

TRANSCRIPT

ENVIRONMENT, NATURAL RESOURCES AND REGIONAL DEVELOPMENT COMMITTEE

Inquiry into the CFA training college at Fiskville

Sydney — 19 June 2015

Members

Ms Bronwyn Halfpenny — Chair

Mr Tim McCurdy — Deputy Chair

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Staff

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Witnesses

Dr Roger Klein, and

Mr Nigel Holmes

**Necessary corrections to be notified to
executive officer of committee**

The CHAIR — Firstly, on behalf of the Committee, I would like to welcome Dr Roger Klein and also Mr Nigel Holmes. Thank you for coming on such short notice to talk to us, we really appreciate both of you sparing your time in a very busy schedule to talk to us.

Now I just have to go through a few issues in terms of the proceedings. All evidence taken at this hearing is protected by Parliamentary privilege, as provided by the Constitution Act 1975 and the provisions of the Parliamentary Committees Act 2003, and is protected from judicial review. Any comments made outside the precincts of the hearing are not protected by Parliamentary privilege.

All everybody given today is being recorded and you will give a proof version of the transcript. Following your presentation to us this evening, we will ask questions relating to the evidence that you have provided to us and again, we appreciate you coming to speak to us and perhaps we will get started.

In terms of format, would you prefer that we start off asking you questions straight away or would you like to give a bit of an overview?

Dr KLEIN — Basically if you outline what information you require from us and we will take it from there.

The CHAIR — Firstly, could you introduce yourself in terms of your title and experience?

Dr KLEIN — Yes, I am from a rather mixed background. I am actually trained as a medic and a physical chemist. I have, however, 43 years experience of working with fire services worldwide initially. I was the county HAZMAT advisor in my county in Cambridgeshire. That elevated itself to policy level with the UK Home Office, particularly to do with risk assessment and command and control and it has slowly gotten more and more international.

I became involved in the post instant debriefing of 9/11 for Fire Department New York. More recently I have been very involved here in Australia with the environmental impact of firefighting foams. I have run a series of international conferences on firefighting foams going back 12 years.

All of that, until I retired, was basically a hobby. I am actually by profession a theoretical quantum chemist, but since I have retired I have done more and more consulting in the area of environmental chemistry.

I have my PhD in physical chemistry from Cambridge. I also qualified in medicine from Cambridge. I did three months obstetrics in the middle of a civil war in Nigeria; so a whole mixture of things.

I am just basically a mere scientist.

The CHAIR — Mr Holmes, Nigel, I am not sure how you would like to be addressed.

Mr HOLMES — Nigel is fine, thank you. Yes, I am here, with Roger that is, to co-ordinate the draft Queensland management firefighting foam policy explanatory notes seminar that we have been running also consultation with industry.

My normal role is a state-wide incident responder. I am a principal advisor for incident management for the Queensland Department of Environment and Heritage Protection with the incident response unit.

My background is about 29 years across multi-disciplinary areas in environmental assessment, regulation, policy, development. That, sort of, spans consulting and government roles in land and marine incident response, pollution management, contaminated sites assessment, remediation, aquaculture and even geotechnical assessment and engineering areas. So I have got a diversity of biological and physical sciences' background, with a fair bit of experience with pollution management and toxic substances.

The CHAIR — Do you mind perhaps a little later on if we ask you a few questions as well?

Mr HOLMES — Sure, that is fine.

The CHAIR — The first question we are struggling with is the old foams that were banned, the PFOA that was contained in the old fire foams.

Dr KLEIN — I will give you a short history of firefighting foam.

The CHAIR — This we understand is an emerging contaminant, PFOS and PFOA out of these foams that are now being banned. We are told they are emerging contaminants and we do not know much about them.

Dr KLEIN — That is not quite correct in Australia. Australia has not yet ratified the PFOS, POPs Annexes A-D in the Stockholm Convention. We thought they were going to have ratified it on 11 June, last Thursday, but in the seminar yesterday, Dr Sarah Broomhall from the Department of Environment Canberra actually said it had not yet been ratified. So technically speaking PFOS is not yet banned in Australia.

Ms WARD — Did she give an indication when Australia would be ratifying it?

Dr KLEIN — I went to Canberra on my last visit and talked to the people in the Department of Environment and they admitted to the process being appallingly slow. They had no idea when it would actually be ratified.

Ms WARD — Can you tell us what industrialised nations have ratified the Stockholm Convention?

Dr KLEIN — The use of PFOS in firefighting foam was absolutely banned by 27 June 2011 in the European Union.

Mr HOLMES — That is correct.

Dr KLEIN — All stock had to be destroyed as soon as reasonably practicable and treated as regulated industrial waste. That included foam contaminated with PFOS. That is an extremely important point to realise. The old foams that would have been bought in the seventies, early eighties were made with PFOS and PFOA, but what has subsequently been discovered is that fire services and big industrial concerns were rather bad at keeping inventories of what was stored in foam bladder tanks. So they ended up contaminating new product with old PFOS stock. What we are now seeing is incidents occurring where companies do not realise they have got PFOS contaminated foam until the regulator demands that the fire water run-off is analysed post-incident.

There is a legacy issue. Most people, I think, have voluntarily ceased to use PFOS foam except—I think I am correct in saying—we are aware of certain country fire brigades who still use PFOS foam because they have it in stock.

Mr HOLMES — And perhaps industrial facilities that do not realise they have it. We are discovering that as we are auditing facilities in Queensland.

Ms WARD — Are you aware of that being the case elsewhere in Australia other than Queensland?

Dr KLEIN — Yes.

Ms WARD — Would it be also the case in Victoria at the current time do you think or do you know?

Dr KLEIN — Was that privileged information we were told?

Mr HOLMES — Probably not.

Dr KLEIN — I actually spoke at Greenvale fire station within 20 minutes of landing at Tullamarine and one of the things that turned up was that it did appear that the Country Fire Authority was still using PFOS foam.

Ms WARD — What period was this? When was this?

The CHAIR — Now.

Dr KLEIN — Last week.

The CHAIR — Who told you that, the crew at the station?

Dr KLEIN — We were in a meeting with a range of fire service officers. I could not be specific who said it.

The CHAIR — The next question is, these residual products of the foam, what is the threat to (1) the environment and (2) to people?

Dr KLEIN — PFOS is classified under the Stockholm Convention as very persistent, biocumulative and toxic. There are trigger levels that are required to be met before you can classify it in that way but it is classified as toxic to humans. There are a large range of papers published from US public health laboratories, I think probably funded by 3M; that indicate a large range of target organs where there is some indication that there is a health problem.

I put it in those very cautious terms because it is not nearly as clear cut as saying if you smoke for 30 years your incidence of lung cancer will be five times the average or if you inhale asbestos fibre you get mesothelioma of the lung. It is much more diffuse than that.

The sorts of systems that are involved, endocrine, immune, hepatic systems, blood lipids, hormones, endocrine disruption and recently, and probably the sort of thing that would cause a toxicologist to be very uncomfortable, is that perfluoro chemicals, of which PFOS is one, have been found to impair the vaccine response in children.

Ms WARD — That is definitive, that it has been found to do that?

Dr KLEIN — I can show you a short video from the United States Government that their Institute of Environmental Health published interviewing the lead author of the work explaining the background and the implications.

Mr HOLMES — There are scientific papers on that as well. The evidence is there.

Mr McCURDY — Again, how current is that information? Is that relatively new?

Mr HOLMES — Very, 2012 onwards would you say?

Dr KLEIN — Phillippe Grandjean and the paper was 2012 in the Journal of the American Medical Association. A lot of the early work was done by the names that come up in the literature, Olsen and Mandelbaum that was done much earlier, in the nineties and early 2000s, indicating there was a problem.

I think one has to be clear that PFOS is not the only problem and Nigel has part of his presentation which points out that there are probably a hundred different perfluorinated compounds in firefighting foam, of which we only know very few.

What is very difficult to pin down is an actual known disease associated with known levels of exposure. The only one I am aware of—and that was published in the Canadian Medical Journal quite some time ago—was that they found that airline pilots had a very high incidence compared to the general population of prostatic carcinoma and they put that down to exposure to PFOA. The reason for that is these compounds, both PFOS and PFOA, are used in aviation hydraulic fluids and the pilots were being exposed to aerosols as a result of the control hydraulics in the aircraft. But none of it is as definite as some other diseases.

When we come to the Fiskville situation, as I understand it, there are a whole range of contaminants there, of which the foam contaminants, quite frankly, are a very minor problem, because I gather the fire training ground was used as an incineration site for industrial waste solvents of unknown composition.

Mr McCURDY — Correct.

Dr KLEIN — I would immediately say that the site should be analysed for polychlorinated biphenyls and polycyclic aromatic hydrocarbons. You have got a much more serious problem, in that the people would have been exposed to PFOS and PFOA but they would probably have been exposed to dioxins as

well from pyrolysis of these other contaminants, and in terms of what we know about toxicity, I would be far more worried about dioxins, polychlorinated biphenyls and polycyclic aromatic hydrocarbons.

The CHAIR — All those names sound a little bit familiar in terms of readings.

Dr KLEIN — All of which have an absolutely well known specific carcinogenic effect.

Ms WARD — What are the cancers that are caused by that contamination?

Dr KLEIN — It is the reason you get lung cancer from smoking.

Mr HOLMES — Polycyclic aromatic hydrocarbons particularly in that case.

Dr KLEIN — People who handle tar products, for example, get skin cancer. It is a question of which organ is exposed. But what you get, polycyclic aromatics, when they burn in air, because there is nitrogen in air, they form nitro polycyclic aromatic and the nitro aromatic is extremely carcinogenic.

In terms of doing a risk assessment, as I said, the PFOS and the PFOA, yes, they are a risk but they are nothing compared to the others. I think I was told—was I not Kelly—that they burnt Agent Orange there?

Ms WARD — There are allegations that they have.

The CHAIR — Everything else was there, so you would not be surprised.

Dr KLEIN — I would not be surprised if there was a high cancer incidence in the area, no. But I would not put it down to foam.

Mr McCURDY — As you said earlier on, that was before we started the hearing, that if the chemicals that we understand have been burnt are far worse than anything to do with the PFOS and PFOA in the foams?

Dr KLEIN — Yes. The other crucial point I think is they should have known better at the time.

Mr HOLMES — About those compounds, certainly; that was well known.

Mr McCURDY — Even in the seventies?

Dr KLEIN — Oh yes.

Mr HOLMES — Oh yes.

Dr KLEIN — The history of the foam, the knowledge about foam toxicity or PFOS toxicity, perfluoro chemicals were not on the radar until 3M made their announcement on 16 May 2000, that they were withdrawing from perfluorooctane sulfonate chemistry, PFOS chemistry. At that point the industry said we had better look closely at the toxicology and to start with there were maybe one hundred or so papers a year being published. It has now gone up by an order of magnitude. If you look at the environmental toxicology journals, there are thousands of papers being published.

That is the firefighting foams but the toxicity of things like polycyclic aromatics and polychlorinated biphenyls and Agent Orange come to that, we are talking about three, four decades before that.

Mr HOLMES — That is half the reason those chemicals were used; they were known to be toxic. That is the reason for using dioxins and furans, for their purposes.

The CHAIR — Those chemicals are contained in tyres, which were burnt at the time. What other products were they contained in? A lot of these were unlabelled, not known.

Dr KLEIN — Solvents with aromatic hydrocarbons like benzene and xylene and toluene, yes, you would get burning of tyres but where you get your polychlorinated biphenyls from is typically transformer oil. In the old days, your substation you would see on the corner of a street would have had polychlorinated biphenyl as an insulating medium inside the transformer casing. On a smaller scale you have got high

voltage capacitors with polychlorinated biphenyls in them, but it was basically the substation transformers that had really quite large volumes in them. When was that phased out?

Mr HOLMES — Certainly about 20 years ago. I think I can remember finding some residual polychlorinated biphenyls in some transformers.

