

TRANSCRIPT

ENVIRONMENT, NATURAL RESOURCES AND REGIONAL DEVELOPMENT COMMITTEE

Inquiry into the CFA training college at Fiskville

Melbourne — 19 October 2015

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Mr Nigel Holmes, principal adviser, incident management, Queensland Department of Environment and Heritage Protection.

The CHAIR — Welcome everybody, and thanks for attending this public hearing into the CFA training site at Fiskville. There has been a considerable break between public hearings and the tabling of the interim report. This was due to the very lengthy process of document discovery. It was also due to the sheer volume of documents as well as in some cases untimely responses from organisations. As you may be aware, the committee has sought and the government has agreed to an extension to the date for the final report. The final report is now due in March 2016. We understand this may cause difficulties for some, particularly those who are ill, and in some cases terminally ill, and family and friends of those who have passed away. However, this is a very difficult inquiry and those affected by the practices at Fiskville deserve a thorough and forensic investigation.

We will now move to our first witness, Mr Nigel Holmes. Before you start your presentation, Mr Holmes, I will go through our formalities in terms of parliamentary privilege. 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 precinct of the hearing are not protected by parliamentary privilege. All evidence given today is being recorded and you will be given a proof version of the transcript. All of that evidence will be part of the transcript that you will be able to review. Following your presentation we will ask questions. Please go ahead.

Mr HOLMES — Thank you for inviting me to the inquiry. As you might understand from some of the material you have already seen that Queensland has produced in the last couple of years, it is a very complex matter, so I am trying to distil that down for you and leave out some of the detail. Nonetheless I am a chemist and a details-type person, so bear with me when I delve into that.

Visual presentation.

Mr HOLMES — I will go straight into the presentation. First off, I am principal adviser for incident management in Queensland. My role is to do with incident risk assessment, preventive measures and also responses, but further to that I am also involved in policy development and also the broader strategic risk landscape in Queensland and how that is managed amongst the incident response unit, of which I am a part.

I thought it was appropriate to cover off on some of the basics in terms of foam characteristics and impact mechanisms. Also to point out that our focus is primarily environmental, being a department of environment, but nonetheless pollution affects health, so we are very aware of that and we do take that into consideration in any management decisions we make in that respect. So we are not singly focused as a department; we have a whole-of-government approach.

Our awareness and risk review of this particular issue in terms of firefighting foam and chemicals associated with it is no doubt a focus and fluorinated organic compounds are a big part of that. How we have come to our regulatory considerations and decisions is something I will outline, and also in our review and risk assessment we have come across quite a lot of information on health issues and worldwide concerns as a matter of our review and policy development. I would also like to touch on foam performance certification, because again we are not just focused on the particular pollution matters; we have to make sure that what we are asking for is reasonable and practicable. As is emerging for many states and many countries in my experience there are soil and water contamination issues from legacy uses. There are a lot of parallels with other things that have occurred over time, where we were not aware in the initial stages of the risks but we have become aware of them since.

Very briefly, just to remind you, there are two types of fires and two types of foam. Class A foams are those that penetrate and wet solids. We are generally not so concerned about those. They really are detergent-based. However, class B foams, which are used on two-dimensional fires and fuel fires of various sorts, can be divided into two types. These are the foams that form a layer or a blanket over the top of the material — the fuel — and extinguish by cooling and excluding oxygen. Within the class Bs you may well be aware that there are non-persistent foams, in common parlance the fluorine-free foams, and you also have fluorinated foams, and there are quite a range of those. If you are used to thinking of AFFFs, there are more than those; there are FFFPs, so film-forming fluoroprotein foams, fluoroprotein foams in general, and various others. This is where we tend to get into a bit of complexity.

In terms of the concerns about firefighting foams, there are four components to most foams, and you can categorise them. Of those there are two that give us concerns for the environment and, to an extent, for health.

They are on the right-hand side of the slide, the surfactants — and that is just a fancy name for synthetic detergents — and also the solvents. First off, the surfactants can be hydrocarbon, fluorosurfactants or even protein-based, and various combinations of those. They have an acute toxicity of their own and so do the solvents, the other part of the mix. About one-third of any foam composition is surfactants and solvents. The solvents, to give you some perspective, are the sorts of things you find in your car radiator, so glycol ethers, that sort of thing. They are organic based, and there is quite a range of them. However, from an environmental standpoint it is really the fact that they are organic and they will degrade.

The things we are concerned about are obviously the biota generally, especially waterways and aquatic ecosystems, because things that live in waterways do not have an option of getting out and moving elsewhere and they will be exposed to the contaminant as it moves through the waterway. Obviously in application on land you can get soil contamination and groundwater pollution from these agents, particularly the surfactants, which are a good soil wetting agent, so they are good at penetrating soil and getting down to groundwater. Obviously groundwater pollution is an issue in itself as a resource and also can impact on health, and you can have health impacts from direct exposure.

In terms of impact mechanisms and the things that really concern us, you need to think about short-term impacts versus long-term impacts and keep those very separate in your mind. Historically we have tended to think about acute toxic effects, so something that occurs over some days or perhaps a week or two, and then after that we think everything is okay. In long experience we have learned that there are things that are persistent, and that can have long-term effects because of the persistence, possibly also due to bioaccumulation. All of this adds up to a chronic toxicity, so a long-term potential for effects. The key issue about firefighting with these impact mechanisms is that firefighting is highly dispersive. We do not really know where the fires are going to occur. We quite often have to do things in a hurry. We are applying a lot of foam, a lot of fire water is involved, so there is a great potential for the components of the foam and various other contaminants from the fires as well to move with the fire water, and control of those contaminants can be very easily lost.

