmation that "gradation and pavement friction are no longer a requirement based on our last PSIC." Mr. Smith replied the same day:

> Yes, confirmed. But the decision has not gone to the Steering Committee as far as I know. So we are not in a position to discuss this externally. If it is raised, the answer is "under discussion at MTO"[583]

452. On March 10, 2015, the MTO circulated an updated specification for hot mix resurfacing with a 3 or 5 year performance warranty, replacing the Minimum Oversight

[579] MTO0038696 at image 6
[580] MTO0019871
[581] MTO0023620
[582] MTO0027637
[583] MTO0019992. See also MTO0023673

PERFs 2222 and 2232.[584] These specifications did not include a friction performance requirement.[585]

453. Representatives from the MTO met with ORBA on May 13, 2015.[586] Maria Bianchin (Construction Contract Engineer, Construction Contracts, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division, MTO) provided Mr. Senior with an annotated agenda the day prior to the meeting. The first topic on the list related to friction, and noted:

> 1.Performance Specification (Skid Number) - Stephen Lee
>
> May 1, 2015 – MTO Meeting
>
> - MTO developed friction number to use in performance specifications.
> - Decision is to revert back to the DSM list.
> - ITEM CLOSED. [587]

454. The minutes of the September 23, 2015 joint meeting of the Geotechnical Committee and the Quality Assurance Committee state that under the updated specification for hot mix resurfacing with a 3 or 5 year performance warranty, testing of physical properties of hot mix aggregates was still required to ensure long term pavement performance (i.e. aggregate durability and surface friction) and quality aggregate for future potential recycling.[588]

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584 MTO0017815
585 MTO0036511 attaching MTO0036512, MTO0036513 and MTO0036514
586 MTO0017830
587 MTO0017829 attaching MTO0017830 at image 1
588 MTO0036666 at image 2

455. On November 24, 2015, Ms. Bennett reported at the Geotechnical Committee meeting that Mr. Cui had distributed results of friction testing to the regions and has not received any comments.[589]

[589] MTO0036687 at image 6

D. Appendix A: Individuals Referenced in Overview Document #4

Last Name	First Name	Organization	Position(s)[590]
Aurilio	Vince	OHMPA	Technical Director - Field Engineer
Bagnariol	Dino	MTO	**Director**, Highway Standards Branch, Provincial Highways Management Division
Bashir	Imran	MTO	**Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2009-current) **Acting Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2014-2015)
Beaulieu	Alain	MTO	**Head,** Engineering Standards and Specification Management, Provincial Highways Management Division
Bennett	Betty	MTO	**Head**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (for some period in 2012) **Senior Pavement Design Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2010-2016)
Bentley	Kevin	MTO	**Manager,** Engineering, Southwest Region, Provincial Highways Management Division
Bianchin	Maria	MTO	**Construction Contract Engineer,** Construction Contracts, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division
Billings	Dennis	MTO	**Head**, Geotechnical Engineering Section, Central Region, Provincial Highways Management Division
Blair	John	MTO	**Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (around 2009) **Senior Soils and Aggregate Engineer**, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch,

[590] Only positions held during the time covered by Overview Document #4 are included in Appendix A. Commission Counsel has created a separate chart containing the complete list of all positions held by all individuals referenced in Overview Documents #2 - #10, which is included in Overview Document #1 at Appendix A.

Last Name	First Name	Organization	Position(s)[590]
			Provincial Highways Management Division (2010 onwards)
Bokalo	Nick	Toronto Police Service	Police Collision Reconstructionist
Bowers	Greg	Blastrac	Manager, North America Market
Brown	Cindy	MTO	**Head**, Corridor Management, Northwestern Region, Provincial Highways Management Division, MTO
Brown	Sandy	OHMPA	Technical Director
Bunting	Joe	ORBA	Chair, Education Committee
Bykerk	Henry	MTO	**Aggregates Supervisor**, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Campbell	Mark	City of Kingston	Construction Manager
Cautillo	Guy	MTO	**Senior Manager**, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Chaly	Mary	MTO	**Administrative Assistant**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Chan	Susanne	MTO	**Pavement Design Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Chaput	Gerry	MTO	**Director & Chief Engineer**, Highway Standards Branch, Provincial Highways Management Division (2005-2011) **Executive Director**, Provincial Highways Management Division (2011-2012)
Cheng	Sam	MTO	**Manager**, Contracts
Comfort	Todd	MTO	**Area Construction Engineer,** Provincial Highways Management Division
Costantino	Joe	MTO	**Area Contracts Engineer,** Central Region, Provincial Highways Management Division
Cripps	Steve	MTO	**Director and Chief Enginee**r, Highway Standards Branch, Provincial Highways Management Division (2010) **Executive Director and Chief Engineer**, Highway Standards Branch, Provincial Highways Management Division (2011-2014)
Cui	Sam	MTO	**Pavement Management Analyst**, Pavements & Foundations Section, Materials Engineering &