Mr McCURDY — What format does that take, the polychlorinated biphenyls? Is that a liquid?

Mr HOLMES — It is dissolved in transformer oil because it has certain thermal properties and insulating properties because transformers can get very hot. Also dry cleaning fluids, chlorinated solvents of various sorts will generate—

Dr KLEIN — Things like trichloroethylene, carbon tetrachloride. Carbon tetrachloride used to be used in fire extinguishers. Trichloroethylene I can remember using at home to get grease off clothes. But I think the one I would be most worried about is polychlorinated biphenyls followed by polycyclic aromatics.

Mr HOLMES — Polycyclic aromatics are going to be produced any time you incompletely burn any hydrocarbon. So it does not matter if it is diesel, waste oil, anything. That black, sooty plume that comes up from incomplete combustion because there is not enough oxygen in the middle of the fire, will give you a range of 200-odd compounds. Naphthalene, moth balls, is a polycyclic aromatic, so they are rings of benzene atoms in different arrangements that are not very soluble but highly toxic and they also partition into fats, so they are biocumulative and carcinogenic. They accumulate to a point where they have an effect.

Dr KLEIN — Probably the commonest way of generating them is burning polystyrene packing.

Mr McCURDY — There is a good example, moth balls. Are there many other items that were used in the seventies and eighties that you would say there is another example? Where I am coming from is something that people would come in contact with on a day to day basis, whether you were a firefighter or whether you were a pharmacist?

The CHAIR — This is burning it, is it not?

Mr McCURDY — Yes, it is still burning it.

Dr KLEIN — Moth ball contact was extremely common.

Mr HOLMES — That is probably the most common. There are not too many others I can think of apart from smokers would be exposed to them because that is incomplete combustion of carbon based materials. There would not be too many others. I guess anybody who is working with bitumen, because that is very high in polycyclic aromatic hydrocarbons, so hot bitumen would give off that sort of thing; so road workers perhaps would have a greater exposure.

There are not many other sources of polycyclic aromatic hydrocarbons. I suppose diesel engines do produce them, so a smoky engine, if you like, is an example where there might be polycyclic aromatic hydrocarbons. There are not too many though.

Ms WARD — In the course of putting out a fire you would be releasing a lot of these because you are allowing incomplete burning of the material?

Mr HOLMES — Not so much timber but anything such as rubber, certainly oils and fuels that are hydrocarbons, you are going to get that incomplete burning.

Ms WARD — So sump oil?

Mr HOLMES — Definitely sump oil, any sort of waste transformer oils. There could be other chemicals, acrylonitrile.

Ms WARD — If you are setting fire to it and then putting it out before it is completely burnt out you

are releasing—

Mr HOLMES — Fires go through stages of combustion. So the hotter the fire, the more carbon dioxide and water, the more complete combustion you have. The larger the fire, the centre of the fire can have less oxygen available to it and also as the fire is being put out, it is being cooled, so you will get more fall out, you will get a different range of products from when the fire is burning fiercely. Certainly as a general comment you would say that you would produce polycyclic aromatic hydrocarbons at any time when it is not at a very high temperature and you can see visible black soot.

Dr KLEIN — One source of this particular site, given that it was being used for disposing of old, dirty solvents that industry wanted to get rid of, contaminated diesel fuel or diesel oil will produce nitro aromatics.

The CHAIR — When you say contaminated, we also were told there are a lot of out of date products.

Dr KLEIN — Diesel oil or diesel fuel will produce nitro aromatics anyway, but if it is contaminated with goodness knows what, you have compounded the problem. Recently, two years ago I was asked to write something on diesel fumes from mining equipment because it is in a closed environment. Out in the open it is not a big problem, but if you are in a pit where the fumes have not anywhere to go, and there is quite significant nitro aromatic contamination of diesel exhaust, so it is quite normal with diesel vehicles, but if you are burning large quantities of old diesel fuel or diesel oil, that is just another contaminant you are going to produce.

The CHAIR — When you were saying the cancer depended on where the contact is—

Dr KLEIN — Well you breathe it in.

The CHAIR — Is it breathing, contact?

Dr KLEIN — It would be even worse if you got it on your skin as an oily contaminated waste product because it would be absorbed very rapidly and of course in the days when it was being done, the fireies did not in general wear sufficient protective clothing. I can remember back in the early eighties in the United Kingdom, it was just about the time that breathing apparatus at incidents became mandatory. There were a lot of training officers that we nicknamed smoky joes who took a macho pride in never wearing breathing apparatus in smoke and they would have done terrible damage to their lungs.

That has improved. Nowadays that would never happen. Having said that, there is one issue in Australia that we do not have and that is you have fireies doing bushfire firefighting and they do not wear breathing apparatus, do they?

Mr HOLMES — They do not.

Dr KLEIN — Some of the pyrolysis products, the wood burning, are quite toxic.

Mr HOLMES — And eucalyptus oil, it is a hydrocarbon.

Dr KLEIN — It is perhaps not a great deal of help to your Committee but it looks like a very multi-factorial toxicity problem. You are not going to be able to put your finger on one toxin and say this is what is causing the problem. I think any good Counsel would turn around and say you have got no proof it was the firefighting foam. It could be any of 20 other toxic materials that they were exposed to.

The CHAIR — Although this is why it is in a Parliamentary Committee, because of this very problem, is the law such that it is not fair because people cannot qualify all the boxes to take legal action for compensation. Is there another way of compensating people on a lower threshold test? That is the issue.

Dr KLEIN — They should have known not to burn unknown flammable liquids.

Ms WARD — You would say that is right during the seventies, the eighties, the nineties, that people should have known better?

Mr HOLMES — Well, if you consider the Vietnam war, dioxins were well known there, Agent Orange was well known there, DDT well known there, Rachel Carson in *Silent Spring* outlined similar issues there, so it was probably an attitudinal thing, not so much a knowledge thing.

Dr KLEIN — They should certainly have known better not to eat eels grown in the contaminated dam water. That is just, frankly, stupid.

The CHAIR — That was children too.

Dr KLEIN — I was quite surprised when we were speaking earlier today I said the thing was getting to be a complete environmental nightmare. Rather than ticking all the boxes, they were doing everything they should not have done. I was in safety in the early seventies and that is something we would not have even thought of doing then.

The CHAIR — Can you expand a bit on that, when you say ticking every box in what they should not have done?

Dr KLEIN — Well, it was fair enough they were recycling their fire water run-off at the training ground; that is very good environmental practice because it saves contaminating the groundwater. In Australia you are much more sensitive about water use than we are, so it saves water. But you then do not grow food in contaminated water and they would have known it was contaminated, if anything else, with fuel. It is just completely stupid to have done that and they should have known better.

Mr McCURDY — You are still talking about the eels or other food?

Dr KLEIN — Well I do not know.

Mr McCURDY — I suppose to qualify the eels—

Ms WARD — There is talk about the eels in the report.

Mr McCURDY — The eels are really a situation because families lived on the site, kids would go fishing. It was not as though it was a mainstay of their diet. Certainly they did consume the eels and I agree, it should not have been done, but I am not sure that it is a practice that was widespread.

Ms WARD — And I do not think it was ongoing for many years either, but your point is taken though that introducing eels into the dam in the first place was probably not a sensible decision.

Mr McCURDY — They introduced themselves.

Ms WARD — I thought they were introduced.

Mr McCURDY — They may have been.

Dr KLEIN — The question I would ask is were they using any of that dam water to irrigate crops?

Ms WARD — No, it was not used for crops.

Mr HOLMES — The exposure pathways, as Roger is suggesting, is important. You have got a direct exposure through air, direct exposure through contact or ingestion, drinking and that might even be poor hygiene, eating and drinking without washing your hands. You have also got fallout from the air. That may land on a roof, finish up in a rainwater tank. It falls on the grass, the sheep eat the grass. That moves into the food chain. PFOS is biocumulative. Other pathways might be there as well in terms of other exposures. So people who might have specific jobs in cleaning out areas, they may have direct skin contact for extended periods and may not be aware of the appropriate protective equipment.

The CHAIR — As we see this Fiskville problem, there was the seventies, eighties, nineties burning all this unknown, terrible carcinogenic materials. That continued up until 1999 we are talking about. Then from 1999 they stopped receiving fuel from petrochemical companies. Then the issue became an issue around the contaminated water and mostly what is spoken about is the PFOS and the chemicals from the

foam.

In one report it says that the burn off and the contamination based on the burning off of the old chemicals, would no longer be of risk to people or the environment on the site. Would you say that is true?

Dr KLEIN — That is a perfectly fair point because if we assume we contaminate the environmental aquatic compartment with two types of compound, highly persistent and non-persistent. The persistent ones are going to still be around. The non-persistent ones, like some of the other burn products, will have degraded. These perfluorinated materials are exceedingly persistent and I can show you data from a United States military fire training ground. Jennifer Field from Oregon State University analysed about four or five former United States military fire training grounds for their groundwater quality. The results were generally rather bad but Tyndall air force base was disastrous. Ten to 15 years after the site was used the groundwater bore holes were still foaming and the concentration of foam breakdown products in the groundwater 10 to 15 years after it was last used, one particular component was as high as 14,600 micrograms per litre. If you evaporated the water in that glass, you would see a deposit in the bottom and in environmental terms, that is a huge contamination. These products are extremely stable.

As explained in the Queensland explanatory notes in great detail, many of these sorts of products have indications that they are not as non-toxic as the industry would like to pretend. So you really do not want them in groundwater for that length of time. Well, you do not want them in groundwater, let alone for that length of time.

Ms WARD — Apart from the residue that is left behind which shows that the water is contaminated, why do you think it is an issue to have heightened levels of PFOS and others in the water and in the ground?

Dr KLEIN — One thing that became very clear in the early 2000s immediately after the 3M announcement was that biological organisms, including man, all over the world were contaminated with PFOS, even when there was no obvious route of exposure. When you start seeing polar bears and seals and Antarctic penguins contaminated with a chemical that they would have never been within 5,000 miles of, you then become seriously worried about long range transport.

It turns out there are two issues, long range oceanic transport and long range atmospheric transport. The long range oceanic transport is important with aquatic waste— that is run-off. Long range atmospheric transport is more important from manufacturing facilities. The industry has taken a great deal of trouble in the recent couple of decades to cut down on the volatile emissions when making these fluoro chemicals, but the fact is that you have a worldwide distribution of contamination with PFOS and other fluoro chemicals.

If you look at stored human serum samples, and I am sure this is true in Australia as it is in the rest of the world, before about the late 1940s when fluoro chemicals were manufactured, you did not find any organic fluorine materials in human serum—perfectly clear. Post the beginning of the manufacture of fluoro chemicals, all of us around this table are now contaminated with fluoro chemicals.

Ms WARD — Why are heightened levels of these in people a problem?

Dr KLEIN — Because the perfluorocarboxylic acids are toxic; that is well known. When you say toxic, what you have got to be very careful of is you have got to have a mechanism for toxicity. You cannot just say such a disease may be associated. There has got to be some logic in it. Certainly for the perfluorocarboxylic acids there is perfectly good laboratory evidence that they are potential carcinogens by a non-DNA mechanism. It was probably 10 years ago the United States environmental protection agency recognised PFOA as a potential carcinogen. PFOA is now being looked at by the Stockholm people as potentially to be classified as a PBT material—persistent biocumulative toxic—and put on the POPs list, the persistent organic pollutants list.

To give you some idea of the current concern, the Norwegian and the German environmental regulators have just put in a document to the European chemical agency, ECHA.

Ms WARD — We can table that?

Mr HOLMES — Yes.

Dr KLEIN — That is asking that the level of PFOA and PFOA precursors in any consumer product shall be reduced to two parts per billion. The industry has gone mad and said that would destroy the fluoro chemical industry—forget foam. Foam is a small part of the fluoro chemical industry. My own reaction to that is that figure is far too low. I actually spoke to the German regulator who I had got to know when I worked in Germany and he said basically they were kite flying. They were forcing industry to say what was achievable because industry would not tell them what was achievable.