As to the long-term effects we are talking about, we will start to zero in now. Fluorosurfactants — in other words, fluorinated organic compounds that are being used to increase the effectiveness of firefighting foams — are a particular issue, which I hardly need to remind you. I will just touch on little bit of complexity here for a moment or two, so bear with me. Chemistry and behaviour of fluorinated organics is important to understand so that you can see how the effects may carry through. The PBT profile is important. You will hear that and see it in the literature a lot. It is about persistence, bioaccumulative potential and toxicity. Obviously if something is not toxic, we are not going to be concerned about it, but if you have those three things, PBT, there are very good reasons to be concerned.

In terms of fluorinated organic compounds, the persistence is pretty much indefinite. They do not biodegrade or degrade in any other way in the environment very readily. You could really regard them as indefinitely persistent. For example, you need in excess of 800 degrees Celsius with some residence time, a very high temperature, to break them apart. This comes about from the very strong bond between the carbon and the fluorine, and that is in the tail you can see there, or the chain, of various carbon lengths, a bit like a pearl necklace joined together. The green spheres there are the fluorines attached to the carbons. You have various chain lengths. C8 is a common term that you will come across in the literature that is of concern in terms of fluorinated organic compounds. However, you can have anything from C3 through to C14 and even larger. For example, Teflon on a frying pan is a fluorinated organic that is indefinite in length. Fortunately it is very neutral and does not have any major concerns.

Fluorinated organic chemistry is quite complex. However, you can distil it down to a few basic things. The fluorinated chain on the end is pretty much indestructible. The functional group attached to the end — and you can see some red and some yellow atoms there — in this case it is a sulphonate. You can also see some other combinations there. It really does not matter what they are; the point being that that functional group on the end determine some biological activity.

In addition to the compounds you are very familiar with, such as PFOS and PFOA — they are on the left and right-hand sides of the screen respectively — there are also compounds, a very wide range of compounds, known as fluorotelomers. You may have come across that. Very recently I was disappointed to see in a defence department media release that they said, ‘Well, since 2008 we haven’t been using PFOS foam, so you don’t need to worry’. There are reasons to worry, because current-generation fluorinated foams are based on

fluorotelomers for the most part, and of various chain lengths, and the longer the chain length, the greater the problem.

The fluorotelomer partly gets its name or at least it is characterised by the group that I have circled there, which is a dimethylene group and is known as a spacer. Essentially it takes the functional group, as you might see on a PFOS or a PFOA, and it pushes it away from the fully fluorinated chain and sits in between the two. They have been very useful in firefighting foams, and give new functionality. However, that spacer is partly degradable, so when that drops out, you then end up with a compound that is a fully fluorinated, fully persistent, probably bioaccumulative and certainly toxic compound. Any idea that your current generation of fluorinated foams that use fluorotelomers, especially long chain ones, are benign, is misplaced.

For example, the fluorotelomer sulphonate that is illustrated there, when that partially degrades — and when I say partially degrades, when it is released into the environment, for example; it is out in the air, it is out in the sunshine, maybe it is in an animal's body, or even in a plant — you get the partial degradation and lo and behold you end up with one of the compounds that you are concerned about, in this case PFOA. With PFOS and PFOA-free foams — and I have seen that in advertising — that is true while it is still in the drum, but once it is used, you have the potential to generate a perfluorinated or fully fluorinated compound of concern that is indefinitely persistent. The example at the bottom there of a sulphonamide will very likely decay to PFOS. Again, your PFOS and PFOA-free foam does not need much prompting to actually generate those compounds. The problem has not gone away when we stopped using PFOS foams is the bottom line from an environmental and a health standpoint.

Additionally, PFOS and PFOA are only two of hundreds of compounds that are in use in firefighting foams and thousands that are in use in industry generally. Again, we are focusing on firefighting foam because of its very dispersive use. Very little is known about the short or long-term effects of any of these compounds. We are only starting to find out about PFOS and PFOA right now, and we are not very sure about those except that we do not like the story.

These compounds are indefinitely persistent and the fluorotelomers, as you can see, transform to indefinitely persistent compounds. They are highly dispersive. They love to move around the environment. They are very mobile. Unlike heavy metals like cadmium or lead, which will bind to sediments, these tend to be very diverse in their behaviour in the environment. For example, fluorotelomer alcohols are volatile. They will go up into the atmosphere and they will do a lap of the world in about 10 days. That is one end of the extreme. Others are not so soluble, so will not move in groundwater, whereas there are many of these compounds which are highly soluble and will move in groundwater or surface waters or the oceans. They are very widely distributed into areas where foams have never been used, for example, the Arctic and the Antarctic.

Many of them are potentially chronically toxic — that is, they hang about for an awful long time, as we can see. Also, especially if they are bioaccumulative, then they can build up in plants and animals and in people. The bioaccumulation potential does vary, some more strongly than others — longer chains more so than the shorter chain compounds. You can see the fluorinated organic chemistry is very complex. It is not just about PFOS and PFOA. Having said that, we can still just focus down onto the fluorinated organic compounds, perhaps somewhat disposing of the terms PFOS and PFOA and talking more generally about FOCs, or fluorinated organic compounds. Just as an illustration of what I have been discussing, in the list of compounds on the right-hand side there are 50 that have been reverse engineered from a handful of the dozens of firefighting foams around. You can see there are some very complex names there. Essentially you can see things with perfluoro on them and you can see things that have fluorotelomer in them.

The ones I have highlighted on the screen at the moment include the PFOS and PFOA that we are familiar with, and there are some longer chain versions of that — for instance decanoic acids instead of octanoic — so the longer the chain, the more of a concern. They were found in these foams. But if you also consider the fluorotelomers that are there, which are a sort of XY formula, so there is an 8-2 fluorotelomer — XY, if you like — the 8 being the fully fluorinated chain, the 2 being that spacer that only has the hydrogens on that I talked about. If we transform or partly degrade those, all of a sudden you have this big transition from fluorotelomers to the compounds of concern (as indicated on the diagram). You can see that it is quite reasonable to say that once you have these compounds out in the environment — out in the biological sphere — you may as well consider them to be part of the fully fluorinated persistent compounds group, and to some extent that simplifies how we think about them and how we deal with them.