Last Name	First Name	Organization	Position(s)[590]
			Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2015) **Senior Pavement Evaluation Officer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2015 onwards)
Della Mora	Joseph		No information
Delos Reyes	Andro	Golder	Senior Pavement & Materials Geotechnical Technologist
Dezsi	Ildiko	MTO	**Administrative Assistant**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Dhillon	Param	DBA Engineering Ltd.	President
Di Lorenzo	Anthony	MTO	**Senior Project Manager**, Area 2 – Traffic Office, Engineering Program Delivery Central, Design & Engineering Branch, Transportation Infrastructure Management Division
Dundas	Dave	MTO	**Senior Foundations Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Dyer	David	Member of the Public	Fourth Year Engineering Student, Queen's University
Dziedziejko	Thomas (Tom)	Aecon Materials Engineering Corp.	Director, Quality, Infrastructure, Aecon Group Inc., AME General Manager, AME (in 2014)
Emery	John	JEGEL	President and Principal Engineer
English	Kevin	MTO	**Head**, Quality Assurance, West Region, Provincial Highways Management Division (2005-2013) **Executive Assistant to Assistant Deputy Minister**, Office of the Assistant Deputy Minister (2008) **Area Contracts Engineer**, West Region, Provincial Highways Management Division (2010) **Area Construction Engineer**, Windsor Border Initiatives Implementation Group (BIIG), Provincial Highways Management Division (2014-2015) **Construction Contracts Engineer**, Construction

Last Name	First Name	Organization	Position(s)[590]
			Contracts, Contract Management Office, Contract Management & Operations, Provincial Highways Management Division (2013-2014 and 2016)
Erickson	Kane	MTO	**Engineer in Training (EIT)**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Eyers	Brian	Miller Group	Manager
Freure	Peter	MTO	**Project Soils Engineer,** Eastern Region, Highway Standards Branch, Provincial Highways Management Division
Gagnon	Estel	Dufferin affiliate	Chef Section Qualite, Demix Agrégats
Garrett	John	MTO	**Construction Officer**, Construction Contracts, Contract Management Office, Contract Management & Operations, Provincial Highways Management Division
Godin	Greg	MTO	**Executive Assistant**, Office of the Assistant Deputy Minister
Gordon	James	Fowler; OSSGA	Materials Manager
Gorman	Bob	MTO	**Senior Aggregate Engineering Officer**, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Hanmer	Roger	MTO	**Regional Director**, Central Region, Provincial Highways Management Division
Henderson	Dr. Vimy	Golder	Pavement and Materials Engineer
Hidalgo	Mireya	MTO	**Project Engineer**, Development, Operations, Contract Management & Operations, Provincial Highways Management Division (until 2013) **Project Engineer**, Construction Contracts, Contract Management Office, Contract Management & Operations, Provincial Highways Management Division (2013-2014)
Holt	Anne	MTO	**Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Janicas	Paul	Dufferin	Senior Quality Control Lab Supervisor (until 2007) Plant Superintendent (2007 onwards)
Jansen	Brian	MTO	**Jr. Editor/Writer**, Road Talk, Resources and Planning Office, Division Services, Provincial Highways Management Division

Last Name	First Name	Organization	Position(s)[590]
Jones	Bill	MTO	**Manager**, Planning & Environmental, Central Region, Provincial Highways Management Division
Kamp	Heather	MTO	Communications Branch
Kazmierowski	Tom	MTO	**Manager**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2007) **Acting Senior Manager**, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2007) **Senior Manager**, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2007 onwards)
Kennedy	Madison	Golder	Geotechnical Co-op Student
Klement	Tom	MTO	**Senior Research Engineer**, Concrete Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Kohlberger	Rob	MTO	**Geotechnical Engineer**, Geotechnical Engineering Section, Central Region, Provincial Highways Management Division
Korpal	Peter	MTO	**Head**, Planning and Design, Central Region, Provincial Highways Management Division
Krol	Karolina	MTO	**Engineer in Training (EIT)**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Lane	Becca	MTO	**Senior Pavement Design Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2007) **Executive Assistant to Assistant Deputy Minister**, Office of the Assistant Deputy Minister (2008) **Head**, Pavements & Foundation Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2008-2011) **Manager**, Systems Analysis and Forecasting Office, Transportation Planning Branch; Policy, Planning and Agency Relations - Integrated Policy

