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Attention: Peter Briggs

Review of Health Impact Issues – Transpacific Cleanaway Pty Ltd, Organic Composting Facility, Gerogery

1.0 Executive Summary

Jackie Wright, of Environmental Risk Sciences Pty Ltd, has conducted a short desk-top review of human health risk issues associated with the development application (No. 42-12/13) (the Application) submitted by Transpacific Cleanaway Pty Ltd (Cleanaway) for an organic composting facility in Gerogery. Provided the proposed facility is operated, as a minimum, in accordance with AS 4454-2012 (Composts, Soil Conditioners and Mulches); implements the proposed management measures outlined in the Environmental Impact Statement for the control of pests and vermin; and complies with the proposed amended General Terms of Approval issued by the NSW EPA in relation to the licenced discharge point from the sedimentation pond to the environment, no risks to human health or the environment (from animal fats, pests, pathogens, livestock diseases, vermin and discharges from the sedimentation pond) have been identified.

2.0 Introduction

Environmental Risk Sciences Pty Ltd (enRiskS) has been commissioned to conduct a desk-top review of documents submitted to the Greater Hume Shire Council in relation to the development application (No. 42-12/13) (the Application) submitted by Transpacific Cleanaway Pty Ltd (Cleanaway) and provide a short report on the potential health risks of the Project.

In particular the review of health risk issues presented in this letter has addressed a number of specific concerns related to health risk raised in submissions received in relation to the Application.

I, Jackie Wright, director of enRiskS, am an expert in the field of human health and environmental risk assessment. I have over 20 years' experience in this field, particularly in relation to the assessment of impacts/risks derived from industrial premises and contaminated sites, including impacts/risks during and following remediation activities. More specifically I specialise in fate and transport assessment of contamination to air and aquatic environments, qualitative and quantitative assessment of human toxicology, ecotoxicology and risk assessment, including the aquatic environment. A more detailed summary of my qualifications is included in **Appendix A**.

3.0 Methodology

The review undertaken and presented within this letter has been undertaken in accordance with guidelines/protocols endorsed by Australian regulators, including:

- enHealth (2012a) Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards
- enHealth (2012b) Australian Exposure Factor Guide
- NEPM (1999 amended 2013) National Environmental Protection Measure – Assessment of Site Contamination including:
    - Schedule B1: Investigation Levels for Soil and Groundwater
    - Schedule B4: Guideline on Health Risk Assessment Methodology
    - Schedule B6: Guideline on Risk Based Assessment of Groundwater Contamination
    - Schedule B7: Guideline on Health-Based Investigation Levels

4.0 Review of Health Issues

4.1 Available Information

Information that has been provided for the purpose of this review is outlined in the following documentation:

- Development Application (including plans) as lodged to the Greater Hume Shire Council.
- The Environmental Impact Statement (EIS), Report prepared by GHD: Transpacific Cleanaway, Organic Composting Facility, Environmental Impact Statement, October 2012, Volume 1 – Main Report and Volume 2 – Appendices.
- Correspondence with Greater Hume Council and other regulators.
- Public submissions.

4.2 Key Issues of Concern

The key health issues which have been identified in submissions received in relation to the Application are as follows:

- Whether there is a general risk of spreading some unspecified stock disease via the use of the composted organic material. In particular, whether there is a risk of spreading phylloxera via the use of the composted organic material. This issue arises as the site is located in a “phylloxera infected zone” but the compost may be distributed to land which is within a “phylloxera exclusion zone”.
- Whether the potential for meat and bones to be included in the source waste will somehow result in farm stock ingesting meat by-products on properties where the resulting compost is used. In particular, whether this poses a risk of a:
    1. Foot and Mouth disease outbreak; and/or
    2. Mad cow disease outbreak.
- Whether the facility will result in an increase in vermin numbers and result in rats and mice spreading leptospirosis.
- Whether the water which will be released from the sedimentation pond onsite could result in the spread of stock diseases.
- Whether dropped waste in the facility impact upon the sedimentation pond and subsequently poses a risk to human health and the environment.

These issues are further addressed in the following sections.

4.3 Pests, Pathogens and Livestock Diseases

In relation to the potential for adverse impacts associated with specific pathogens and specific livestock diseases, these can only be considered to be of concern if they are present in Australia and in the waste products received and handled at the proposed facility. There is only then a risk to health if these pests, pathogens or diseases are present in the final product at levels that could cause harm.

The Department of Primary Industries (letter dated 19 June 2013) has confirmed that Bovine Spongiform Encephalopathy (BSE), commonly known as "Mad cow disease", is not known in Australia and hence cannot be present in any waste received at the proposed facility.