These transformations occur fairly quickly. From the literature it can be days to weeks to months. At the same time you will have some of the fluorotelomers persist for years, so they are very variable in their characteristics depending on the environment they are sitting in in terms of oxygen and exposure to sunlight and all sorts of other things. Nonetheless the end point compounds are generally toxic, more or less, persistent, very definitely, and bioaccumulative to a greater or lesser extent.

Getting away from the complex chemistry, I will just point out that here is another handful of half a dozen foams. You can see they have been reverse engineered in terms of the chain lengths of compounds that are in them. You can see foam is not foam; they all have very different formulas. Naturally these formulas are a trade secret and very confidential but nonetheless are of concern to us because we do not know what is in them. If you look at foam B you would say, 'Okay, that's a 6 carbon foam. We're not so concerned about that. It's a shorter chain then, say, something that has more of the orange and red in there, which are the 10-carbon and 12-carbon longer chain and more toxic compounds'.

Having said that, we probably only know what is in fluorinated foam, or at least the proportion of the compounds that we have any idea about, is somewhere between 10 per cent and 50 per cent. We have no idea what is in 90 per cent to 50 per cent of the composition. This is just a snapshot, tip of the iceberg, comment. That concerns me. We do not know what is in these foams.

In terms of how Queensland has looked at this and become aware of the issue, we obviously have the context of environmental management and pollution management under our regulatory strategy. Our regulatory strategy is focused on user responsibility, so it is the poor old user who has to deal with the problem and manage the issue. Quite often they will need some prompting and guidance for that either from consultants or from government, and that, as it is an emerging issue, has not been forthcoming over the last few decades because we simply have not been aware of the issue.

Western Australia and Queensland became aware of the issue through a hazmat conference in 2011 and a national foam workshop in Adelaide in the same year, where foam and chemical expert Dr Roger Klein presented. We then undertook to see whether this was an issue and, if so, how extensive it was and how perhaps it might be managed.

In terms of context for the legislation, we looked at it in terms of other compounds. We were fully aware of other organohalogens like PCBs and DDT pesticides and other chemicals and obviously whether there was a need for any specific management regime. We determined that the general legislative requirement and duty not to pollute — in Queensland it's the General Environmental Duty — applied. So there is nothing really all that special about these compounds in terms of management. They really should just be managed on their own merits. Throughout 2012–13 we undertook a review and clarification of the issues — where are they being used, what are their characteristics, how might we deal with those, are they being dealt with adequately — and came to the conclusion that industry has not self-regulated adequately. They rarely ever do when it is not part of their core business. If they understand the chemicals they are using because they use them every day, then there is a good chance that they will know the characteristics and manage them appropriately.

The point about foam is that it is not core business for most industries. It is in a drum in a corner in case there is a fire, which might occur once every 50 years or so. So from that point of view it is understandable that industry at the user level did not understand too much about the environmental and health risks because it is not part of their day-to-day activities.

You might think that the producers would have a responsibility, and that is certainly the case, but there is limited guidance in an international sense with the globally harmonised system, safety data sheets and that sort of thing, there are lots of places where information can be missed, lost or simply not be put in at all, so our review needed to cover some of the ground that had not been covered before. Between Western Australia and Queensland we looked at the current knowledge worldwide not only through peer reviewed scientific papers but also by seeking expert opinion — unpublished material, if you will — and also best practice for foam types in use, because it is important that it is achievable and reasonable. If we are going to manage it, we need to know what is reasonable in terms of risk and what is reasonable in terms of cost as well.

We also realised that there needed to be time for compliance to be achieved by industry. Obviously things like budgeting, redesign, modifications, changeover of stock, all sorts of issues come into it, so we were trying to be very holistic in terms of risk management but also having a focus on interim risk management. For example, I

have had contingency plans from large industries next to waterways that had as part of their contingency plan to release fire water to waterway. Clearly we were in a position to say, 'No, that's not a good idea. There must be some interim steps in terms of containment and management'. So we were getting into the nitty-gritty even at that stage before we had even developed a policy.

In terms of our regulatory position, I just said that the user carries the risk and liability for the most part. Having said that, we have plenty of experience where the community and the government end up paying when the user is no longer around or is insolvent. We had a situation in Queensland where a very small warehouse of pesticides and herbicides caught fire in 2005 and we are still paying for that clean-up. We have hit \$12 million so far. The company concerned went broke in about the first month, so it can very much come back to the community and government. The user might have the responsibility, but they might not have the capability to deal with the issue. We need to provide some fairly firm guidance when you have large-scale risks of that sort.

As I have illustrated, most users do not understand their non-core business risks. Foam is generally non-core business, so they do need some guidance there. Regulators, I think, need to step up to the mark to provide some of that guidance, especially where they have an understanding of the issues and probably a better scientific capability than perhaps some of the users there who are focused on a different aspect of science and production.

It is also important that best practice is achieved so we do have some wriggle room, some buffers there, if you like, rather than the bare minimum approach which is taken with some issues. Bare minimum may be okay where something is eventually going to biodegrade and dilute and go away, but in this case I think there is an added dimension to it because of the persistence issue, so achieving best practice environmental management in a context of reasonable and practical is what we have been focused on.

The insufficient information and advice available is a significant factor, and to a large extent I think the producers are the problem there. They will produce a foam for a particular application and they will be very good at defining how it will perform under certain circumstances, but the peripheral issues of environment and health and what have you are again not their core business, so there will be pretty lean information available to carry out a risk assessment in terms of risk for the government and risk for the community in environmental and health terms.