In the Queensland document we came to a figure of 50 parts per million as a transitional trigger point. The argument for the 50 parts per million, this is in foam, was that we know that the current best—

Ms WARD — What does a transitional trigger point mean?

Dr KLEIN — When you are trying to regulate anything, you have got to have some sort of dotted line, dotted red line that you must not cross. They are not absolute. These dotted lines have to do with what is practicable at the time.

Mr HOLMES — Or what is known, what is achievable.

Dr KLEIN — And what is detectable at the time. The current situation with foam is the very best foams, modern foams, are about 99.5 per cent pure component that does not involve PFOA precursors. So we have got 0.5 per cent, that is 50 milligrams per kilo in an average foam concentrate, 50 PPM. The Germans and Norwegians are demanding 25,000 times smaller than that and my own opinion, for what it is worth, is the end result will be somewhere in the middle. If I had to guess, I would say one PPM. That is not an uneducated guess because I know the very best product at the moment is 10 PPM and manufacturers are getting better at it all the time. But the German and Norwegian thing is kite flying to get a reasonable figure out of industry.

Ms WARD — For you then the line is 50 milligrams in a human is the threshold?

Dr KLEIN — 50 milligrams per kilo in the foam concentrate.

Ms WARD — What would be safe levels in a human?

Mr HOLMES — Good question.

The CHAIR — Or what would be unsafe levels?

Mr HOLMES — There is another good question.

Dr KLEIN — I do not think there is a safe level with a persistent material.

Mr HOLMES — There is not enough information on that at the moment. That is the question that everybody is asking. It is very difficult. We are barely coming to grips with safe drinking water standards in regards to that. So there may be some of the health publications like those in the scientific publications that delve into that but I am not aware that any of them are definitive.

Ms WARD — What would you be comfortable with in your own system? What would trigger alarm bells with you?

Dr KLEIN — I would not.

Ms WARD — You would not want any?

Dr KLEIN — I will give you a very specific example of how I would avoid it. Many of the products you buy to spray on outdoor clothing or your boots are basically pure fluorotelomer alcohol in solvent. There are some that are not. I would not use the ones that contain fluorotelomer alcohol because what happens, you spray your clothing, that you inhale the aerosol, because you do not wear breathing apparatus when you are doing it in your garage or wherever you do it. Your liver converts the fluorotelomer alcohol

to toxic perfluorocarboxylic acids, which are carcinogenic.

These are highly persistent and I think this is where there is an extremely important point in Australian law which has recently been established, the precautionary principle. The burden of proof moves from the user to the provider when you do not know where the harm will be caused but because they are persistent, the temporal extent is very great. The time span is very great.

There is a judgment by Preston J in 2006 in the New South Wales High Court where he lays out absolutely analytically the points in the precautionary principle approach. The trigger points that are extremely important to these sorts of compounds, temporal extent, are they persistent, spatial extent, are they widespread, and the answer with these fluoro chemicals is they are both highly persistent and globally spread; and uncertainty as to the harm caused, particularly if there is evidence that similar structures cause harm.

So it is when the index of suspicion is high, when you have reason to believe that based on chemical structures you would be concerned that this new chemical might behave in a similar way to this known one, it is persistent and it is widely spread, then you apply the precautionary principle.

Ms WARD — If you were to have a blood test, what level if your own blood would concern you?

Dr KLEIN — The straight answer to that is I do not know. Put it this way, yes, I do know. If my blood level was more than 10 times the population average I would be very concerned.

Ms WARD — What is the population average?

Dr KLEIN — Depends on the country.

Ms WARD — Do we know what the average is in Australia?

Dr KLEIN — It has been done for Australia; I can give you the reference.

Ms WARD — Could you tell me what that is for Australia?

Dr KLEIN — I cannot tell you what the figure is; I would need to look at the reference. You can get these figures for the United States as well. Probably most work has been done in the United States.

Ms WARD — So anything 10 times the national average would concern you?

Dr KLEIN — I would be very concerned at 10 times the national average, given that I have no reason to have been exposed. This is where you have to be very careful; you have to know the history of your patient. If it was a firefighter I would have said that would not surprise me at all. The next part of the question is at what level is it bad for you and I am afraid one does not know.

The CHAIR — Because there has not been enough time gone by for conclusions to the research? I do not know if you have seen our terms of reference?

Mr HOLMES — No we have not.

The CHAIR — We are supposed to make a comprehensive historical study of pollution, contamination and unsafe activities—we can do that. A study of the health impacts on employees, residents and visitors—that is both the old chemical burning, plus the foam and the water contamination. A study of the role of past and present executive management at the place; an assessment on how feasible it is to decontaminate the 360 hectares of land and recommendations as necessary to mitigate ongoing harm and provide justice to victims and families.

That is why we are asking some of the questions, especially in relation to mitigating ongoing harm and to provide justice to families who are suffering from cancer, auto-immune disease, whether there will be issues in the future.

Mr HOLMES — In the scientific literature that we have reviewed—and we have not particularly

looked at the health issues because it is a peripheral issue to foam use—it has been raised, so we have looked at it to the extent that it satisfies us that there is an issue.

The sorts of things that you have mentioned, immune disease, side effects, all the way up to cancer, you cannot make a direct association very easily. Unlike something like asbestos exposure and mesothelioma, you could probably tie that pretty closely to somebody's history working with asbestos.

The CHAIR — But in the early days it was completely denied.

Mr HOLMES — That is right.

Ms WARD — It took us a while to get to arrive at the point where we concluded that that was the connection, but suspicions were there for a very long time.

Mr HOLMES — Exactly, for a very long time in the case of asbestos and then you have more subtle things like tetraethyl lead in petrol hindering childhood learning and development. Even things like thalidomide were not understood fully. There are plenty of examples; DDT being another one.

Because of the relatively low expression of symptoms, if you like, so that you do not have an immediate identifiable disease that can be associated with it, the subtleties of what the effects can be would be quite easily confounded and hidden in amongst other factors.

If a person is a smoker, if a person works with farm chemicals spraying other things; whether they work in a very smoky environment normally in terms of bushfire fighting or occupational exposures to other chemicals; somebody who works in a workshop is breathing in solvent fumes in the days when they used to wash parts in kerosene and petrol, which contains benzene and other things that have a very similar effect.

So that is the difficulty that you do not have, and also for environmental impact as well, a very clear association between an effect, whether it is reproductive impact, reduced ability to reproduce or to grow through to things that maybe have caused death; so what was the actual cause? In some ways you need to look at what is the residue because in a sense, persistence is one of the things that maybe in your favour, because you will still find this stuff in the environment because it does not go away. Persistence is pretty well indefinite, as the end point compounds. Some of them are a bit complicated but they will always finish up as more or less a PFOS or a PFOA or something very similar in behaviour and structure.

You may find that in your people, in your soils, in your water, in your groundwater. That is where you might look to say: Is the concentration in those different compartments, whether it is animal or environmental, is that above the normal in other areas? But making the link to particular effects, even though there are many papers that show effects in different ways, so cultured rat liver cells, for example, show an effect, but relating that back to human liver cells or humans is a difficulty, because these compounds react differently according to hormones; so for males and females it is different, for different species of animals it is different; for different exposure routes it is a problem. It is not a clear link. It is not even as clear as smoking and lung cancer or throat cancer.

We fully understand the difficulty you face with this and that is why I think the precautionary principle is important to the argument, because enough is known certainly now to apply the precautionary principle and say if we know there are compounds that are having an adverse effect or could have adverse effects, then similar compounds should not be used until the proponent, in other words, the manufacturer/supplier, can show us that they are safe to use and that in Preston's judgement is a very clear elucidation of that as well and our understanding.

I think the issue there is how long ago should the precautionary principle have been applied? How long ago were these effects clear enough? There is a reference in our explanatory notes to a paper that actually charts the number of peer reviewed scientific papers about fluorinated organic compounds and back in the nineties or thereabouts there was probably only about 150. If you extend it out, there are about 150 a year published, so we are looking at about 1,000 now and from my review of maybe 250 of those—and there is probably more that we do not know about—it is a fairly well established area of enquiry from the point of view of are there any indications that there are problems with these compounds and the answer is yes. That train of scientific papers going back would show where that knowledge should have been known.

Scientific papers are not something you read in the Courier Mail or the Telegraph so how it comes into the workplace area, the commercial scene if you like, and translates is another issue. Was it reasonable for somebody to have read an obscure scientific journal might be the question there as well? But certainly the information is there and it is fairly clear when that became available, when there were significant indications of problems in biological systems or humans or the environment.

I think that much is clear. It is whether or not it was reasonable to know might be the question which you need to look at.

Mr McCURDY — Do we know whether firefighters throughout the world, in Europe or the United States, are tested for PFOS or PFOA?

Dr KLEIN — I would have said almost certainly in Germany.

Mr HOLMES — Workers in the United States.

Dr KLEIN — I am not aware it is done in the United Kingdom. It has been done in the United States. I think the problem with all of this is actually associating any particular health effect with the exposure. This short clip I have got from the United States Government actually highlights some of the uncertainty. It is an interview with the lead author of the work on the vaccine immunisation program. What he did was take a population of children in the Faroe Islands, because they have a predominantly marine source of food which is contaminated with fluoro chemicals. He explains very well the limitations to the work; that you cannot actually put your finger on cause and effect. You have a presumptive connection, but not an absolutely cast iron council-proof one.

Ms WARD — Why was PFOS banned in the European Union?

Dr KLEIN — PBT—unacceptable persistence biocumulative toxicity.

Visual presentation

Dr KLEIN — I think what I would say to this is one of the problems is that firefighting foam is not the only source of these materials. On a global tonnage scale, firefighting foam represents about five per cent of the fluoro chemical tonnage used. It is, however, the most highly dispersive application of any. None of the other applications involve spraying a fluoro chemical on open ground and drainage into groundwater or waterways for example.

Having said that, there are other means of exposure to fluoro chemicals—carpets, textiles, paints, food packaging and it has turned out that some of the contamination pathways involve waste water, going to waste water treatment plant. The fluoro chemicals end up in the sludge. They end up in sediments. If any run through the waste water treatment plant, which they do, they will end up in river, estuarine and marine sediments.

Mr HOLMES — And irrigation.

Dr KLEIN — They will be eaten by bottom feeders and go up the food chain. The sludge itself from the waste water treatment plant is used for agricultural top dressing. Direct contamination of the food chain and groundwater and there is a very well known example in Europe where a farmer top dressed one field of 10 hectares in the Möhnetal in Germany and managed to contaminate the entire rural valley water catchment area. That is waste water treatment plant.

Landfill you would imagine was well contained but in times of flooding the leachate overflows, but more importantly normally in landfill and also waste water treatment plant, produce volatile short chain compounds by degradation of fluoro chemicals which diffuse to upper atmosphere, travel round the world in very short periods of time. The transit time in the upper atmosphere has nothing to do with Jules Verne's *Around the World in 80 Days*; it is seven to 10 days to go around the globe.

Ms WARD — What do you think of mounds of contaminated soil, not so much landfill, but mounds?

Dr KLEIN — It would not make any difference. What happens is you get soil bacteria, you get volatile

compounds released to the atmosphere. There is another significant problem, these volatile compounds have global warming potential. So there are multiple routes of contamination. One of the big problems, even with PFOS, is that historically you would find it very difficult to blame any particular source.

Ms WARD — In a normal environment?

Dr KLEIN — In a normal environment. The presumption would be if you had a firefighter with a very high level, that they had been exposed to it through firefighting foam but equally well a really wily Counsel could argue they had been exposed to it by another means and you could not prove otherwise.

The CHAIR — [REDACTED]

Dr KLEIN — Let me try and find my reference to the Australian results. I did not think I was going to need my 8,500 references when I came.

