Chemical Hazards, Contamination at Oakey, Queensland and Human Health Risk Assessment: *What is an Acceptable Risk? How Should it be Determined?*

Dr Ted Christie, 14 September 2016

Disclosure Statement

Ted Christie does not work for, consult to, own shares in or receive funding from any company or organisation that would benefit from this article, and has no relevant affiliations.

"No matter how much the specialists sneer at an "irrational" and "ignorant" public, lay judgements about possible dangers are equally as important as scientific or technical analysis."

Emeritus Professor Tim O'Riordan

Environmental contamination, caused by chemicals used in fire-fighting foam at the Army Aviation Centre near Oakey, Queensland, has galvanized community reaction in the town of Oakey and surrounding rural properties.

The first stage of a public interest environmental conflict – ***the ignition stage*** – has been reached.

Environmental contamination has been caused by the chemicals, '*per*'- and '*poly-fluoro alkyl substance*' *(together, "PFASs")* and '*perfluorooctane sulfonate*' *("PFOS")* and '*perfluorooctanoic acid*' *("PFOA")*.

PFASs are a class of man-made chemicals that are not found naturally in the environment. PFOA and PFOS are the most extensively produced and studied of these chemicals. Both chemicals are very persistent in the environment and in the human body.

One of the many uses of PFASs is to help fight fires at airfields and other places where petroleum-product-based fires are a risk. These chemicals have been used at the Oakey Army Aviation Base since the 1970's - as part of fire-fighting training and emergency responses services.

On 5 September 2016, Australia's Department of Defence responded to community concerns by releasing a quantitative *Human Health Risk Assessment* regarding the detection of PFAS contamination around the Army Aviation Base at Oakey.

Some of the conclusions have been summarised in the media[1] and include:

- That the "Human Health Risk Assessment would not predict the health outcomes of exposure to contaminants". The study "had been designed to determine the key exposure pathways";
- But the study "could estimate the nature and possibility of adverse health effects and assess the potential for current human health risks associated with contaminant exposures";
- Forty-seven exposure pathways were identified for "*Residents*", "*Commercial Agriculture Workers and Subsistence Farmers*", "*Recreational Receptors"* and "*On-site employees*".

For example, for Oakey "*Residents*" and "*Commercial Agriculture Workers and Subsistence Farmers*", some of the exposure pathways identified in the Department of Defence's Human Health Risk Assessment included: -

(i) "Ingestion of groundwater";

(ii) "Inhalation of dust as a result of outdoor activities or dust tracked";

(iii) "Consumption of fruit and vegetables irrigated with water containing detectable PFAS - or grown in soil that has been irrigated with water containing detectable PFAS"; and

(iv) "Consumption of meat from sheep or cattle that have consumed water containing detectable PFAS and/or consumed plants that have accumulated PFAS from irrigation water".

One key conclusion of the ***Human Health Risk Assessment*** was:

"The weight of evidence … is considered to indicate, based on the available data, that there is a ***low and acceptable risk*** *to health associated with typical exposure to the PFAS detected in the environment for the general community within the Investigation Area*[2]*".*

Understanding Health Risk Assessment Methodology in a Nutshell

Health Risk Assessment, as used in in chemical exposure–public health problems, moves through a number of stages. These include:

(i) Identifying the chemical hazard(s) that are a source of potential harm to human health;

(ii) Identifying an exposure pathway that demonstrates a causal link between the hazard and an adverse outcome for human health;

(iii) The effects on human health, for a hazard identified as a risk[3]. This will include a "*dose–response assessment*" i.e. the association between varying exposures to the chemical hazards identified and subsequent health impacts on exposed populations; and

(iv) Characterisation of the risk. Scientific evidence is used to estimate the level of risk based on a combination of the likelihood (or probability) of risk and its consequences for potential harm to human health.

(v) The estimate of the level of risk is then used to consider the control measures that may be used to manage those risks.

Risk Characterization & Acceptability of Risk: Who Decides?

Risk characterisation relies on a mathematical model to predict the likelihood (or probability) of the risk to public health along potential or actual pathways of exposure to a hazardous chemical.

However, risk analysis[4] recognises that all human activity involves some level of risk - but that it is rarely possible to reduce risk to a zero level.

The approach taken by science, in these circumstances, is to initially assess whether the risk to human health arising from exposure to a hazardous chemical represents an ***acceptable level of risk***; and, if not, whether it can be managed[5] to an *acceptable level of risk* in order to protect human health?

Science has a clear and valid role to undertake this role in human health risk assessment.

But an issue that persists as a source of controversy is whether science, in this case, can answer the trans-scientific question of "*how safe is safe enough*"?

Decisions by science about what is an acceptable level of risk e.*g. by toxicologists, epidemiologists* - based on their expert knowledge of public health and exposure pathways - may be quite different from public opinion and subjective community perceptions of risk.