The CHAIR — Excuse me, Nigel, I am just a bit concerned in terms of time. I know the committee has lots of questions. We do have a copy of and have read the draft policy. We need to know about these things, but we do have the draft policy. There may be some points you can raise out of that and then we can talk a little bit about some comparisons and things.

Mr HOLMES — Sure.

The CHAIR — Thank you.

Mr HOLMES — That is okay. I think there were only a couple of issues that I wanted to cover. One is something that has become very evident, and that is the consideration of Ecologically Sustainable Development and the Precautionary Principle which, to some extent, is a bit of a motherhood statement and an add-on in an awful lot of legislation and in the way things are considered by government. So it is worth making a note that there are some legal precedents and judgements which outline what our real obligations there might be and also just to do a quick comparison or, if you like, an assessment against the precautionary principle of that.

The key issue triggering the precautionary principle is that if there is a serious threat of irreversible environmental damage or serious environmental damage and there is scientific uncertainty as to the nature of that, you then have to go through a further assessment, and it is all common sense. I think it is definitely the case here that we do not know enough, but we do know that the threat is reasonably significant. We are starting to see that now. The issues outlined in various places, and in particular by Justice Preston, are the key considerations against which you need to assess any effect, if you like. It does not matter whether it is an environmental decision or a pollution management decision.

If we look at this table here — and I apologise; I have added that scale at the bottom there to try to give a bit of a context as to where we are at with all of this — you can see that in assessing any persistent compound it ticks all the boxes. You have got the large-scale threat. You have got quite significant magnitude to the problem in terms of environmental and health effects. It is not just a one-disease-type issue that we need to think about or a

one-environmental-impact issue. With perceived values, obviously we value health and environment very highly. Timescales are very long. All of the issues there for a persistent compound are certainly significant. With reversibility and manageability in the long term, we are starting to find that out with some of the legacy sites that we have got. For non-persistent compounds it does not matter what you are talking about, whether it is a spill of molasses, detergents or fluorine-free foams. There are certainly limited concerns, and you treat them the same as any other pollution event.

In terms of where we are at with that bottom scale there, I think we are well past the suspicions and indications and even emerging evidence for some of these compounds like PFOS and PFOA. We are probably still early days for some of the replacement compounds that have been proposed — the fluorinated compounds. It really does trigger the precautionary principle in terms of being very cautious about how we manage this.

There are many references to a range of potential health effects, and the attachment to those is strong in some cases and not so strong in others. Nonetheless there is more than enough there to give you concern, especially in light of these compounds being persistent within the human body and within the environment for a long, long time. Once you have been exposed, it is a long time for you to get back to normal, as it were. Concerns have been growing. This illustrates the number of scientific papers that have been published. You can see prior to about 2006 or so not much was known. There has been an escalation in terms of the amount of information now available, and I do not know more than about one or two papers within that group that are really positive in terms of characteristics of fluorinated organics. They all have some adverse indications associated with them. That graph is pretty much the related concern. A summary of the sort of concerns worldwide is in two papers that I provided to you there as references — references 9 and 10 on the bottom of that slide.

With non-persistent foam performance, people are saying, ‘Well, if fluorinated foams are of concern and we are not entirely able to contain them, then what are we going to use as an alternative? Is it reasonable to say, “We want you to use something that does not have persistent compounds in it”’. Whether that is a fluorinated compound, a siloxane or something else really does not matter. It is the industry that is focused on the fluorinated or fluorine free, not so much my agency where we are thinking more in terms of persistent compounds and non-persistent compounds.

A fairly cursory review, because we are not fire experts, has found by polling the manufacturers particularly that there are fluorine-free foams certified for every major application. Whether that is entirely applicable to the situation that you have — your legacy tank farm built in 1920, for example, with very poor bonding, limited room and all the rest of it — is another matter altogether for the user, manufacturer and regulator to talk about at a later date. But as a general overview there are non-persistent foams certified for every major application. We have looked at all the standards, we have polled the manufacturers who produce both and we have found that. As to the idea that some of the tests are invalid, all the tests are carried out by independent certifying agencies for all types of foam. If somebody is saying, ‘Well, that test is invalid’, it is the same agency that tests the foam that has got a different compound in it, for example. So, as I have just said, the specific uses are important.

This table illustrates the standards in Australia, and every major application there is now covered. Even handheld extinguishers are on the list because they have just been certified in Europe — a foam system for that. That is as far as we went in terms of the claims that fluorine-free foams, one, do not work, and two, are not certified. We cannot see any evidence of that. Regarding the examples I have been given where there have been problems or tests, let us say that somebody testing a competitor’s foam is probably not a reasonable test, especially when it is not a certified agency, with not the appropriate equipment and not the right anything. There is an awful lot of competition out there, let us say.

In terms of foam uptake, as proof of the pudding is in the eating, Queensland fire services have been using fluorine-free foams for quite some years, since 2003, and very successfully — not on large-scale fires as a general rule, but certainly mostly on the roadsides and places where they cannot be contained. From my point of view I have not come across any situations where environmental harm has been caused. Larger organisations I have to say are generally very choosy users, very fussy. Seaports, air services, overseas airports, the oil rigs in the North Sea that Statoil changed over are incredibly fussy. The uptake you can see with a very cursory view. I sort of stopped once I got a significant number. I did not do a full review. It is certainly very clear that there is plenty of uptake in that sense, and I do not think those users would be making those decisions on the basis that they did not know whether it worked or not.