Last Name	First Name	Organization	Position(s)[590]
			and Planning Division (2011-2013) **Manager**, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2013 onwards)
Lau	Geoffrey	MTO	**Co-op Student**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Layton	Carol	Province of Ontario	Deputy Minister, Ministry of Transportation of Ontario
Ledsdal	Chris		No information
Lee	Warren	MTO	**Pavement Design Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Lee	Stephen	MTO	**Head**, Geotechnical Engineering, Central Region, Provincial Highways Management Division (until January 2012) **Acting Head**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (January 2012 - October 2012) **Head**, Pavements and Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (October 2012 - July 2019)
Li	Joshua	MTO	**Pavement Design Evaluation Officer**, Pavements West, Geotechnical Engineering, Central Region, Provincial Highways Management Division
Liegler	Brenda	MTO	**Contract Innovations Engineer**, Contract Innovation Office, Contract Management & Operations Branch, Provincial Highways Management Division
MacDonald	Carole Anne	MTO	**Petrographer**, Soils & Aggregates Section, Materials Engineering & Research Office, Highway Standards Branch
MacKenzie	Lisa	Golder	Marketing Coordinator
MacLean	Robert	MTO	**Regional Contracts Engineer**, Central Region, Provincial Highways Management Division
Magisano	Fernando	K.J. Beamish Construction Co., Ltd.	Vice President, Technical Services (as of September 2012)

Last Name	First Name	Organization	Position(s)[590]
Mantha	Ray	MTO	**Executive Director**, Asset Management, Provincial Highways Management Division
Marciello	Frank	MTO	**Pavement Evaluation Supervisor,** Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Marks	Pamela	MTO	**Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2013) **Head**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2013 onwards)
Martin	Ashton	Fermar Ltd.	Vice-President
McColl	Dave	MTO	**Manager**, Operations, Northwestern Region, Provincial Highways Management Division
McGonigal	John	MTO	**Quality Assurance Officer (Bituminous),** Quality Assurance Section, Contracts Office, Central Region, Provincial Highways Management Division
McVeety	James	Coco Group of Companies	Director, Infrastructure (as of May 2011)
Medcalf	Nathan	Equipment Journal	Editor
Mercier	Carole	MTO	**Sign Designer**, Provincial Highways Management Division
Metcalfe	Tiffany	MTO	**Team Lead**, Organizational Effectiveness
Moore	Gary	City of Hamilton	**Manager**, Design, Capital Planning & Implementation, Public Works (2001-2009) **Manager**, Design, Red Hill Valley Project, Public Works (2002-2007) **Director**, Engineering Services, Environment & Sustainable Infrastructure Division, Public Works (2009-2018)
Morris	Dave	City of Mississauga	Coordinator, Geo Tech and Material Testing
Ng	Raymond	MTO	**Senior Project Engineer**, Provincial Highways Management Division (as of at least 2012)
Ningyuan	Li	MTO	**Senior Pavement Management Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway

Last Name	First Name	Organization	Position(s)[590]
			Standards Branch, Provincial Highways Management Division
O'Connor	Mike	OHMPA	Executive Director
Oddi	Marco	City of Hamilton	**Senior Project Manager,** Red Hill Valley Project, Public Works
Payette	Ken	MTO	**Quality Assurance Officer**, Central Region, Provincial Highways Management Division
Pearson	Terry	MTO	**CCO,** Quality Assurance Section, Contracts Office, Central Region, Provincial Highways Management Division
Phillips	Ted	MTO	**Supervisor**, Geotechnical Engineering, Eastern Region, Provincial Highways Management Division
Pinder	Frank	MTO	**Head**, Quality Assurance Section, Eastern Region, Provincial Highways Management Division
Politano	Lou	MTO	**Manager**, Engineering, Central Region, Provincial Highways Management Division (until 2009) **Regional Director**, Central Region, Provincial Highways Management Division (2009 onwards)
Ponniah	Joseph	MTO	**Senior Research Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Rahman	Ataur	MTO	**Senior Structural Engineer,** Provincial Highways Management Division
Raymond	Chris	MTO	**Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2007) **Senior Pavement Design Engineer**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2007-2009) **Head**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2009-2011) **Executive Assistant to Assistant Deputy Minister**, Office of the Assistant Deputy Minister (2012) **Head**, Construction Contracts Section, Contract Management Office, Contract Management &