Mr HOLMES — The issue would be to compare it to the local population, who would have a particular exposure through drinking water, exposure to textiles, that sort of thing. So that is why you would not compare it to the United States or the United Kingdom population, to say whether exposure of a particular person is higher or lower than the average.

Ms WARD — The challenge there is if you have got people living around an area that is polluted, they are not going to be the average with which you would compare?

Mr HOLMES — No, so perhaps look at the Red Cross blood bank who may have done something in Sydney or Melbourne or wherever.

Ms WARD — If it was someone in Victoria who had been tested, you would look at what the Victorian average is?

Mr HOLMES — Yes, preferably in an area that does not have a particular exposure.

Mr McCURDY — Can we test everybody who went through Fiskville for example, get a blood test from them and rate that against the State average of Victoria? Would that tell us anything?

Ms WARD — That would tell us whether or not their test results would be higher than average.

Mr HOLMES — And also if you looked at say your new recruits of firefighters coming through whatever facility that is now properly controlled, compare them to the average. It might be easy for you to get blood samples from those recruits, but the general population figures should be available.

Dr KLEIN — These are four specific references I happen to have to Australian serum PFOS levels. We will just see how informative the abstract is.

Visual presentation

Mr HOLMES — There are some results there from 2002, 2008, 2010, 2011, south east Queensland.

Mr McCURDY — [REDACTED]

Dr KLEIN — [REDACTED]

Ms WARD — [REDACTED]

Dr KLEIN — [REDACTED]

Ms WARD — [REDACTED]

Dr KLEIN — [REDACTED]

The CHAIR — [REDACTED]

Ms WARD — [REDACTED]

The CHAIR — [REDACTED]

Dr KLEIN — [REDACTED]

Ms WARD — [REDACTED]

Dr KLEIN — [REDACTED]

Ms WARD — [REDACTED]

Mr HOLMES — [REDACTED]

Ms WARD — Can I just show you a map of Fiskville. Now unfortunately I do not have a key here to tell you the distance. Here is where they practised. This is the area here. This is where you have high contamination of PFOS but where you have also got the burning of fuels and so on. That is all happening here. You have got a school here and you have got residences here. What do you think about that proximity?

Dr KLEIN — Far too close.

Mr HOLMES — Proximity is not good. Prevailing weather would also be an issue; so who is being most exposed, if it is a south east or south west wind.

The CHAIR — To the south west, was it not?

Dr KLEIN — Where are the prevailing winds?

The CHAIR — South west.

Mr HOLMES — If you have a south westerly wind coming from southern west—

Mr McCURDY — It is going straight over the school.

Ms WARD — It is going straight over the school.

Mr HOLMES — [REDACTED]

Ms WARD — [REDACTED]

Dr KLEIN — [REDACTED]

Mr HOLMES — [REDACTED]

Ms WARD — [REDACTED]

Mr HOLMES — [REDACTED]

Ms WARD — But you do think that that school is far too close to where the burn offs were occurring?

Mr HOLMES — Taking the road reserve is about a 20 metre—

Mr McCURDY — It is 500 or 600 metres, is it not?

Ms WARD — Yes, it is not far.

Mr HOLMES — That is about it.

Dr KLEIN — The important thing is it is downwind with the prevailing wind.

Mr HOLMES — Winds at different times of the year could be in different directions. If it is used extensively, anybody could have been exposed and their exposure route may not necessarily be on the day of the fire. For example, if there is fallout to vegetables in the garden or something and then they are consumed later or through rain water.

Dr KLEIN — I can supply you with full bibliographies when I get home.

Ms WARD — Is that location of the school of concern to you? It is not there now, but it was there when the PFCs were being used and when the contaminated oils were being burnt?

Mr HOLMES — Certainly that would be within the range of a plume of burning material to have settlement, depending on the weather conditions, especially on a cold day where you will get an inversion layer and you may have fallout in that area.

The CHAIR — When you are talking about people's knowledge and obscure papers, when we are talking about a public school and big decisions, do you think these are things people should have known?

Mr HOLMES — I think the location of the school is probably a planning decision, a convenience decision at the time and what was maybe considered mostly was whether or not there would be smoke nuisance, noise nuisance, odour nuisance, that sort of thing, rather than any consideration of health effects. Once those facilities are in place there is a fair inertia about moving them and maybe not a consideration anyway if there is no direct impact or link. Say suddenly you have kids getting sick every time there is a fire, they might then consider it.

Ms WARD —

The CHAIR —

Ms WARD — Animals grazing on an area with that run-off, would that be of concern to you?

Mr HOLMES — Yes and fallout.

Dr KLEIN — Yes, entering the food chain, another source of human contamination. You can get very, very marked what is called trophic magnification defaults. The Arctic Council in Oslo published some data for the northern hemisphere. That had data for clams running up to shrimps, small fish, large fish, predatory gulls and as you go up the food chain, the clams feed on contaminated marine sediments, the next series eats the clams, and so on up the chain. We are at the top of the predator chain. There was a million-fold concentration of PFOS up that chain.

Ms WARD — Would you want to eat any animal that has got PFOS in it?

Dr KLEIN — I am absolutely certain I have.

Ms WARD — Would you want to?

Dr KLEIN — Not if someone told me.

Ms WARD — So you would refuse it.

Dr KLEIN — But I am certain the steak I had the other evening had trace amounts of PFOS in it.

Ms WARD — It is just to what level?

Mr HOLMES — That is right and that is what we are not sure about.

Dr KLEIN — Exactly. This has been known for years with mercury in fish. You have to be very careful, it is very organ specific. It turned out it is not the muscle in the fish, it is the skin for mercury. You cannot guess which bit is contaminated, you need to know, but mercury shows the same sort of trophic magnification up the food chain. What you will find is the industry these days says our modern products are not toxic. What they mean is they are not as toxic. They come under the regulatory trigger levels. That is not the same as saying that they are non-toxic; they are less toxic.

There was the Queensland Government seminar on managing firefighting foam and the industry was still saying the new compounds are not toxic. But yesterday evening, the last speaker then said, they were just about to publish a paper in environmental science and technology which showed that the short chain materials that were supposedly non-toxic were gene toxic.

Mr HOLMES — We are finding out more and more as we go and generally it is an addition to the concerns.

My thoughts on the particular location, it may be very useful to engage an air quality consultant to run plume modelling under a model similar to one called AUSPLUME because they can model quite accurately given the location, weather inputs for different times of the year, different conditions, how the plume will behave. In other words, how hot the fire is, what the scale and size of it is. That information should be readily input into that sort of model and they can then tell you where the greatest risk areas are, what the dilutions are, for example.

For example, I would say that when you are actually fairly close to that fire you are actually in a safer place than if you are further away because it is hot and going up and when it cools and comes down at a distance, that is where your risk will lie. Putting an arbitrary scale to that to say is 600 metres safe or not? It depends on the size of the fire, how hot it is, whether they light it, extinguish it, light it, extinguish it, hot, cold, whatever. There are so many variables.

That could be reduced to a set of models and a coloured contour plan if you would like to say: what are the typical concentrations. You could then look at that and say, at least in terms of exposure on a relativistic scale, probably not in terms of concentrations of PFOS because that is really not going to be known or polychlorinated biphenyls or anything else because you do not know what the starting concentrations are.

But certainly on a relative scale, what the plume behaviour and distribution is going to be, that could be visually put over a photograph like that in a series under the different conditions of fire and weather. That would be one suggestion that could clarify things for you.

The CHAIR — That would be about providing some proof or information as to whether it is an accumulation of PFOS in the body or maybe a particular cancer that would give you an indication of the amount of exposure.

Mr HOLMES — It would certainly give you a feel for the extent of risk. I do not know that you would get any way of correlating the potential effects, as it were, but you could certainly say if somebody is at a certain distance and a certain location, how does that compare to somebody else who is twice that distance away or four times that distance away or 10 kilometres away? The dispersion modelling that they might do would show you and I think fires would be fairly easily modelled in that sense with typical fuels in hydrocarbons.

That could be helpful to you to say based on experience, and some of these consultants may well have had situations where they have had to do that. For example, in my previous consulting work I have seen that sort of thing done for say, a pulp mill that has a stack that emits whatever gases, a magnesium smelter, magnesite production, all the different particulates, how sulphur dioxide may affect somebody nearby. You can do it for different contaminants. In this case I am not sure that anybody would have the data on

how PFOS might be distributed. They may have equivalents for polychlorinated biphenyls or, concerning polycyclic aromatic hydrocarbons and general plumes. That would have to be discussed with a consultant to decide what would fit your interests most. I think you could get some very professional advice in regards to that better than we can provide.

The CHAIR — The next one of course is the link, establishing the amount of exposure and if it is above normal levels, so therefore it comes from there. Then the second is how you determine if an illness or disease is as a result of that.

Mr HOLMES — At the simplest form, if you have the contours on there for different conditions and say here is relative exposure and then if you also plotted the PFOS concentrations or other contaminant concentrations in soil, water, people perhaps, then you might find an association that says these people fall along this contour, are their values or their soil values or water contamination following the same pattern or not? That might decide whether there is an association between air emissions and fallout versus say, downstream run-off, which is much harder to model.

Certainly groundwater flow is relatively easy to model but they do need a lot of data from bore holes in the area to do that, so that one may or may not be possible depending on what information is available and that is far more complicated, whereas air emissions are relatively easy to do. It is topography, weather, emission source and temperature conditions.

Visual presentation

Dr KLEIN — This is just some pictures underlining what I have said before. That is published data on distribution of PFOS globally. Polar bear and seal livers; increasing contamination on the right, over here. The human PFOA levels are now decreasing because in 2005 the industry entered a so-called voluntary stewardship program to reduce PFOA levels and that has had an effect. But this is quite interesting, again it is far distance contamination. This is a lake in northern arctic Canada where they have taken sediment core samples and analysed them for break down products from fluoro chemicals.

In the early days it was predominantly PFOS but what we see as we get to the shallower cores in more recent years, is we are getting increasing contamination with the modern fluoro chemicals. This is the bio-magnification I was talking about. Clams are down at the bottom, shrimp, various sorts of fish, plankton, walrus and we go up the predator chain. That slope there, it is about something of the order of 100,000 to a million between the clam and the gulls. That is very significant, since we are at the top of the predatory chain.

Mr McCURDY — I am not going to eat gulls anymore.

Dr KLEIN — Do not even think of eating gull's eggs, they are terrible. But seriously, the fish at the top of the chain which we would eat, will be contaminated.

Ms WARD — The European Food Safety Authority, for PFOS, I understand restricts daily intake to about 0.15 micrograms, is that right?

Dr KLEIN — Now those results are in the explanatory notes, are they not?

Mr HOLMES — I am not sure. I do not think so.

Dr KLEIN — Or in Jimmy's paper?

Mr HOLMES — Yes.

Dr KLEIN — Dr Seow of the Western Australian Department of Environmental Regulation published a document on perfluoro chemicals about two years ago.

Mr HOLMES — I can provide that to you.

Dr KLEIN — That, taken together with the Queensland explanatory notes, actually has these cut off levels, these trigger levels for drinking water, dietary intake. They are jurisdiction dependent. The health

department in Minnesota was one of the first to set drinking water levels and they are quite low. The Brits, I am ashamed to say, are much more laid back about it and they are about 10 times what the Germans are prepared to accept.

Ms WARD — What has this meant for food production in Europe?

Dr KLEIN — I do not think it has had any direct impact. It is probably more important if you are a water undertaking, because it means the moment they set a trigger level, there is what we call a consent level and you are actually required to measure it. There is a huge problem with PFOS and other fluoro chemicals. The industry has tried to get rid of it but it has found that it sticks to tank walls and pipe work and valve seals. So the only way of getting rid of it is to replace the process plant. There is a residual level of PFOS contamination and many of these trigger levels represent a realistic practicable solution to the fact that it is very difficult to get rid of.

Ms WARD — What would be your view on remediating sites, including dams that have got PFOS in the sludge as well as the other chemicals caused by the burning of the petrochemicals and so on?