There are plenty of legacy issues around. The plume that you can see there is Oakey air base. That plume, from top right to bottom left, is about 4.5 to 5 kilometres long in the groundwater. It is PFOS. The little dots there are people's bores — drinking water. We have got a big problem, and there are plenty of similar situations arising worldwide. The Buncefield incident in 2005 in Britain knocked out north London's drinking water supply pretty much forever in the groundwater.

The standards are a real problem. There are very few standards. Drinking water has been considered by various agencies, and the US EPA levels shown there are fairly well accepted. However, having said that, there are papers — and I have provided those in your package — where those levels may be 100 to a couple of hundred times too high because of non-lethal effects such as immune suppression, vaccine suppression and that sort of thing.

I think we are making some progress on soils. There is a move across all the agencies in Australia to come up with standards for soil contamination, because if we have contaminated sites we need to clean them up. We need to work out what the health investigation levels are and what the risk exposures are. Some numbers have been proposed. Some of them may be early. That program will most likely come up with some results in about 12 months time.

There is a list of references for your convenience and a summary of health guidelines for your convenience. For PFOS and also for PFOA you will notice that the other couple of hundred compounds are missing from that. We know nothing about those, and they are of similar concern.

The CHAIR — Thank you. Just with you were talking about in terms of suggested safe levels, I think on your site you talk about current engagement across agencies to determine appropriate and consistent contamination assessment standards. What agencies are we talking about? Are they within Queensland or across Australia?

Mr HOLMES — Across Australia, mostly through the EPAs, basically, and the associated health departments, Queensland Health particularly.

The CHAIR — So you have had dealings with, for example, the Victorian EPA around these issues?

Mr HOLMES — Yes. 'Early days' would be a qualifier, and also the fact that the CRC CARE project, which is currently looking at soil contamination levels, needs to consider the health exposure levels as well. How far that goes is yet to be seen. I think that is something that is under development.

The CHAIR — When you said 'early days' — early days working with the Victorian EPA? What does that mean?

Mr HOLMES — No, I think in terms of the overall determination of health exposure levels or soil contamination levels or groundwater contamination levels that are specific to Australia and Australia's population.

The CHAIR — In our inquiry there are two parts. There are the fuels and the unknown chemicals that were burnt and used at the Fiskville site as well as then the PFOS and PFOA in the actual firefighting foams. On the PFOS and the PFOA in the firefighting foams, I think there was, as I understand, some research and documentation of levels that may or may not be safe in the 1990s, but since then there has been an increasing volume of information and research about the health effects. You have referred to the 2014 research such as the Madrid report. How do you think things have developed? Is there an increasing body of evidence to demonstrate the health effects, or is it still relatively in the early stages?

Mr HOLMES — One of the problems is that with the models that are being used we cannot test these chemicals on humans. You have rat liver or human liver extracts in a petri dish. Translating that into the real world has always been a problem. Nonetheless I think there is a growing body of evidence that says there are a wide range of effects that have been determined from population studies of exposed populations — and some of those in the US and also in Europe are not small samples; they are in the thousands — that are demonstrating that there could be associations. There are all sorts of other factors as to whether people smoke or whether they eat healthily, exercise and all that sort of thing. There are complex non-lethal effects and combinations. You do not have an immediate disease like mesothelioma or lung disease from things like asbestos, where you can tie

them together very neatly. However, the associations are getting stronger and stronger — that is the way I would put it — certainly to a level that I would be concerned, given that the chemistry and behaviour of the compounds are certainly very clear.

The CHAIR — I think you might have mentioned Teflon, and there is talk about PFOS in shaving creams and things like that. Is that an area of concern, or is it really the stuff in firefighting foam that is a much greater issue of concern?

Mr HOLMES — Fluorinated organic chemicals in all uses are of concern. In firefighting it is certainly the most dispersive. It is a direct release in the environment, or it is direct exposure for those involved in the activity, so firefighters in particular. Having said that, if you are able to contain and dispose, there is not much of an issue. It is the same for the production of frying pans with Teflon. That quite often involves PFOA. Whereas, if you contain it as a waste and dispose of it, it is no different to a goldmine containing sodium cyanide and disposing of it. Yes, it is toxic, but if it is managed, it is okay. It is no different in that sense, so it is about the dispersibility in terms of use and also how they behave once they are in the environment, because they are very good at moving around.

Mr McCURDY — On the Stockholm Convention on Persistent Organic Pollutants, can you give us a very brief overview of what that is about? Is there any logical reason why Australia would not be signed up to that?

Mr HOLMES — I have not delved into that in any detail, but nonetheless my feeling is, firstly, that the Stockholm convention is relatively ineffective in terms of day-to-day management, because it is pretty late when it comes to regulation. It is only after problems have existed that have been failed to be regulated by industries and that have emerged with serious risks that things go under the Stockholm convention. As to why Australia has not signed up, I guess there are various pressures internationally and politically in the different countries. I really could not comment on the detail of that. I would be speculating.

Mr McCURDY — If I go back to some of the sites that have been contaminated internationally, is there evidence of successful clean-ups throughout the world?

Mr HOLMES — Yes. Where the contamination has been relatively confined and can be recaptured, as it were, the risk can be reduced to a reasonable level. That does not mean a complete clean-up; it means that perhaps it is saline groundwater, nobody is drinking the water, so cleaning up the soils above it reduces the contamination — for example, airports in Australia that are right next to marine environments. Nobody is drinking that water; it is part of the mangrove system, as it were. There are still environmental concerns, but cleaning up a site to prevent further release is generally the best that can be done.

I know of situations where groundwater has been cleaned up to a high degree in one location in Australia, where CRC CARE has developed a very effective system there, but not of the scale of, say, Oakey, where you have a massive area that is contaminated at relatively low levels. In this case, risk management is probably ‘don’t drink the water’.

