Normal scientific practice is meticulous in all areas such as fully referencing to original sources and fully describing experimental procedures and sites before using the science. It does not rely on or accept an endless supply of experimentally unsupported data including personal communications to construct opinions, beliefs and ideas on top of what are already derived estimates.

Neither of these fundamental practices have been followed for Roydons or Yaldhurst-Mote 2018 and consequently any results for "science" would be suspect or unsafe enough to be rejected by prudent scientists refereeing this work and requests for considerable improvements to be made before acceptance for publication.

I am further disappointed at the petty scientific bickering between ~~between~~ experts which consist largely of ideas, opinions, beliefs, considerations etc largely based on unproven derived data including personal communications (see below). I note for example that there errors in several estimates given in Table 1, 9 Dec. Joint Witness Statement, having read the accompanying accessory data eg Table D-1. One expert does not supply any calculation details and Ms Ryan has coincidentally obtained the same estimate of 174 kg/year as Mr Cudmore - the correct value is 192. Five mistakes in Table 1 by three experts, however small, does not augur well for meticulous science.

It does not help that uncertain information given at the last minute, 29 Jan, re-reading helps the calculations in Table 1, Dec 9th. The supporting tables to Table 1 contain incomplete descriptions of formula constants "folders not set", assumptions etc along with personal communications that provide no supporting detail of methods used eg Mr Bligh and Mr Jolly state that average topsoil depth is 70cms (Table D-1, Dec 9th), whilst Mr Mthamo (29 Jan) states in point 10 that this value is 20cms according to Fulton Hogg Mr Cudmore gave a value of 50cms (Table 6-2, 6 Nov.). Such differences on an areal and volume/depth basis will markedly affect the already derived USEPA sources.

The USEPA sources eg Ms Nicklaus appear not to have been checked to source quoted in their accounts eg references to stone crushing on close inspection invariably refer to granite and limestone which are not greywacke yet this data from unrelated (to Canterbury) U.S. regional areas is applied to Roydons which is greywacke.

All experts used a silt value of 4.8% supplied by Mr Cudmore who states with no evidence that Pound Road material has a silt content of "around" 3%, presumably on a dry weight basis. The value of 4.8% is based on an average from three samples taken from one road in Missouri 1974 (email to Cudmore Jan 30, 2020). It is not a representative yet some independent inexpensive simple research could have yielded NZ relevant data!

Based on Landcare soil maps the experts agreed, with no details given, that a moisture content of 8% as an annual average would be appropriate for Roydons. However no indication is made for Top or subsoil and no appreciation that soil moistures are not given in the Landcare maps only potential available water. Soil moisture varies appreciably with depth, season, prevailing weather at sampling. These observations will affect the results to varying degrees of uncertainty

There are many reasons why experiments go awry and in the present case the poor planning, design and misguided secrecy of ECan and Moto has produced a set of results especially for PM and weather but which have been obtained from poorly sited and non replicated machines known only to Mr Baynham of Moto- not even the ECan Air Quality Team Leader. (I thank the local residents, hosting the machines for their co-operation). No information has been supplied by Holder on the precise location of the T640x machine at Roydons but since it has only operated for a short time the results must be treated with caution. The other Moto machine when viewed by me at Roydons in Dec. 2018 was incorrectly sited and incapable of providing representative data. This fact together with the heavily reworked data by experts causes me deep alarm at the usefulness of this unsound data. A similar case prevails in the case of site 2 at Yaldhurst-Moto, the so called reference site, and its deficiencies were noted by Ms Wickham. I have discussed these concerns in my earlier submissions especially the first.

Perhaps the experts were unfamiliar with the unsatisfactory planning/ siting of the Yaldhurst work and the Chemsafety work but it remains that this was a terribly short experiment conducted in summer with no rainfall measurements on site. I do think that the science is unsafe and should be repeated for a minimum of one or preferably longer eg 2 to 3 years. This will increase the chances of obtaining good reliable data including NZ relevant emission data. I draw the reader to the simple experiments described in paragraphs 144–149 of my Dec 10th submission examining dust contents of stockpiles and truck undersides (not including wheels)

The comments on PM_{10} by Mr Cudmore (5 Feb) in the light of the above are not convincing because they are extrapolations and derived from unsound original data with further manipulations which on close inspection are opinions lacking no or unreliable data. It becomes difficult for me as a scientist to accept such unsupported material. One is, after all, speculating on processes and dusts at a yet to be built quarry and I cannot understand why one cannot undertake relevant and reliable NZ research data to help in decision(s). I suggest that independent, experienced "air" scientists, likely University based be approached to act as referees on all aspects of the Roydons and Yaldhurst work.

In relation to Appendix 2 and Drs Seddon-Smith and Humphreys comments 3. I remind the Commissioners and applicants including Ms Wagenaar and Mr Cudmore to read both of my submissions especially paragraphs 110–117, 121–130 in that of Dec 10th. They show that $PM_{2.5}$ and nanoparticles can deposit in bronchial lung tissue of humans with nanoparticles capable of entering the blood stream. The cytotoxic effects of these deposited $PM_{2.5}$ has been shown at low concentrations. It should be remembered that autopsies of smokers lungs who quit many years before show the presence of PM particles. With the evidence of McGowan, Heine and Mitcham Park supporting hierarchies of harmfulness the "no safe dose" comment in the short and long time of Seddon-Smith gains credence. These comments are quite likely to apply in the case of racehorses and Mr Fitch quotes some reliable papers in support of his points whilst Mr Sorgensen cites no reputable scientific papers in support of his largely speculative opinions.

My final comments emphasise, again, the poor quality of much of the data gathered during the Yaldhurst and Roydons studies and how this material has been endlessly reworked into opinions unsupported by properly resourced scientific references. This has lead to much unsafe science with which to base a decision and I recommend that a decision be postponed until Fulton Hogan undertakes long term 2-3 years simple research in cooperation with an independent University scientists using FH unquarried but consented land for such experiments. I also recommend much tighter, careful and non political planning in the design of this new research.

L. Greenfield, J.P., D.Phil.(Oxon), 21 Feb. 2020.