Dr KLEIN — Here in Australia you have one of the premier remediation companies, CRC Care. The direct of CRC Care, Ravi Naidu, was speaking at our seminar yesterday afternoon. They are developing methods for remediating both large volumes of run-off and soil. They have a method based on amine modified clay that they pass large volumes of contaminated run-off from a dam or from a fire incident, from a river if it is badly contaminated, and can produce drinking water quality effluent and a highly concentrated fluoro chemical waste which is much cheaper to get rid of by high temperature incineration.

DuPont in the States has developed a completely different process, which involves taking run-off, contaminated water, wherever it has come from, using electrocoagulation to deposit a lot of the unnecessary material like protein, because you cannot put protein down these columns to strip out fluoro chemicals and then use reverse osmosis to remove the fluoro chemicals. It is the same principle. You use a physico-chemical technique to remove the fluoro chemical and you end up with a concentrated fluoro chemical on activated charcoal or clay which you can then high temperature incinerate.

This used to be very expensive. It used to be by plasma arc or specially adapted commercial domestic waste incinerators that had to scrub their flue gases to get rid of the hydrogen fluoride produced, because there are very strict threshold limits on the hydrogen fluoride content in flue gas that you are allowed to release. Recently the price was somewhere around \$AUD20 a litre. If I were to tell you at a big incident like the Buncefield tank farm fire they had 55 million litres of contaminated run-off at \$20 a litre it becomes prohibitively expensive.

Recently in Australia it has turned out that Cement Australia can put this material into the rotary calcining kilns. Now this has the great advantage that you have got fluoro chemical contaminated waste which can be liquid, because they have a slurry process, to put into a high temperature kiln, it is converted to calcium fluoride, which remains in the cement and the calcium fluoride was the mineral the fluoro chemical industry got its fluorine from in the first place. So it is a completely neutral environmental cycle.

Ms WARD — How much soil would you have to pick up to burn in order to remediate a site? How far do you have to go before there is no PFOS or hydrocarbons in it?

Dr KLEIN — I have a video if anyone is interested, but Jersey airport had exactly the problem that Fiskville had, exactly the problem that Oakey has. They contaminated a closed hydrological system, the island's water supply, with a fire service training ground at one end of the airport. Very unusually, the states of Jersey published in the State gazette the deed of settlement which outlined the cost of all the remediation strategies. They should not have done so because the document said in one of the paragraphs this is confidential information and not to be made public.

I happened to read it before it was taken off the site and made a copy of it of course. Basically it has four options, and this was a very small site.

The CHAIR — What size roughly?

Mr HOLMES — A few hectares.

Dr KLEIN — A hundred yards across, something like that.

Mr HOLMES — There might have been a couple of hectares, a hectare being a hundred metres by a hundred metres.

Dr KLEIN — I can show you the video if you are interested but the four solutions were removal of 30 metres of soil depth of the fire training site would have cost £30million in 1999; removal to 10 metres would have cost about £22 million from memory; removal to a couple of metres, with the insertion of impervious membrane and a deep concrete wall to stop groundwater movement or a fourth option, do nothing at all.

Ms WARD — What did they choose to do?

Dr KLEIN — Option three and they actually said thank goodness, because option four, doing nothing at all was politically, ethically and environmentally unacceptable. So what they did was take the top soil, the couple of metres.

The CHAIR — Of the whole site?

Dr KLEIN — Of the whole site, put in impermeable membrane I, put a deep concrete wall vertically to stop groundwater flow.

Ms WARD — Around the perimeter of the site?

Mr HOLMES — In the direction of flow on the contaminated site.

Dr KLEIN — And then put an impervious concrete apron for training on with isolated drainage.

Mr HOLMES — So to not release more contaminants but more to stop the—

Dr KLEIN — This is the only example I know of that you have any idea what it actually costs. But the significance of the Jersey airport incident was they actually did groundwater analysis over a long period of time and the plume continued to spread and it impacted on the island's drinking water supply, property prices and agriculture.

Ms WARD — This is just from a couple of hundred metres?

Mr HOLMES — Yes.

Dr KLEIN — Tiny site.

Ms WARD — And it has caused that much damage?

Mr HOLMES — Yes.

Dr KLEIN — The senator in charge of this said it was a complete and absolute disaster because Jersey relies on its agriculture. Nigel and I have discussed this in terms of the Queensland experience, were one to contaminate the fisheries in Queensland, it would be an economic disaster and this has happened. There was an incident in Botany Bay, just down the road, where the foam was discharged into Botany Bay. The foam was not particularly toxic. It was a high protein foam. Many people would say there is nothing wrong with protein in the long term. The result was they had a toxic dinoflagellate bloom because the protein was a nutrient, which wrote off the shell fish industry for some months.

The CHAIR — When you talk about the Jersey example and the potential for the economic disaster in terms of the drinking water, the livestock and all of that, they were saying that they cannot prove anything, so why was it going to be an economic disaster, just because people did not want to eat their products?

Dr KLEIN — Leaving aside the hard facts one can establish, there is a very serious problem of public perception and reputational damage. Whether or not one has scientific evidence that a certain level of

PFOS is bad for you, they would not have been able to sell their vegetables on the United Kingdom mainland if they were in competition with uncontaminated food.

The CHAIR — And they would have to declare it or people would know through publicity?

Dr KLEIN — It was all over the press.

Mr HOLMES — And testing was being undertaken to ensure that their produce was free from it or had contamination and I suppose if something had shown up in results then people are very cautious, they would have sought a different supplier.

Ms WARD — Was any livestock contaminated from this site?

Dr KLEIN — I am not sure whether they measured that or not.

Mr HOLMES — You mentioned site clean-up, there are a number of techniques that are arising there Professor Ravi Naidu from CRC Care is probably the best person to talk about that. There are ways of remediation through fixation, so you immobilise what is there. These are very recent developments.

Ms WARD — And then wait?

Mr HOLMES — No, you lock it up and it can stay there or you can lock it up in the soil matrix and take it somewhere else, the landfill for example. Groundwater, there are ways of filtering out the contaminant, if you like. If that is not economic, then the Jersey example applies where people no longer drink the water and that is happening at Oakey in a particular area where the levels are high.

Ms WARD — On the island of Jersey no one drinks the water?

Dr KLEIN — They had to provide bottled water. Let me just show you the video. It indicates all sorts of issues that are currently being experienced.

Visual presentation

Dr KLEIN — Leaving aside that this is PFOS, this could be any persistent biocumulative toxic contaminant in the environment.

Mr HOLMES — Including polychlorinated biphenyls.

Dr KLEIN — This was an ITV television report.

Ms WARD — In Jersey they were using the United States measuring system as their reference point?

Dr KLEIN — The United States actually has been very much in the forefront in this because, of course, 3M were a big United States company. The health department in the State of Minnesota was one of the first to set drinking water limits.

Ms WARD — This is what Jersey is referring to when they have got that in the letter about the US Environmental Protection Agency?

Dr KLEIN — They are referring to the US EPA setting a provisional cut-off of one PPB. We found this when we were doing this work on the Queensland and Western Australian policy, that a lot of the early reference material was United States based. The Germans followed fairly quickly. The Brits were fairly slow. That is fairly low, one part per billion.

Mr HOLMES — It is very low.

Dr KLEIN — It is one microgram per kilo.

Visual presentation continued

The CHAIR — Could we get copies of those?

Dr KLEIN — You can have copies of the United States Government one, that is freely available. This Jersey, unfortunately I obtained under licence.

Mr HOLMES — I think you can have it under Parliamentary privilege.

Dr KLEIN — But they have a very good archive department in St Helier and you could acquire a copy.

Mr HOLMES — The Committee has Parliamentary privilege Roger.

Dr KLEIN — Then there is no reason why I should not give you a copy.

The CHAIR — For the rest of the Committee that could not come up to Sydney, it would be good for them to have a look at it.

One of the questions I have been asked is Jersey the same as Norway? Was that a similar situation in Norway?

Dr KLEIN — I did not have anything to do with the Norway investigation. The Norwegian investigation was carried out by their environment agency, the SFT at the time. They looked at four sites in Norway. They looked at Gardermoen, which is Oslo airport. They looked at Rygge former military airport. They looked at Mongstad, which is the refinery in western Norway and they looked at a foam manufacturing facility.

Basically they found contamination of soil, water supplies. In fact, the Skype that interrupted us was actually from the former managing director of the foam company involved. They found that they had significant PFOS contamination of their run-off into the fjord and they have had to undergo really very expensive remediation procedures to make sure that does not happen. They found shellfish in the fjord were contaminated. It subsequently turned out it was not their fault. There was an old paint store up the hill from them and paint has PFOS in it. The old paint store was leaking PFOS into their groundwater.

This is just another example of where you think you have got the obvious source and then you discover it is really something quite different.

Mr HOLMES — That paper is amongst our references.

The CHAIR — The remediation in both cases, was that as required by law or for moral and ethical reasons?

Dr KLEIN — This particular company we are talking about is probably the most ethical company I have ever come across.

Mr HOLMES — I would agree.

Dr KLEIN — They did a lot of their own research, spent a lot of money and then have ended up with a state of the art installation. The factory site is about 20 metres from the edge of the fjord, separated by a road. They have installed on the fjord side of the road a waste water treatment plant so that run-off from the company site goes through the waste water treatment plant and then to the fjord. They have been collaborating with the Norwegian regulator.

It is a very good example actually. It has probably cost them less in the end because they would have been heavily fined or lost their operating licence.

The CHAIR — On the basis they were contaminating the environment?

Dr KLEIN — Well Norway is very touchy about its fisheries. To give you an example of just how touchy, in the Norwegian sector of the North Sea, you are not allowed to use fluoro chemical containing firefighting foam. That is very unusual and basically the North East Atlantic fisheries is considered so important by the northern European countries, there is something called the OSPAR Commission where if you are an operator in the North Sea oil and gas fields and you use any chemicals, there is a notification

format called HOCNF, which everything has to be classified and it is mandatory. You have to do it and if you do not do it, you do not use it.

This compares with terrestrial environmental regulation where there are let out clauses. We have been discussing this at our meeting here in Sydney on Tuesday and Wednesday. Safety data sheets for terrestrial products, you are allowed to say no data available, which is a complete get out of free gaol card, whereas in the North East Atlantic if the data is not available it cannot be used. It is a completely different approach. But the Norwegians are particularly sensitive.

The CHAIR — Just going back to remediation, in the Jersey case and the work they did there, did they then continue to use the site?

Mr HOLMES — Yes.

The CHAIR — It is still used for firefighting?

Dr KLEIN — After they rebuilt the fire training ground they would have had an impervious—

Ms WARD — So they completely rebuilt the whole thing?

Mr HOLMES — Yes.

Mr McCURDY — You spoke about other places like Tyndall Air Force Base, were they remediated as well?

Mr HOLMES — No is the simple answer there. There are investigations being done. Sometimes it is not possible to remediate. The groundwater is very difficult. For instance, Oakey, the PFOS plume is at different levels and what is significant is uncertain. But certainly in terms of drinking water the plume extends about four and a half kilometres to the south west. So it is an enormous area. The economics of it are what do we do to minimise the risk to human health or whatever other uses there are for that water and we perhaps have to accept some legacy issues in terms of contamination.

I know in Western Australia there are situations where aquifers are polluted but because they are saline aquifers and they are not moving, then the risk can be managed by a do nothing approach or a wait and monitor approach. You have to consider each situation separately.

In terms of soil contamination criteria—which was raised earlier—there are standards. In the United States I think it is 10 milligrams per kilogram for PFOS and 16 for PFOA.

Ms WARD — In soil?

Mr HOLMES — In soil as trigger levels for further investigation. So it is not about above this there is a problem, below this there is not. You have to do the risk assessment. We are considering those in Australia separately, so we should come up with some guidelines on that in the next 12 months.