In addition given that the proposed facility will be accepting meat and bones in the source waste the Department of Primary Industries has also noted that, provided there is no meat and fat in the product compost, there are no issues of concern in relation to the ruminant feed ban. The department noted that the use of compost for cropping and grazing is common in Australia, as is the composting of livestock. There are some aspects that should be incorporated by the producer in the use of compost from these facilities to ensure that a breach in the Ruminant feed ban does not occur. It would be appropriate that such measures are noted on the product packaging to mitigate these issues.

In relation to pathogens that may be present in the source waste, the EIS has stated that the composting process will achieve the requirements outlined in the Australian Standard for composting (AS 4454-2012: Composts, Soil Conditioners and Mulches) which requires as a minimum, a temperature of 55 ^{o}C for at least 3 days. These conditions are required to destroy pathogens in the waste. The EIS states that the proposed system is expected to achieve temperatures of 65-70 ^{o}C for at least 10 days. The composting process has 6 weeks of covered composting (with forced ventilation and moving of the compost after 4 of the 6 weeks) followed by 2 weeks of uncovered composting and 6 weeks of maturation. Given this duration of composting the conditions required to destroy pathogens in the source waste would be expected to be met.

More specifically in relation to phylloxera, trials have been conducted by NSW Agriculture (Bishop, Powell et al. 2002) to determine the survival of this pest during composting, including consideration of the minimum conditions required as outlined in AS4454-2012. This study showed that no phylloxera (or source root systems) survived any of the composting experiments including that conducted to meet the minimum requirements in the Australian Standard. Hence this pest is not expected to survive in the compost product manufactured at this facility provided the minimum requirements as outlined in the Australian Standards are met.

The potential introduction of phylloxera at other stages of composting (i.e. contamination from source materials) was found to be lower with increasing distance between the source materials and the maturing compost. The layout of the proposed facility as provided within the EIS indicates that the maturation and storage area is located on the opposite side of the site to the Receivals Shed (i.e. as far away as possible on the site). The maturation areas would not provide a feeding source so the phylloxera pest cannot survive long regardless of the temperature. Hence there is a negligible potential risk of phylloxera entering the mature compost and, if it did, it would not survive long enough to be of concern.

4.4 Vermin and Disease

Based on the information provided in the EIS, the compost is fully covered for 6 weeks after which time no source materials that would attract vermin would be expected to be present in the compost materials that are uncovered or are moved to the maturation area. The main risk area for vermin would be the source materials shed, Receivals Shed and in areas where there is the potential for leachate to be present. Vermin are typically addressed in any facility through good housekeeping and appropriate management measures such as vermin excluding fencing, for example.

The EIS provides a range of management measures (refer to Chapter 16 of the EIS) to minimise the potential for vermin to be present at the facility. These management measures are consistent with those outlined in industry and government guidelines for composting facilities. This includes the more detailed guidelines outlined in the NSW Department of Environment and Conservation *Environmental Guidelines: Composting and Related Organics Processing Facilities* (2004).

In the event that vermin did circumvent the proposed controls and enter the Receivals Shed, any diseases that may be carried by the vermin would be destroyed in the composting process (as discussed in **Section 3.3**) and would not be present in the product.

4.5 Sedimentation Pond Water Release

The proposed facility, where the source materials in the Receivals Shed are located within a roofed structure and the active composting is conducted under covers, will minimise water contact with these materials during rainfall events. There are other areas of the proposed facility, namely the uncovered compost and maturation areas, where the materials are not covered and there will be the potential for rainfall infiltration and runoff.

The EIS states that the sedimentation pond will allow for the storage of surface water runoff from the facility as well as providing emergency backup for the storage of leachate or other spills. Water from the pond is proposed to be re-used in the site as “dirty water” which is applied to the compost in the initial stages of the composting process. The reuse of water from the pond may limit the potential for overflow and off-site discharge.

The EIS states that it is unlikely that water from the sedimentation pond would contaminate surface water. However, it would be expected that water in the sediment pond, as derived from a compost facility would be anaerobic and have elevated biochemical oxygen demand (BOD), ammonia and nitrogen levels as this is common in other compost facilities.

The EIS notes that the following monitoring will be undertaken:

- Daily visual inspections of sources of leachate
- Inspection of the sedimentation pond and site runoff
- Testing of chemical oxygen demand and ammonia in the pond at a frequency determined by pond levels and other operational considerations.