Mr RICHARDSON — Thank you for seeing us today. Just a question around obligations on authorities: in the absence of a full understanding of the health and environmental impacts, particularly of those chemicals, those compounds, that particularly focus on PFOS and PFOA, what should authorities be doing and putting in place right now? What procedures?

Mr HOLMES — I think the most effective management measures are containment and changeover to a better standard, so best practice. That takes time. Our focus in Queensland has been to say, ‘Yes, we recognise it is a risk now. We need some interim risk management mitigation measures’. For example, a contingency plan that said, ‘We will release to the river when we have too much water’ might have to be changed to, ‘We’ll pump it to a dam out the back and dispose of it’.

The incentive for industry is probably that disposal of contaminants is very expensive at \$18 a litre, so 1 megalitre of water is \$18 million. Through a cement kiln rather than a plasma arc, it is maybe \$1 a litre. That is still significant. It is still \$1000 for a cubic metre of water for disposal. However, for fluorine-free non-persistent foams you can probably treat them on site — leave them until they degrade on site and not worry about it so much or use standard treatment methods like sewage treatment plants or similar water treatment. I

guess the thing to do is to look at it on a case-by-case basis to say, 'What is reasonable for each site and each industry to do, given their legacy issues, location, plant, operations and lots of confounding factors?'

Mr RICHARDSON — On that point, is it your opinion that there is enough information in the public domain now and over the subsequent years that would require authorities to act on those discoveries of those persistent chemicals today?

Mr HOLMES — Yes. Looking at the scale that I put under the precautionary principle assessment, I think we are well advanced in terms of some of these chemicals. The previous assumption was: 'If we did not know of any effects, we just hoped there were not any effects', whereas now if we have any sorts of suspicions about it or indications, then we need to deal with that. I think we are well beyond suspicions and indications; we are right into significant evidence. Once you get to certainty, then you know what you can do about it or what you should do about it, and for PFOS I think certainty is there. We really should not be using it and should not be releasing it, because the effects are well known, but it is only one of hundreds.

Ms WARD — Hi Nigel. Can I just get you back to the safe levels of PFOS in drinking water and in soil. You touched on it briefly with our Chair. The figures that you have got, you are obviously comfortable with them. Where have they come from and how have you decided on the figures that you are using, such as the 4 millilitres per kilo for drinking — sorry — —

Mr HOLMES — Yes, there are a wide range of values that have been in the literature and different agencies. The main reason for there being different values is that the exposure model is different in every case. So a community that, say, depends upon their groundwater for their only drinking water, you would have a fairly well-defined exposure there. A community that eats seafood almost exclusively, like the Faroe Islands example that is in one of the papers I provided you, they have a well-defined exposure. The exposure limit there might be a lot lower than for a community that only has seafood occasionally, only drinks contaminated water occasionally. Each one of the values has been determined on the exposure for that particular location, that particular state, even that particular town, for example, so that means that you will have a lot of different levels out there. That is why we really need to develop those for Australian conditions, where you probably need several standards around Australia.

Ms WARD — So the only way to really understand a figure would be to compare it with its local environment to see what else is happening in that community, to understand what the figure that is found and what is the average for that area. It would be pointless, for example, for us to compare figures in this state with somebody in — I do not know — Iceland.

Mr HOLMES — Yes, that is right. Australia, I think, is in a good position because the great majority of our drinking water comes through water treatment plants. It is not so much people drinking natural waters or bore waters, although it does occur. I could see that we might need several different standards to say, 'If you are drinking water from a particular contaminated source, then you would have perhaps a more restrictive standard than occasional exposure'. Water treatment authorities, which generally is the local council, would be in a position to test for that and to ensure that the public is not being exposed.

The other exposures that we have are very diffuse, and they are very difficult to quantify. For example, PFOS and other fluorinated organics occur in fabric treatments, so scotchguard and food wrappers, even photocopy paper, depending on your sources. They are not the only source. We are focusing on these for this particular policy, but as a sideline to that we are looking at fluorinated organics in a much broader sense in conjunction with the commonwealth regulatory authorities, like NICNAS and DOE.

Ms WARD — I know we covered this a little bit when we went up and spoke to you in Sydney. In terms of levels in blood, can you talk through how that is measured, what are the current measurements for Victoria or Australia and what you would consider to be a safe level and an unsafe level or a level that would give you concern?

Mr HOLMES — The problem is I do not think anybody knows what an unsafe level is. We know what the median levels are — I think it is between 2 and 10 for eastern Australia as a general rule.

Ms WARD — So when you say 2 and 10, what does that mean?

Mr HOLMES — Sorry, that is nanograms per mil, I think, is the measure. That perhaps does not tell you much apart from what the average is. If I refer you to Grandjean's investigation, he has found indications that the environmental exposure levels that are occurring right now can have an effect on immunisation suppression in children particularly. That is the reason why I think we should be concerned. He is saying that current levels, such as the USEPA one for drinking water, might be a couple of hundred times too high for that particular effect.

We are not talking about PFOS causing cancer; we are talking about immunisation suppression causing or contributing to other disease occurrences, and that is where I think it will become very blurry. I do not think there is a safe level that anybody has looked at. We certainly ask the question of many people, to say, 'Above which level are you going to be affected and below?'. I have not seen any figures on that. I have certainly seen some figures for heavily exposed persons of 100 to 400 nanograms per mil.

Ms WARD — Sorry, what was that number?

Mr HOLMES — I think I can recall values of 100 nanograms per mil and 400 nanograms per mil for particular individuals. I certainly know of one individual who has suffered some adverse health effects in the form of cancer who used to work in one of the production facilities, and I think his levels were a lot higher.

Ms WARD — So that 100 to 400 is a figure that you would start to be concerned about if you had that in your bloodstream?

Mr HOLMES — I guess anything above the mean I would be concerned about.