Mr McCURDY — What was that trigger level you said?

Mr HOLMES — For the United States EPA, 10 milligrams per kilogram and that is for PFOS and 16 milligrams per kilogram for PFOA. Remember, there are maybe 50 to 100 more compounds very similar in characteristics and the great majority of them will also degrade to PFOA or similar compounds.

Short adjournment

The CHAIR — The transcript recorder will be finishing at 7.15, so if we can go till then, but we are happy to stay a bit longer and talk, unless you have got to go.

Mr HOLMES — That is fine, we have not got anything to go to.

The CHAIR — Can we start by asking what your view is of the possibility of remediating and removing the contamination or stopping it from pluming?

Dr KLEIN — You really need to see CRC Care, they are the specialists.

Mr HOLMES — And most likely it will require a contaminated sites assessment by a consultant, taking soil and groundwater samples, depending on what compartments you think are contaminated. My background is in contaminated sites assessment when I was in consulting. In a site like that you might have superficial contamination, you might have much deeper contamination in the actual fire training areas, for instance, if they are using just dirt pits to throw the oil into and burn it. What is underneath that is important.

Mr McCURDY — They did earlier on, before they did the pads.

Mr HOLMES — Very likely, it was a common practice.

The CHAIR — They closed the site on the basis that they did 73 tests for PFOS and 65 came back including in many unknown, never to be thought of locations.

Mr HOLMES — That is not surprising. It would sound like a more comprehensive site contamination assessment would need to be done to ascertain not only what is on the surface but also what is deeper in the soil profiles in particular areas and that is what a consultant would do. They would do an initial site history assessment to say what happened where. Further away you would be interested in the superficial contamination on the soil surface because you know nothing would have gone terribly deep there. Certainly in the training area there would be particular issues around anywhere where there was bare earth used for training because your firefighting foams are a soil wetting agent as a feature of detergent. So just the same way as you would put it on your lawn to make your watering more efficient and get the water into the soil, exactly the same would happen.

The CHAIR — They have already had consultants and that has been limited to digging out some dirt from the dam and the lake, put it in a pile and then trying to do some water course work with a bit of gravel and that is about it.

Mr HOLMES — It sounds like there is some partial remediation because they have recognised contaminated soils in the silt ponds, so that was where fire water was going. That would narrowly entail the consultant testing for contamination afterwards to say yes this area is all clear and disposing of that contaminated soil in an appropriate way according to the local regulations.

Ms WARD — The soil that they have dug up from the dams that they have got in rows here, these mounds that I was talking about before, going on what you were saying earlier, you would want to burn them, would you not?

The CHAIR — They are leaving them there and saying it is okay.

Mr HOLMES — It would depend on what criteria they are using for soil contamination.

The CHAIR — Class A?

Mr HOLMES — It is site specific so the local State environmental protection agency or Environmental Protection Act guidelines would apply. Certainly you might want to consider whether the levels are such that mobility or remobilisation might occur. So again, a consultant can answer that and it might be that Professor Ravi Naidu from CRC Care is the best person to ask because they do have methods for fixing it to make sure it does not move.

Ms WARD — Considering that you were saying that you would want to dig deeper around here to test the soils down at a deep level around the pad, considering that every 12 months they scraped the pits and got the residue, carted it with a tractor onto fields or somewhere and ploughed it in, what are your thoughts on that and how deep would you probe around the site?

Mr HOLMES — In that case you should be testing where the sludge was disposed of.

Ms WARD — What if nobody knows?

Mr HOLMES — A risk assessment needs to be undertaken I suppose to say if they can identify a typical area and then test that. Then on the basis of that decide whether they need to test further. I have worked on sites where exactly this has happened, where waste water ponds have been dug out and that has been spread in the belief that it was benign and then you find some significant contaminant in that. Then you decide based on the further sampling levels whether a clean-up is necessary, whether some other protective measures such as a protective layer over the top is appropriate if something is going to degrade—heavy metals and these sorts of chemicals will not degrade—or whether you do need to do a removal of some sort—in situ treatment, in situ protection or dig and dump.

Ms WARD — What are your thoughts on ploughing it into the ground as a practice?

Mr HOLMES — It is not a good practice because these chemicals and certainly I think the other contaminants that are there can be taken up into whatever is being grown in those areas. So it is not a waste disposal site, you are actually talking about a beneficial use where somebody is going to grow something. I did read recently and I think it was mentioned at this conference that we organised that the uptake of things into plants is differential depending what the plant is. So wheat and barley—did not Ravi Naidu say that uptake into cereals was a problem for perfluorinated chemicals?

Ms WARD — That would be grasses as well?

Mr HOLMES — Grasses, wheat, barley I think was mentioned in this recent seminar.

The CHAIR — CRC Care, are they considered well recognised?

Mr HOLMES — Yes.

Dr KLEIN — They are the contractors to DOD for remediation. What I was going to suggest was you talk to DOD Estates, because CRC Care have been developing remediation methods for remediating DOD areas.

The CHAIR — Can we move onto Oakey now.

Ms WARD — We can keep recording on my phone after 7.15 and have it transcribed later.

Mr HOLMES — This should give me Oakey as a picture to talk around.

The CHAIR — Were there any Victorians at this conference?

Mr HOLMES — I do have an attendee list. Yes, certainly in the way of consultants but I do not think in terms of the environment protection agency.

The consultant who worked for Defence in assessment was Parsons Brinckerhoff and this is one of the reports. These were available from the Defence website, so they are a publicly available document.

Dr KLEIN — I think the other thing I would say about these pictures of plumes that you see, you have got to realise that the vertical transect will look quite different, it will depend on the geology and in some cases it can spread extremely far distances and appear as if it has jumped across the land because it has gone underground in an aquifer.

The CHAIR — It reminds me of that Cat in the Hat book where you have got the bath ring, it is on the towel and he tries to get rid of it and it goes everywhere.

Dr KLEIN — What I can do when I get home is prepare you a bibliography based on my data base of relevant references and that is a starting point to go into the literature

Visual presentation

Mr HOLMES — This is actually a public presentation that Defence put out that is not the whole story but it is pretty good. In terms of the aviation centre it was a pretty normal, pretty small area, nothing special; probably similar to Jersey in that respect. Groundwater is quite shallow, so that was the first risk.

The geology is quite porous if you like so access to the groundwater for any sort of spillages, especially things like detergents would be easy.

Ms WARD — When did Defence stop using PFOA and PFOS foams, do you know?

Mr HOLMES — They have not. Well they have stopped using PFOS but fluorinated organic foams, remembering that there are no PFOA foams really, what you have is eight carbon fluortelomers that partially transform to PFOA and there are a lot of them.

Ms WARD — 2006—a year before the metropolitan fire brigade stopped using it—Defence stops using it?

Mr HOLMES — Yes. In that Jersey video I did pick up that it was 2003 that the issue came to light.

Ms WARD — That is right.

Dr KLEIN — The use of PFOS foams started about 1975.

Mr HOLMES — Even though they are saying they stopped using PFOS and PFOA, there were PFOA precursor foams used after that, because that is not recognised. There are 50 other compounds you have got to think about.

Dr KLEIN — They were developed by 3M specifically for the United States military, because of the USS Enterprise fire in 1969. What is still true is the United States Department of the Navy is the guardian of the MIL-SPEC approval of firefighting foams that your own defence forces use.

Mr HOLMES — It requires fluorinated organics in it because it is a legacy specification. The United States Navy are considering a change to a performance specification, so they are not going to specify what is in there, how you do it, it will specify that you must put out a fire in these ways with these times with this efficiency. So that is the difference, but we are in changing times.

2010 PFOS detected in groundwater on the basin. Not sure what the basis for that was. There is a bit of a chronology in this. If you look at the investigation area, they went well outside the Commonwealth area, which is that white rectangle there. They did various groundwater samples and this was the plot based on the results that came back from established bores that are there. The township relies heavily on groundwater. In fact, the meatworks uses the groundwater for washing the meat and that sort of thing, so you have got other exposure pathways. People use it for drinking; people use it for washing, the stock, the vegies, their paddocks. You can see some irrigation areas in that; so, very reliant on groundwater.

When you look at the scale of that, that is about four and a half kilometres from the training ground, which is in this area, down towards Oakey Creek, which is running along here. There have been investigations since this was put out that show the plume has extended under Oakey Creek and away. The creek is not really a groundwater barrier; sometimes they are. The creek is probably not a permanent creek.

As far as levels are concerned, 0.3 to 9.99 is the medium blue area, 10 to 500 is this very dark area and then limited reporting, which is 0.3, is the light blue area. The Minnesota guideline is basically the medium blue area and above. So within that area I would certainly be concerned about drinking water if that is your primary source of drinking water. Because remember, exposure is also about dose, so how many glasses of water you drink a day. If your rellies visit once a year and drink a bit, well they have got a far less dose exposure. That is the problem. The groundwater is something like 11 metres down from looking at bores in the area.

Ms WARD — Eleven metres down in the ground?

Mr HOLMES — Yes, so it is shallow. It is unconfined. In other words, it is attached to the surface geology layers. There is another groundwater aquifer down 200 metres.

Ms WARD — But PFOS has filtered down through 11 metres?

Mr HOLMES — Yes. It is a soil wetting agent; it will move down quite happily and then be driven by

rain on top of it. Then obviously the groundwater flow is to the south west there. Defence are now looking at that from the point of view that the contamination has extended beyond Defence Estate, so it is now in State land and affecting the local population. Where they are at with that, there are certainly issues about a loss of value for the land, not just we do not have water supply anymore. So the perception issue is a big issue. It has certainly been in the media quite a lot, in the local media at least and occasionally in the State media, the *Courier Mail*. There has been a little bit in television media and at the moment Defence are undertaking further studies about that.

I am not directly associated with liaising with Defence. I have been in an advisory role to some of our staff in Brisbane. So there are environment and heritage protection staff who are better acquainted with the issue than I. Our department of health, Queensland Health are involved in this and I guess that is the primary area of concern, so they would be the State lead department on the issue. From an environmental perspective, groundwater is regarded as an environmental value but from a pragmatic point of view, there is not an emergence into an aquatic environment where there are plants and animals. From that point of view it is a resource contamination and the main issue is that the beneficial use is people using the water for domestic and commercial purposes, for that matter.

The CHAIR — Was Defence concerned about this?

Mr HOLMES — Yes.

The CHAIR — So they are actually worried?

Mr HOLMES — Yes. In similar form to Jersey, they are now looking at alternative water supplies for people in the worst affected areas. I am sure they are considering all sorts of options in terms of what is it going to cost to remediate certain areas to prevent further contamination being driven into the ground. Of all of that, I am not up with the latest thinking on that and I know they have progressed from this. I am not sure when this document was done, but it was perhaps about a year ago.

There will be further information available, possibly on the Defence site about that and we do not have any bright ideas about what you do about this.

Dr KLEIN — Just for the Committee's information, I have just had notification from Norway from a colleague, "Talked to the Norwegian EPA. They told me that they are most likely to ban PFCs and AFFF in 2016." The Scandinavians are very sensitive about these fluoro chemicals.

Stenographer withdrew at 7.20 pm and further conversation recorded by iPhone.

Continuation of public hearing from 7.20 pm

Ms WARD — We know that with the dams, for many years they used dam 1. Dam 1 was the sole source of water run-off would go into dam 1, which is right here, next to where the main PAD is. They were recycling that and spraying it over themselves to fight fires and this was happening over a great deal of time.

What are your thoughts on the quality of that water that they were fighting with and overall do you think that for training purposes it is satisfactory to use water that you are able to swim in, or is better to use water that is drinkable?

Dr KLEIN — It depends if you are wearing protective clothing.

Mr HOLMES — Yes.

Dr KLEIN — These days firefighters should be wearing protective clothing. Having said that, to fight a standard fire, protective clothing is fire kit, which is not waterproof and breathing apparatus; if you are dealing with heavily contaminated water that is not the best solution, because you have essentially got a chemical hazard.