As a result, conflict may arise between competing interests - representing expert scientific knowledge or the democratic ideal of public participation - on how best to answer the question of "how safe is safe enough"!

Why does such a predicament arise? Are there any solutions?

It arises because any risk to human health, such as the risk associated with exposure to the *"fire-fighting foam chemicals*[6]*"* at Oakey, has two dimensions. Both dimensions need to be considered in decision-making on risk:

- ***"Scientific" (or "factual") risk***, based on objective science.
  This dimension consists of outcomes that can be measured, or predicted using mathematical models e.g. "*dose-response assessment*"; and
- A ***"socio-cultural"*** dimension for ***risk***.
  This dimension reflects how a particular risk is viewed when values and emotions come into play. *Risk perception* involves people's feelings, beliefs, attitudes and judgements.

But there is a way forward to overcome this "log in the road" for risk evaluation and risk management: That is, by providing room for both scientific evidence and community value-based perceptions of risk.

The *International Risk Governance Council*, (the "IRGC") based in Lausanne, Switzerland has broadened the concept of risk assessment by adding the parallel activity of ***'concern assessment'***.

Concern assessment considers:

- *individual, organisational and societal perceptions of; and*
- *concerns about,*

the consequences of risk. Perceptions and concerns are seen as relevant inputs for risk evaluation and risk management.

A cornerstone for IRGC's ***concern assessment*** is that it implements the idea of inclusive governance[7]: This concept is *"based on the assumption that all stakeholders have something to contribute to the process of* ***risk governance*** *and that their inclusion improves the final decisions rather than impedes the decision-making process or compromises the quality of scientific input".*

Conclusions

1.0 The Defence Department's Human Health Risk Assessment identified key uncertainties associated with the existing scientific database and the risk assessment process undertaken for the detection of "fire-fighting foam" contamination around the Army Aviation Base at Oakey.

2.0 This information would enable the ***dominant risk characteristic*** for each exposure pathway to be identified. This would facilitate decision-making by the Department of Defence as to the appropriate level of stakeholder involvement for risk evaluation and risk management.

3.0 The ***dominant risk characteristic*** of ***uncertainty*** arises because of "a lack of clarity or quality of the scientific or technical data".

In this situation, IRGC recommends that the participation process should "involve all directly affected stakeholders to collectively decide the best way forward" e.*g. Department of Defence/Regulatory Bodies, External Consultants/Researchers and the Oakey Local & Rural Community.*

4.0 One source for the ***dominant risk characteristic*** of ***ambiguity*** is divergent or contested opinions on the justification or severity of a risk.

In this situation, much wider stakeholder consultation is required as a means for reconciling differences between science and the community for interpreting an "acceptable level of risk or for evaluating the options for risk management".

The IRGC recommends that the participation process should involve the wider stakeholder base "in societal debate about the risk and its underlying implications".

5.0 The IRGC notes that *"very few risk governance models currently include procedures or guidance for how, or when, to involve the concerns of stakeholders – particularly the general public".*

6.0 Meaningful involvement of the Oakey community in risk governance, provides a pathway for acknowledging the legitimacy of local community concerns over hazardous chemical contamination; and to enhance public trust and confidence in Government and the Department of Defence.

Key Words: Chemical hazards; human health; fire-fighting foam; PFAS; Oakey; health risk assessment; concern assessment; IRGC; risk governance; acceptable level of risk; factual risk; socio-cultural risk; participation

About Dr Ted Christie

Ted Christie was a *Commissioner* on the Federal Government's '*Commission of Inquiry into Shoalwater Bay, Capricornia Coast, Queensland'* which focussed on the ongoing and future uses and activities of the 454,500 hectare Shoalwater Bay Military Training Area.

A cross-disciplinary (*Science/Law/Alternative Dispute Resolution*) review of the topic "*Hazardous Chemicals and Public Health*" has been published in Ted's book: *"Finding Solutions for Environmental Conflicts: Power and Negotiation"* at Chapter 8.

End Notes

[1] Tara Miko, "*Oakey contamination: Hundreds gather for report'*, The Chronicle, Toowoomba, 5th September 2016

[2] "The **Investigation Area** is the broader area, and includes the Site and surrounds being studied to assess the extent of PFAS detections in groundwater".

[3] A **hazard** refers to a source of potential harm to human health or the environment.
A **risk** refers to a chance or probability that harm to human health or environmental harm will actually occur.

[4] **Risk analysis** is a broad concept that incorporates the processes of *risk assessment, risk management* and *risk communication.*

[5] The objective of **risk management** is to reduce identified risks to an acceptable level of risk by evaluating various options for environmental management and protection as control measures to manage risk.

[6] The chemicals, 'per'- and 'poly-fluoro alkyl substance' (together, "PFASs") and 'perfluorooctane sulfonate' ("PFOS") and 'perfluorooctanoic acid' ("PFOA").

[7] **Good governance** is about the processes for making and implementing decisions. Its focus is about using the best possible process for making those decisions.