Ms WARD — Anything above the mean?

Mr HOLMES — And now I am concerned about the mean for non-lethal effects. Much more work is needed in that area, and I am not sure how easy it will be to come up with values there.

Mr RAMSAY — Thank you very much, Mr Holmes, for your evidence this morning, and certainly for the work that you have done in relation to the policy setting for Queensland. I have certainly learnt, as I am sure the committee has, a lot more about the different types of foams and the effects they have. I want to draw you back to a transcript that was recorded in Sydney, and I gather it was not a closed hearing so I am going to refer to it, and commentary made by Dr Klein, who will be a witness shortly. I need to understand from the commentary that was made — and you appeared to be working in tandem in that particular public hearing — that:

When we come to the Fiskville situation, as I understand it, there is 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 ...

Dr Klein goes on to say, and you have made some commentary after:

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.

Mr HOLMES — Yes.

Mr RAMSAY — You have given quite a lengthy summary in relation to the dangers of PFOS and those type of foam activants, yet your commentary in that transcript was that you do not believe there as a serious contamination as other contaminants and industrial waste that was burnt at different firegrounds in the 70s. The government has made a decision in closing Fiskville based on testing of PFOS in their perimeter, yet you have indicated you do not believe that the contaminants regarding PFOS are as serious as other chemicals that were burnt back in the 70s which have not been tested. The argument I put to you, perhaps, is that there is a whole range of sites right across Australia that have high levels of PFOS that have not been closed, and we could name three or four defence bases here in Victoria that have levels of PFOS that have not been closed. I am a little bit confused about the fact that we have a training facility that has been closed on the basis of PFOS contamination, yet your own testimony indicates that you believe there is far more serious contaminants that were involved in fireground burning in the past.

Mr HOLMES — Certainly.

Mr RAMSAY — Just in respect of that, if I may, the EPA is conducting a lot of notices of clean-up in relation to Fiskville. Can you give some commentary about whether you would be satisfied, if in fact some parts of that facility were proven to be uncontaminated, that they would be safe for use?

Mr HOLMES — Exposure is the issue, and past practices in many places would be that the appropriate personal protective equipment was not used. Having spoken to many firefighters, including some who have worked at Fiskville, walking through foam with no breathing protection whatsoever, with bursting bubbles, taking in chemicals of all sorts via inspiration so it is directly going into the bloodstream, that is a very high exposure. Whereas with skin exposure, really normal hygiene will cope with that.

In terms of that facility, the real concern, I think, and it is a relative concern — there are certainly concerns about all the chemicals used there — was that the unknown and to some extent, I suppose, reasonable-to-assume content of the materials being burnt would have produced far more toxic chemicals at the time. For example, waste oils will generate polycyclic aromatic hydrocarbons. They are carcinogenic — well known — several hundred compounds there. The activity of firefighting — letting something burn up and then cooling it down — generates even a wider range of chemicals. The failure to wear and use the appropriate PPE would be an issue.

I cannot comment on what happened at Fiskville, but I know as a historical thing the use of breathing apparatus and full chemical suits and that sort of thing has been a bit variable in the past, purely because of a lack of understanding of some of these chemicals. I suppose the biggest risk there would have been the fuel being used, unlike fire training facilities at the moment, which burn n-Heptane or something that is a relatively pure fuel. It would have been a high risk to, say, collect a drum of something and the only prerequisite was ‘does it burn or not?’. That has certainly been the case all over the place. I can think of facilities where piles of tyres were put underneath the aircraft simulator of an airport to generate fire and conditions to challenge the firefighters in their training. So relatively speaking, yes: the other contaminants that are being generated as part of the fire, the other contaminants that are in the drums that are being brought to site — a lot of them unknown and a lot of speculation about those, but in general I am fairly confident that it would have been old sump oils, old transformer oils, that sort of thing. There could be a wide range of contaminants before you even set fire to them.

Whether or not the site should have been closed purely because of PFOS, that is not something I can comment on. Certainly it is an issue that needs to be managed in terms of risk: is there a risk to the people using the site, is there a risk to the adjacent community? That risk assessment needs to be done in every case, whether it is Oakey, which is underway at the moment in Queensland, Pearce in WA and various other locations. Air Services Australia are doing a good job on all of their airports around Australia because they changed over in about 2010 to non-persistent foams and they are dealing with their legacy issues right now. Certainly I think the issue of whether or not PFOS was the trigger in a certain circumstance, I do not know the details or the risk assessment that was done at the time as to why PFOS was considered the key issue in terms of Fiskville, but you are quite right that there are other sites that have similar contamination.

Mr RAMSAY — There is no excuse for it, but back in the 70s at the time that PFOS and other chemicals were used, we were working on the basis that, yes, we did not take the appropriate occ health and safety response. Me being a farmer, I was using DDT and dieldrin, splashing it all over myself.

Ms WARD — But you have to remember PFOS is still being used — —

Mr RAMSAY — But there are many workplaces that were using chemicals undefined that no doubt, as we now know, were a risk to their health. We would change those practices if we knew then. It is a time and a place, and we learn as we go along a journey.

Mr HOLMES — I completely agree. As I say, as the Queensland department of environment we only really became aware of the issues in 2011. We probably should have been aware earlier. However, the industry, I do know, was aware earlier, and when I say ‘the industry’ I am talking about suppliers. They would have had the indications well in advance of that. In fact one of the references I have provided you says that a large chemical company knew of the risks in about 1997 yet did not really pass that on to the user. That is still a problem we have now, and one of our complaints to industry is that when they provide product information safety data sheets, they are inadequate in just about every respect. The HazMat 2015 conference in June, the whole conference was about the inadequacy of industry information to the user, so really the user perhaps should have

known, perhaps should have asked questions, but naively maybe assumed that what they were being given in terms of advice and product information was all that they needed to know — and the regulators assumed the same thing too.