Ms WARD — Based on the water that was running into the dam and then recycling that water time and time again—

Dr KLEIN — And getting soaked to the skin.

Ms WARD — Correct.

Dr KLEIN — Not a good idea.

Mr HOLMES — And that would result in concentration as well, from each fire you would add more contaminants to it and if those contaminants are not degrading or volatilising and going into atmosphere, then they will still be in the water.

Ms WARD — So you would be concerned about skin conditions as well as other—

Dr KLEIN — Almost anything, absorption through the skin, skin irritation and put in a very British way, I would say it never would have represented best practice.

Mr HOLMES — Especially when you consider you have got surfactants, which are detergents, which will help things get into skin. You have got bursting bubbles, which give you aerosols, which you breathe in and that would be a primary exposure route.

Dr KLEIN — To give you some idea of the level of contamination you could expect, some years ago I was involved with the fire service college in Marsh looking at chemical protective clothing and this was supposedly a chemical protection suit that you should not have got contaminated underneath. We are talking about firefighters not even wearing that. Even with a chemical splash suit, using a contaminant which we made of raw molasses and fluorescein, so it was horribly sticky and difficult to get off, when we undressed the guys in the shower room under ultraviolet light, armpits, crotch, everywhere contaminated with fluorescent dye and my chief officer at the time who was with me fell about laughing and said, that was worth a few pints of beer not to tell their families.

But it made the point even with chemical protective clothing you get serious body contamination. Without it you have got total skin contamination.

Ms WARD — In the nineties firefighters were told to swim in either dam 2 or dam 3, which it goes from dam 1, to dam 2, to dam 3. What are your thoughts on that?

Mr HOLMES — Highly ill-advised, primary exposure route would be through ingestion. You would get it in your mouth, up your nose. With skin contact, the PFOS may not have been such an issue; however, you have got so many other contaminants there as well.

Ms WARD — Would it have been reasonable for people to be concerned about that water at that time?

Mr HOLMES — I would think so. What was the date?

The CHAIR — The close one was 2002 or 2003, it was a triathlon exercise. You run, you swim, you cycle.

Dr KLEIN — We were concerned about that sort of contamination in 1978. The work I did on chemical protective clothing at the college was done in the late seventies, so yes, they should have been concerned.

Ms WARD — What are your thoughts Nigel?

Mr HOLMES — I would think that if you take it from the point of view of what was the knowledge base within the fire service that was running the facility at the time; so did they understand contaminants? Did they have appropriate personal protective equipment? I would have said that it would have been fairly obvious that people swimming in water that has been through a process bound to contaminate it, it would have been pretty obvious; having said that firefighters tend to be people who are focused on fighting fires. Did they have a scientific unit, for example, that dealt with those sorts of things that we do now, so HAZMAT type incidents that I deal with, that Queensland fire emergency services have a dedicated unit for and every other fire service now have that. So a question might be when did that unit come in and when did education of firefighters in regards to exposure commence, and was there a health and safety person

who would also be another channel through which information would go to the firefighter that says this is how you do not get yourself burned, chemically exposed, poisoned.

The CHAIR — The Country Fire Authority chairman of the board was a former secretary of the environment protection agency in Victoria.

Mr HOLMES — You would think contamination and pollution would have been stock in trade for anybody who is concerned with environmental contamination because those levels are generally more stringent than human health. You should be more aware if you are an operational person with that sort of understanding rather than say, perhaps, an executive director who is more concerned with administration. So that would be another aspect to their knowledge.

The CHAIR — He would have visited the site, I am sure.

Ms WARD — What are your views then on the water that you use in training operations? Is it okay for it to be water that you would swim in, and this was an issue?

Dr KLEIN — That is over the top.

Ms WARD — Or would it be water that you would expect to drink?

Mr HOLMES — Definitely not, definitely not drinkable. Any sort of contamination, it would be very ill-advised to swim in any water like that. Recirculation of fire water for use is a common practice, simply because mains pressure cannot keep up sometimes and I have certainly seen it used. Exposure in those circumstances is a concern because you know that combustion products are coming back, contaminants are coming back and mostly you do not know what they are; so I would not have thought it was a reasonable thing.

Ms WARD — If you are a trainer who is regularly getting doused in water, would you want to be getting doused in water that is of a swimmable standard or a drinking water standard?

Mr HOLMES — I would say that you would prefer potable water, which in other words, you can shower in it, you can drink it. If it is not potable water then you would need to take appropriate precautions. For instance, if you have a fresh water dam that you use and you do not recirculate, then you would consider exposure to bacteria and other organisms. So yes, okay, we might swim in it; we might use it for firefighting but you make sure that you do not drink it or ingest it.

Ms WARD — Which you cannot always do if you are fighting fires?

Mr HOLMES — No, that is right. The exposures that you might get through particulates through aerosols—

Ms WARD — In your view the best thing to do is to use potable water for training purposes?

Mr HOLMES — Yes, certainly.

The CHAIR — There is one other allegation and there seems to be a little bit of documentation but I put it to you just as an allegation, that then the Country Fire Authority introduced a bacteria called aero—

Mr HOLMES — Aeromonas?

The CHAIR — Yes, that one, to try to eat up—

Ms WARD — The oils and so on that were in the water. They introduced that in 2002.

Mr HOLMES — It is certainly valid to attempt by remediation of one sort or another but that would be something that you would then assess the risk in terms of exposure for people, even doing basic things like sampling. If it is being remediated it should not be used for any other purpose because you have got contaminants, you are remediating them, you need to establish the water is clean before it is put to some other use and then it has to be fit for that use.

Ms WARD — So you would leave it dormant until?

Mr HOLMES — Until you tested it and said that it is fit for whatever purpose you are thinking of. For example, sewage effluent when it is tertiary treated or even secondary treated, it does have a bacterial load in it. It has plenty of nitrogen phosphorous. It is definitely not fit for drinking but it is fit for say, drip irrigation, which is human consumption, because it is not going to take up a contaminant and you are not putting it on the leaves, so you do not have an exposure route, so it is fit for purpose.

In this sort of case you are talking about the uses of skin exposure and possible ingestion, so it would be rational to go to a potable water standard.

The CHAIR — Is it usual to use the aeromonas?

Mr HOLMES — That is the first time I have heard of that being used in remediation. Generally you would not necessarily introduce something because in any situation you will have a natural progression of the best available micro organisms that will get going. Those that do not like the contaminant will die off; those that like it as a source of nutrient for food or they can tolerate it, will develop naturally. That was the approach we took in remediating Coode Island in remediating the hydrocarbon component there, because we were not aware of the foam issue at the time and the PFOS. We introduced the nutrients, put the piles of contaminated material in heaps and then irrigated it and returned the water to keep the flow through the material so that the micro organisms could get on with the business of breaking down the contaminants which were biodegradable.

So the use of micro organisms, it is going to occur naturally anyway, you cannot prevent it. You can encourage it with nutrients. You can put an inoculum in there. In other words you take some, for instance, active sewage sludge and put that in there because that is a good way of having microbes that are already active in breaking down biological materials. If you have got similar materials, and even fuels and oils are organic, you will accelerate the process. So I can see that it is certainly valid to try to kick start the process and somebody must have assessed the suitability of that particular microbe for that purpose, but I am not familiar with it.

Mr McCURDY — Can we very quickly move to presumptive legislation and your understanding of presumptive legislation for firefighters? In Australia some States have moved to presumptive legislation for firefighters.

Mr HOLMES — I am not familiar with it.

Mr McCURDY — Are you familiar with it, Dr Klein?

Dr KLEIN — In the United Kingdom they would just come under the standard Health and Safety at Work Act type legislation and there would be a duty of care on the employer but there would also be a duty of care on the individuals.

The CHAIR — This is more about the compensation. A firefighter might go to a hundred fires, different chemicals, because in workers' compensation you have to prove what fire you went to and what chemical caused your cancer, so there is now talk about legislation that says if you get any of these types of cancer—bladder cancer, melanoma, this or this, the expectation is it is because of your job. Then you can make a claim.

Dr KLEIN — I am not aware of that sort of legislation in the United Kingdom and historically, for example, the people that got mesothelioma from asbestos exposure, it took decades before it was even recognised as an industrial disease.

The CHAIR — Do you see these sorts of chemicals in the same light?

Mr HOLMES — Absolutely.

The CHAIR — There is a bit of talk now; there is the worry, not quite sure but over time.

Mr McCURDY — Five, 10, 15 years down the track.

Mr HOLMES — I think so for firefighters, it could equate in a very general sense to smoking. Now that might be also a confounding issue that you have firefighters who also smoke, but if you compare that to the general population in terms of frequency of occurrence, you could then maybe come up with a probability element that says a firefighter who gets lung cancer, for example, it may not be related to their job, it may be related to smoking but on the balance of probabilities firefighters have got a greater chance of that occurring, that you might then lean towards saying we will presume that it is work related.

Mesothelioma from asbestos, you really do not get that any other way, so that would be a very strong association; whereas lung cancer it would not. The sorts of chemicals that you were talking about, including PFOS, which is carcinogenic and thought to be carcinogenic—

The CHAIR — So PFOS is thought to be carcinogenic?

Mr HOLMES — Yes, it is thought to be carcinogenic.

Dr KLEIN — If the firefighter had a history of exposure to smoke products without breathing apparatus and he got lung cancer, it would be fairly presumptive that that was part of the process, particularly if he was a non-smoker. If he was a smoker Counsel would argue it is nothing to do with the smoke, it is the smoking.

Mr HOLMES — Or a fifty/fifty chance.

Ms WARD — We know that PFOS can lead to reduced immunisation in children.

Mr HOLMES — Yes.

Ms WARD — You have said it is recognised as a carcinogenic.

Mr HOLMES — Yes.

Ms WARD — Are there other conditions that we recognise that PFOS can be a contributor towards?

Mr HOLMES — Yes, well fluorinated organics generally. PFOS is regarded as one of the worst in terms of potential to cause adverse effects on health and perhaps that may also reflect that it has been the best studied, if you like. We have not delved into that in great detail but in the health related literature associated with fluorinated organics, there are a number of associations drawn with varying degrees of strength of association if you like ranging from kidney disease, liver disease, which is entirely possible because it partitions to the blood sera and its proteins to prostatic carcinomas, ADHD has been mentioned in some publications I have seen.

The CHAIR — In the children that are directly exposed?

Mr HOLMES — Yes. I think in that study, from memory, it was looking at the concentrations of fluorinated organics in the blood versus the occurrence of ADHD and whether or not that was statistically significant. In passing over that one, in looking at potential effects of fluorinated organics to illustrate it for our explanatory notes, there were a range of things there. I can probably show you one of my presentation slides that I have printed that has about a third of what I came across that were associated or possibly associated at varying degrees of certainty, if you like.

Dr KLEIN — I think the importance of that presentation from Phillippe Grandjean was that he identified a cellular mechanism that is absolutely ubiquitous, which is cytokine messenger between cells involved in the immune response; having said that, you could say that perfluorinated chemicals would almost certainly affect almost any type of immune response because this is a totally general mechanism, the cytokine mechanism.

Ms WARD — So the document that Nigel has just handed me says that “FOC exposure effects— possible health effects include reproductive impairment, chronic kidney disease, liver disease, endochronine disruption, developmental impairment, immune system depression, cholesterol elevation, vaccine interference, cancer and ADHD”.

Based on what you have heard about the chemical pollution at Fiskville regarding the fires of petrochemicals and so on, plus the PFOS, would it surprise you then to learn that there is a higher incidence of brain cancer, prostate cancer, testicular cancer and melanoma?

Mr HOLMES — I do not think I would be terribly surprised about that. I would not be certain that it had caused it.

Dr KLEIN — Melanoma has a high incidence in Australia anyway.

Mr HOLMES — Well, that was the one that I am not—

Ms WARD — They were higher than the average though.

The CHAIR — There were rare types.