Last Name	First Name	Organization	Position(s)[590]
			Operations Branch, Provincial Highways Management Division (2012-2015)
Rogers	Chris	MTO	**Manager**, Soils and Aggregate Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Rollings	Rob	MTO	**Head**, Quality Assurance, Central Region, Provincial Highways Management Division
Schell	Hannah	MTO	**Manager**, Concrete Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (until 2007) **Head**, Concrete Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2008 onwards)
Schutte	Dan	MTO	**Head**, Geotechnical Engineering Section, Northwestern Region, Provincial Highways Management Division
Senior	Stephen	MTO	**Acting Head**, Soils & Aggregate Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (May 2008 - August 2008) **Head,** Soils & Aggregate Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (August 2008 onwards)
Smith	Dale	MTO	**Head,** Geotechnical Engineering Section, Northeastern Region, Provincial Highways Management Division (as of at least 2009-2012) **Team Lead**, Performance Specifications, Design and Contract Standards Section, highway Standards Branch, Provincial Highways Management Division (2013 onwards)
Smith	Karen	MTO	**Head**, Geotechnical Engineering, Central Region, Provincial Highways Management Division (2012-2013) **Area Contracts Engineer**, Provincial Highways Management Division (2013-2016)
Smith	Steve	Coco Group of Companies Miller Group	Vice President, Construction, Coco Paving Inc. (2009-2012) Vice President, GTA Paving and Special Project. Miller Group (2012-2013)

Last Name	First Name	Organization	Position(s)[590]
Sproule	Darwyn	MTO	**Head**, Geotechnical Engineering Section, Eastern Region, Provincial Highways Management Division
Stacey	Jamie	MTO	**Quality Assurance Engineer**, Provincial Highways Management Division
Stephenson	Bob	MTO	**Head**, Program and Planning, Central Region, Provincial Highways Management Division
Tabib	Seyed	MTO	**Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Tam	Kai	MTO	**Manager**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2002-2007) **Head**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division (2008 onwards)
Taylor	John	MTO	**Regional Director**, Northwestern Region, Provincial Highways Management Division
Theodore	Jim	Morrison Hershfield	Contract Administrator, MTO Contract #2007-2031
Tighe	Dr. Susan	University of Waterloo	Professor, Department of Civil Engineering
Todd	Gary	MTO	**Manager**, Design & Contract Standards, Highway Standards Branch, Provincial Highways Management Division
Tremblay	Guy	Ministere des Transports du Quebec	Head, Pavement Laboratory Division
Tuinstra	Tony	MTO	**Contract Innovation Engineer**, Construction Contracts, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division
Turner	Bruce	Aecom	Senior Contract Administrator, MTO Contract #2005-2008
Uzarowski	Dr. Ludomir	Golder	Principal, Pavement and Materials Engineering
Vanbiesbrouck	Jim	MTO	**Head**, Claims, Central Region, Provincial Highways Management Division
Vandenberg	Robert	MTO	**Project Engineer,** Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division

Last Name	First Name	Organization	Position(s)[590]
Vanderlaan	Frank	MTO	**Head,** Geotechnical, Eastern Region, Provincial Highways Management Division
Vayali	George	City of Calgary	Bridges and Structures, Transportation Infrastructure
Verok	Peter	MTO	**Manager**, Contract Management Office, Contract Management & Operations Branch, Provincial Highways Management Division
Virani	Anil	MTO	**Senior Bituminous Engineer**, Bituminous Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Wade	Jason	MTO	**Pavement Evaluation Technician**, Pavements & Foundations Section, Materials Engineering & Research Office, Highway Standards Branch, Provincial Highways Management Division
Wear	Jack	Road Authority	Engineering Manager, Authorities
White	Jason	MTO	**Head**, Highway Engineering, Central Region, Provincial Highways Management Division
Wilkinson	Geoff	ORBA	Executive Director/Chief Operating Officer
Wynne	Kathleen	Province of Ontario	Premier of Ontario