Mr RAMSAY — Thank you, Mr Holmes. The Joy report indicated they also believe there were more dangerous toxins around at that time than PFOS. Your evidence indicates a similar picture. While we cannot do much about previous activity in relation to use of industrial waste-burning incineration by different facilities, the discussion this morning is about the impact of PFOS, its long life and its environmental damage more so than perhaps the human health issue around what happened, say, at Fiskville.

Mr HOLMES — Yes. It is certainly a bigger issue, as I have said, just with fluorinated organics. There are more than two chemicals involved, and we do not know much about those. And in terms of firefighting there are a lot of other risk factors involved in terms of exposure to different contaminants.

Ms WARD — With the plume at Oakey, will that continue to grow?

Mr HOLMES — It will continue to move. If Defence cleans up the source material — —

During the activities you would have fresh applications of foam that would then travel down to the groundwater. Defence stopped using PFOS foam in 2008, I believe, but they are still using fluorinated foams and they are still soil wetting agents. Even if they went to fluorine-free foams, which is pretty much equivalent to Palmolive dishwashing liquid, then you would still have a driver pushing contaminants down about 11 metres, I think, where the groundwater is located, and the groundwater movement naturally is to the south-west. So the plume will continue to move. I guess the quantity of PFOS has been cut off, if you like, or the source of PFOS has been cut off. If they then move to a model where they contain and dispose of all firefighting wastes, fire water, then there will not be any addition to that, so it will reach an equilibrium point. But I suspect it will continue to move and continue to grow for quite some time, and quite frankly there is nothing much we can do about it.

Mr TILLEY — Just very quickly, Nigel, you speak about contemporary issues and going into the future with legacy things. In Queensland, on a public policy setting, some of the things that you are looking at, like in the resource sector in relation to environmental bonds, what I am getting from your contribution is that significant public moneys are being expended into some of these areas. Has that at any stage been in consideration?

Mr HOLMES — Yes. It came into consideration from mining in particular perhaps 10 years ago in terms of financial assurances for rehabilitation and remediation. I am not aware of any significant application of that in chemical production. Most of the facilities are relatively small. Gladstone has got some production-related chemical production or chemical use. I think that is something that is needed, but certainly even in terms of mining I believe it has been ineffective because there is a large pressure to say, ‘Well, if you put too large a financial assurance requirement onto an organisation, it might make them non-viable economically’. It is a balancing act that the government needs to make a decision on based on ESD and the precautionary principle.

Mr TILLEY — A personal observation: the service ribbon that you display, is it the Defence Force Service Medal?

Mr HOLMES — Yes, it is.

Mr TILLEY — With your service career — I do not know what experience you had considering your large experience with the department — do you have any personal experience with Defence facilities yourself and coming into contact with — —

Mr HOLMES — Not with firefighting foam. I was infantry.

Mr TILLEY — Okay.

The CHAIR — Just quickly, on the other toxic chemicals and the firefighting foam, PFOS sort of chemicals, would it be correct to say the firefighting foam was used to put out fires which were chemical-type fires, whether it is kerosene or diesel or whatever — that was the use for them.

Mr HOLMES — Yes.

The CHAIR — So if there are high levels of PFOS in a firefighter's body or in the bodies of residents in the area, is the next link to say that they would also have been exposed to the actual burnt chemicals which the foam was putting out?

Mr HOLMES — Yes. The exposure, I guess, can be divided into on-site and off-site, so trainees and instructors on-site would have a certain exposure in terms of handling the materials, walking through areas that have got, say, bursting bubbles or aerosols that they might breathe in, even hygiene issues of exposure through food and water. Outside of the site I guess the contaminant plume can travel a couple of different ways. Primarily it is going to be by air, and you will have fallout, especially as you start to cool the fire down as part of the firefighting training. Then the plume gets colder and will fall out closer to the area. You can obviously have in the fire some volatilisation of whatever is in the fire, including the firefighting foam, the detergents, the solvents, the PFOS, the PFOA, the, whatever, and then the exposure route would need to be something like food or water for the most part. I do not see that there would be a large exposure through aerosols or inhalation, because anybody who is going to have a significant exposure to those contaminants or the firefighting chemicals would probably quickly get out of the way because it will be smoke. I would think, outside of the site, the exposure is primarily going to be through food or water intake.

Ms WARD — In the draft report you talk about operational and cultural challenges to responding to the changing understanding of foams. Could you just briefly speak to that — the challenges that you mentioned in your report around operational and cultural shifting in attitudes towards foam?

Mr HOLMES — Yes. I think the one thing that we did discover for ourselves and also for the organisations we were dealing with, whether it was the suppliers, the users or the brigades, is that education was a problem. We needed to educate ourselves. We also then needed to provide the relevant summaries of the complexities to the particular users to say, 'Look, here is what we know; here is how we think it applies in your circumstances for the environment and also into the health area', and then have advice from those organisations on how they might be able to deal with it. So we are not telling them what to do about it; we are saying, 'Here is an issue. How can you deal with it?', because the user is the only person who knows how they use it, what the legacy issues are, what their cost constraints are — all of those other complexities that go with it — and so come to a cooperative approach of saying, 'How can you reduce your risk to a reasonable level', not completely eliminate it, because I do not think we can do that. It is like leaded petrol. We could not get rid of it overnight, and we had to put up with a certain amount of exposural risk in the meantime. Fluorocarbons to the upper atmosphere, those ozone depleting substances are all exactly the same. I do not see this as any different to the phasing out of DDT. It is an issue that has crept up on us.

The CHAIR — Thank you for coming down today and presenting to the committee. Your presentation has been very valuable.

Mr HOLMES — Thank you.

Witness withdrew.