Ms WARD — There were rare types of melanoma.

Mr HOLMES — I have not heard of that as such actually but certainly the others that you have listed—

Dr KLEIN — No, it would not surprise me because having said that you can get these carcinogenic toxic pyrolysis products from polycyclic aromatics in fuel—

Mr HOLMES — Yes, the PFOS and polychlorinated biphenyls and all the other polycyclic aromatics.

Mr McCURDY — That is why I want to draw the comparison to firefighters to people who work in the petro-chemical industry or a cleaner of this building, who has been cleaning this building for 20 or 30 years and been exposed to chemicals that may be PFCs were in. We are targeting firefighters because of what we are talking about.

Mr HOLMES — Yes.

Mr McCURDY — Where do you see PFCs in terms of the broader community?

Mr HOLMES — Certainly you have got two aspects to that—one is a domestic exposure, if you like, where it is not an emergency, there are not dramatic methods of exposure. In other words, flames, updrafts, outdoors, wind, aerosols, particulates; all of those things happening, so firefighters certainly have the potential for much greater exposure and that is why they wear the personal protective equipment. Whether or not they wear it appropriately or it is appropriate for a particular risk—some gases, for example, will just pass straight through whatever they are wearing, unless it is breathing apparatus. Other chemicals you are fairly safe, with skin exposure, you just wash your hands.

I think domestic exposure is very low on the scale because the cleaner may breathe it in occasionally but it is not going to be red hot and part of the plume. Firefighter exposure is certainly going to be far higher probability of exposure, if you like, or inhalation or some sort of an ingestion than you would have in any domestic situation.

Domestic situations tend to be a chronic exposure. If you have, for example, PFOS coated old carpet from the seventies; then it is going to be giving off a little bit every now and again, generally not volatile so it is really the guy who washes the carpet with a cleaner and puts it down the drain who is exposed.

Mr McCURDY — That is the example I am giving.

Mr HOLMES — He might get some exposure, but provided he is not actually ingesting the material, there is probably very low exposure and then it is more the environmental issue of it going down the drain.

Firefighters certainly have a far greater risk because if you heat anything up, it tends to volatilise. If you have a whole lot of aerosols generated by bubbles or fire hoses, especially if you are recycling fire water, then you are going to generate aerosols with contamination in them and that is certainly a common enough practice, where you do not have sufficient water supply.

Ms WARD — Are you surprised about the way in which they were transporting the petro-chemicals to Fiskville, which is what they called a mucking and that happened until the early 1990s?

Mr HOLMES — I would say it was never best practice. How it fitted into the regulatory requirements of the day is another matter. I would not have thought it would have been an acceptable method. It would have been done on a handshake rather than any sort of approval process and certainly quality control in that instance is very, very difficult.

These days regulated waste transporters are required to identify the load very carefully in terms of quantity picked up, quantity transported, quantity treated and the quality of that, so that the disposal is appropriate. Most facilities will have on site a laboratory that is able to characterise what the waste is. But back in those days, well, not sure.

Mr McCURDY — When you spoke about five per cent of the worldwide PFCs were foam, of the rest of the 95 per cent—and I know we have gone through some of the things—is there anything else bigger than foams?

Mr HOLMES — Yes, the foams are really one of the minor uses. You have got five per cent of global tonnage in PFC production. The rest of it is textiles, paper products, electroplating industry. Roger has a pie diagram there that shows those figures that are taken from commercial sources. It is by no means the major use of PFCs but it is the most dispersive use. Nobody else sprays it directly onto the environment or puts it in a situation where it may go to the environment or have an exposure that does not have proper controls on it. So in electroplating they use it to suppress bubbles in chromium plating, that sort of thing. The waste is controlled, it is disposed of.

Mr McCURDY — It is not like being sprayed on a property, on a farm?

Mr HOLMES — That is right. I think that is probably really the only dispersive use of it at all.

Ms WARD — I have got one more question for Roger which is on what Victoria can learn from Queensland and the Western Australian Government in what they are doing.

Mr HOLMES — I suppose I can partly answer that in as much as our approach after realising that there was a problem in about 2011, that we should undertake a risk analysis of.

Ms WARD — This is you being the environment protection agency?

Mr HOLMES — Yes, the environment protection agency for Queensland at that time, I am not sure what we were called—Environmental Resource Management I think—effectively the environment protection agency and Western Australian, Dr Jimmy Seow and I were at a HAZMAT conference and Dr Roger Klein was presenting, we looked at the issue and said: We need to analyse the risk, in this case to say are there issues that we need to address as a regulator and as a responsible department for administration of the environment protection Acts in respective States.

Having realised that, we said yes there is an issue to address here. Dr Jimmy Seow undertook a review of fluorinated compounds use. I undertook similar sort of work in terms of determining what was the use in Queensland and between us we realised that there was a need to control or better manage the use of firefighting foam in particular because of its dispersive nature of use. We were aware of all the other uses of PFCs.

So we decided in consultation with all of the other State regulators and the Commonwealth that the way to approach that was to develop a policy and the purpose of that policy was to clarify what the existing requirements were of legislation. We looked at it from the point of view is new legislation required? No it is not because existing principles and provisions and requirements under environmental legislation at the general level or general environmental duty which is the duty to prevent pollution, was all that was really required; that there were mechanisms under the legislation to manage that, so that if we recognised any situation with any chemical, we can act upon that and bring somebody back into compliance with the legislation and general environmental duty.

What we needed to do was to clarify what the standards were that needed to be met. So what was reasonable practice, what was best practice in relation to fluorinated organics and very much in particular with firefighting foam? We determined to undertake a review of the literature and to some extent Dr Jimmy Seow had done a lot of work on that. We consulted with overseas experts in Europe, America and Australia to determine what the scope and scale of the issue was to become more familiar with the global position and the state of knowledge about all of that.

Then to distil that down and formulate a position that would essentially define what we would expect to be best practice. That resulted in a first draft policy on the environmental management of firefighting foam. That was put out for industry stakeholder consultation, including all the regulators, so that was our primary consultation was to go around the regulators; all the State environmental protection agencies essentially to get comments to say are you happy with this approach? We adopted an approach which was not State specific because we realised we needed a consistent approach across Australia, so there was a level playing field for industry to work under; so you would not have different regulation and different interpretations in each State. So we were looking to achieve consensus not only between Western Australia and Queensland who are most interested in this, but also from the other States. So the other States have come along in terms of being satisfied with content from the point of view that they may wish to use the same content or reference it in some way in terms of regulating industry use of firefighting foams in their States.

Between Western Australia and Queensland we probably have the biggest concerns because Western Australia has offshore platforms and large industrial facilities. Queensland has an enormous coastline with industrial facilities. We do not have offshore platforms but we have very sensitive aquatic environments.

We felt that we had the resources, the means and the will to do this and to do it the way that could be applied across Australia. That has also been looked at by various overseas countries to say that what we have done in our approach of summarising the whole issue and drawing together the state of knowledge is very useful to other agencies overseas and in terms of the policy, certainly the Commonwealth, has been involved in that as well to come up with a consensus view that is not going to conflict with the border strategic obligations under various treaties, for example, like the Stockholm Convention.

The CHAIR — Would that go through a Council of Australian Governments process or it is not necessary?

Mr HOLMES — It is not necessary in as much as this is no new legislation, it is no new regulation. It is a clarification of existing positions. So that was the first thing we determined, was whether we needed any new power under legislation.

The CHAIR — You said that, sorry, yes.

Mr HOLMES — That was not the case so we were happy with that position. We determined to undertake a parallel process if you like, of looking at the cost benefits of it, the risk analysis and fortunately other jurisdictions have already undertaken those sorts of studies. So we are able to compare ourselves with those rather than undertaking a full process that you might do with new legislation.

From a technical point of view, I guess the regulatory impact statement that was done for the Environmental Protection Act in Queensland applies because that is the provisions that we are looking at. We do recognise it is a very specific issue, so therefore we are looking at it from that point of view, to say: well is it reasonable and practicable for industry to comply? What are the timeframes that might be needed? What is the type of re-education that we need to do for ourselves, as well as for industry, as well as for manufacturers and suppliers? What are the demands that we might put upon industry suppliers?

It does come down to the user of any product being liable for the use, because they are the only persons that determine how they are going to use it and where they are going to use it, but there needs to be a co-operative approach between the regulator, the user and potentially the supplier through a somewhat diffuse pressure, if you like, because I have no jurisdiction over a manufacturer in Germany or another State for that matter. So it is up to the user to really drive that in some sense because if they do not have sufficient information to manage their risk, then they really should not be using the product.

The CHAIR — Was the consensus from the Environment Protection Agency representative in all

States that the PFOS and PFOA and so on is something that should be treated as a dangerous product?

Mr HOLMES — As a product of concern that needed appropriate management, yes, and that was part of the reason for producing the explanatory notes. It was a case of here is what we are think the bottom line is of the policy, take our word for it, and that was the purpose, was to give it to regulators and to the stakeholders to say this is why we think the bottom line comes down to certain standards and certain requirements. This is where we think we can go in the long term. So this is not something we will change our minds about in five or 10 years' time. We hope it is going to last a long time. So industry has that certainty.

The perception that we are just doing this for the environment is not the case, because under Queensland legislation at least and I am sure under every other State, we are required to address standard criteria, which is cost benefit, the sustainability aspects, the precautionary principle, the practicality of certain things and whether or not it is reasonable and the risks to environment, to the economics. So we are not just looking at environmental issues.

It has been quite a wide ranging study and even ranging to human health as a peripheral issue so that we make sure that we are not missing something there. We have consulted with a range of people across that spectrum of stakeholders.

Ms WARD — Roger, we were talking about what Victoria can learn from Queensland and Western Australia.

Dr KLEIN — Looking at it from outside Australia, from an international perspective, I would have said the Queensland/Western Australian policy is probably leading the pack and there have been expressions of interest from the United States Environment Protection Agency to be told the results of the policy; as those explanatory notes do most of the work for them.

The same is true—Dr Christoph Schulte in Germany, the head of the Directorate in the Umweltbundesamt (Federal German Environment Agency) said exactly the same thing. We invited him to the conference but he said he wanted to be kept up to date on what was going on. Yes, my experience outside Australia is this is very much the leading edge, but it totally gels with the approach of other countries.

Mr HOLMES — I think I mentioned earlier that we have parallels in this document, the ECHA and its Annex 15 restriction report proposal for restriction by Norway and Germany. Their review and explanations of where they see a restriction which is paralleling our policy and its basis sit; parallel to what we have come to as a conclusion separately. So that is a reinforcement of that.

There are other things that you might look to. For instance, there is the Helsingør Statement and the Madrid Statements, which are statements put together as a result of eminent scientists with an understanding of fluoro chemicals who have come to the same conclusions and have summarised and paraphrased the issues into a few pages.

Again, reading through those we draw very close parallels quite independently. So that is why we think we are on very firm ground with this and it is nice to know, because if it was not for those sorts of parallels, I would be thinking have I missed something; and it seems not.

Apart from the cost benefit analysis, which is very clearly outlined in this ECHA annex 15 restriction, that is very useful because the landscape for foam use across the world is the same. It is the same manufacturers. It is the same foam. It is the same sort of fire. It is the same sort of fuel burning. There is nothing different about it, so you can draw a complete parallel with that.

What you then have to consider is what is the application landscape? It is Australia. We are far less disturbed and polluted if you like or previously industrialised than most countries. We have a lot more pristine environment. So they are coming to the conclusion about a complete ban on something and a complete restriction on something and very low levels, we should be thinking of a higher goal post.

So that gives me comfort that what we are saying is not out of proportion and in fact, it reinforces what we have said. In fact, this publication references about 250-odd papers and there are some parallels with ours

and a lot of others that are similar. They have actually done more work than we have in some respects.

The CHAIR — Maybe on that we might leave it. We have given you a good run in having you be here and having all these questions fired at you.

Committee adjourned.