# Appendix B. Supplemental Information for Hazard Ranking Approach

# B.1 Supporting Documentation

## B.1.2 Environmental (Aquatic) Toxicity Assessment

Guidance manuals are available in Australia on the data requirements and methodology for assessment for environmental hazard and risk assessment of industrial and agriculture and veterinary chemicals, consistent with international best practice. NChEM guidance is prepared by the National Environment Protection and Heritage Council (EPHC) for the Department of the Environment, Water, Heritage and the Arts (DEWHA). DEWHA undertakes environmental risk assessments of industrial chemicals for the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and of agricultural and veterinary chemicals for the Australian Pesticides and Veterinary Medicines Authority (APVMA).

In addition, the following international literature for PBT assessment was consulted:

- CCME (2008) Canadian Council of Ministers of the Environment The National Classification System for Contaminated Sites (NCSCS) Guidance Document;
- Christensen et al. (2003) Assessment Tools under the New European Union Chemicals Policy;
- Environment Canada (2003) Existing Substances Branch Guidance Manual for the Categorization of Organic and Inorganic Substances on Canada's Domestic Substances List, Determining Persistence.

Bioaccumulation Potential, and Inherent Toxicity to Non-human Organisms;

- European Commission (2003) Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances, Part II Chapter 3 Environmental Risk Assessment;
- ECETOC (2005) Risk Assessment of PBT Chemicals;
- Franke et al. (1994) The Assessment of Bioaccumulation;
- Langley (1993) Refining Exposure Assessment. In: The Health Risk Assessment and Management of Contaminated Sites. Proceeding of the Second National Workshop on the Health Risk Assessment and Management of Contaminated Sites;
- Swann *et al.* (1983) A rapid method for the estimation of the environmental parameters octanol/water partition coefficient, soil sorption constant, water to air ratio, and water solubility. Residue Reviews; and
- UNECE (2009) Globally Harmonised System (GHS) of Classification and Labelling of Chemicals. Revision 3. Part 4 Environmental Hazards and Annex 9 Guidance on hazards to the aquatic environment.

## B.1.3 Terrestrial Toxcity Assessment

As noted by the draft NEPM (Assessment of Site Contamination, NEPC 2010) and the European Chemicals Bureau (ECB 2003) terrestrial toxicological data can be scarce compared to aquatic toxicological data, and where data are available, results from short-term tests using earthworms and plants may only be available, rather than the preferred long-term test results (ECB 2003). As a result of these limitations, soil criteria based on terrestrial receptors comprise a much smaller dataset than that for water criteria.

Due to these limitations, there are approaches to supplementing or generating terrestrial toxicological data. The draft NEPM (NEPC 2010) notes that models can be used to predict toxicity. The Australian

and New Zealand Water Quality Guidelines (ANZECC and ARMCANZ 2000) used QSAR models to derive trigger values for narcotic organic contaminants where there were insufficient data.

ECB (2003) suggest that the equilibrium partitioning method can be applied to aquatic data to identify a probably no effect concentration (PNEC) for soil organisms. The equilibrium partitioning method uses aquatic toxicological data combined with chemical partitioning properties (between soil and water) and soil density to predict the toxicity to soil organisms. However, this method cannot replace toxicity data for soil organisms and should only be considered as a screen for identifying substances requiring further testing (ECB 2003). Furthermore, the draft NEPM (NEPC 2010) recommends the use of the equilibrium partitioning method only where QSARs are not available. For these reasons, equilibrium partitioning has not been used in this assessment to generate terrestrial toxicological data.

A third approach is to draw from the large dataset of laboratory mammal (rat, mouse, rabbit) toxicological data and use these animals as surrogates for the potential mammalian terrestrial receptors (e.g., stock animals and native mammalian fauna) that may come in contact with fracturing fluid chemicals on or near a drill pad. It is acknowledged that these data are limited in application, as they generally comprise acute (LC50) data for receptors that are not of direct interest for the risk characterisation. Moreover, toxicological data from laboratory mammals are not suitable surrogates for other terrestrial receptors such as reptiles, birds, invertebrates and plants.

# B.2 Exclusions and Limitations

## B.2.1 Environmental (Aquatic) Toxicity Assessment

The environmental hazard assessment is a relative assessment and not a comprehensive evaluation of environmental hazards. Below are the exclusion and limitations:

- The approaches consulted for assessment of PBT in devising the environmental hazard assessment approach are predominantly focussed on the assessment of organic chemicals. There is limited guidance for PBT assessment of inorganic chemicals;
- The environmental hazard assessment approach is subject to professional judgment and the evaluator's subjectivity in designating the parameter ranges for each parameter assessed;
- The environmental hazard assessment does not consider, inter alia:
  - Breakdown or reactive products of the chemicals that may pose more or less of an environmental hazard than the parent compound;
  - The quality, adequacy or accuracy of the available information sourced, noting that only sources considered to be reputable were used;
  - Endocrine disruption effects that are not assessed by standard ecotoxicological tests;
  - The combined effects of these chemicals when present in mixture.
- The data collated in the Chemical Information Sheets are treated the same regardless of whether the data are measured experimental values or estimated / calculated values;
- The test endpoint description in the (secondary) sources consulted are relied upon although it should be noted that true chronic and acute NOEC, LOEC, MATC and L(E)C50 are dependent on a variety of factors such as test duration, species tested, stage in the life-cycle, etc. which can only be verified by review of the primary literature;
- It is noted in relation to the aquatic ecotoxicological data that the species *Daphnia magna* are a sensitive species, frequently displaying sensitivity to chemicals orders of magnitude greater than other invertebrate species;
- Sources of Australian aquatic ecotoxicological data are consulted but the information is very limited. Furthermore, many species reported in the Australian literature are not necessarily indigenous species;
- The environmental hazard assessment approach devised for this study will not adequately assess chemicals which are:
  - Hydrophilic i.e., are highly soluble and have low $K_{ow}$. Where aquatic ecotoxicological data are limited for these types of chemicals, toxicity may be underestimated because there is potential for these chemicals to be highly toxic;
  - Poorly biodegradable, have low acute toxicity, but are bioaccumulative (based on the BCF or $K_{ow}$). These chemicals may exert chronic toxicity.
- Use of surrogate toxicity data for hydraulic fracturing chemicals, which are best described as mixtures, may further bias the hazard assessment towards assessment of T potential. Where a highly toxic chemical is present in only small quantities the effect on the overall hazard assessment is greater compared to a chemical with lower toxicity.

## B.2.2 Terrestrial Toxicity Assessment

The terrestrial environmental hazard assessment is a relative assessment and not a comprehensive evaluation of environmental hazards. The limitations with regard to the hazard assessment and source data are listed below:

- Sources of Australian terrestrial ecotoxicological data are consulted but the information was limited;
- The terrestrial toxicity assessment is largely based on modelled data of lettuce and earthworm that may not present in soil on drill pads. Modelled data introduces more uncertainty than if measured data are utilised;
- The effects of exposure to the inorganic chemicals identified as higher hazard than other chemicals cannot be fully assessed;
- The terrestrial toxicity assessment identifies chemicals with the highest hazard relative to the chemicals assessed. Actual hazard is based on the exposure concentration and exposure scenario.