It is also noted that the NSW EPA has issued General Terms of Approval for the project and has indicated that they propose to amend these General Terms of Approval so to confirm the concentration limits and monitoring requirements (including frequency of monitoring) which will apply to the licenced discharge point from the sedimentation pond to the environment. Provided that the proposed facility complies with the proposed requirements outlined in the EPA’s Additional General Terms of Approval, there will be no risks to human health or the environment arising from any discharge of the water in the sedimentation pond into the environment (including any off-site surface water body such as a farm dam or creek).

4.6 Runoff of Waste from the Facility

It is possible that small amounts of material may be spilt in the area of the site located between the Receivals shed and the composting area as materials are moved from one location to the other. The materials will be made up of green waste from Kerbside collections and animal wastes. It is proposed that regular housekeeping will occur along this route through the site (that includes regular sweeping) but it is possible that there will be occasions where rainfall occurs prior to the materials being cleared away. If such a rainfall event should occur then any materials that are present on the ground in this area would be washed into the stormwater system at the site and then into the sedimentation pond. Hence any materials that may be washed from the site will not directly enter the environment but will be contained in the sedimentation

pond. It is possible that, from time to time, sufficient material will be present that it won't all be washed away into the collection system, but rather the rain will wash from the material into the sedimentation pond the contaminants that might be present on the surface. It is noted that this pathway only occurs during rainfall events, where rainfall will significantly dilute any contaminants that may be derived from the small amount of waste materials present on the ground surface.

Contaminants that could be present in the waste include fats and other naturally occurring compounds from the animal wastes or pathogens from the waste.

Animal fats and pathogens are present throughout the natural environment. The water quality in surface water bodies (including farm dams, rivers and creeks) includes pathogens and fats that are derived from a wider range of sources that include runoff during rainfall events from human waste (in particular sewage and overflows/leaks from septic tanks), animal waste (faecal waste and contamination from decaying native fauna and livestock) and in-stream defecation from various wild animal species and livestock. In rural areas in particular, these are more significant sources of animal fats and pathogens within surface water bodies than would be expected to occur as a result of runoff from the proposed facility (that would then enter the sedimentation pond, not directly into the environment).

The fats and other compounds are easily degraded in sunlight and/or other treatment processes. The pathogens that may be present are most likely to be ones that affect livestock rather than people. Also most pathogens need favourable conditions to remain alive – for some this means rapid uptake by another host while for others it means continued presence in a warm food rich location. The sedimentation pond (and potentially other treatment processes to be added to the system) will enable sunlight and bacteria to break down a range of organic compounds, like animal fats, as well as allowing sediment particles to settle out. This situation is similar (but on a much smaller scale) to the handling of such wastes at abattoirs where it is common practice to have ponds that allow the wastes to be exposed to sunlight and bacteria over a period of time to allow break down of these compounds and the death of any pathogens that might be present.

At this site, the amended general terms of approval issued by the NSW EPA require that biological oxygen demand and oil and grease be monitored and specified standards met prior to any discharge. These are the parameters that would indicate whether an excessive amount of any waste materials deposited between the Receivals shed and the composting area has been washed into the stormwater control system. If an excessive amount reaches the sedimentation pond, discharge will not be permitted until the discharge limits on the licence are achieved. This means that, while it is unlikely that such material will wash into the system on a regular basis, if they do, the correct system is in place to identify the problem and allow rectification prior to any release of wastewaters to the environment.

If you require any additional information or if you wish to discuss any aspect of this assessment please do not hesitate to contact me on (02) 9614 0297 or 0425 206 295.

Yours sincerely,

Jackie Wright (Fellow ACTRA)
Principal/Director
Environmental Risk Sciences Pty Ltd

References

Bishop, A. L., K. S. Powell, et al. (2002). "Mortality of grape phylloxera in composting organics." Australian Journal of Grape and Wine Research 8(1): 48-55.

Limitations

Environmental Risk Sciences has prepared this report in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

It is prepared in accordance with the scope of work and for the purpose outlined in this report.

The methodology adopted and sources of information used are outlined in this report. Environmental Risk Sciences has made no independent verification of this information beyond the agreed scope of works and assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in the reports provided for use in this assessment was false.

This report was prepared in August 2013 and is based on the information provided and reviewed at that time. Environmental Risk Sciences disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Appendix A – CV for Jackie Wright

Jackie Wright

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Professional Profile

Jackie Wright has more than 22 years' experience in human health and ecological risk assessment in Australia. Experience includes leading and developing a national risk practice group for a major consultancy, training of staff, providing technical (and toxicological) direction, developing internal technical standards, participating in the development on industry guidance and standards, developing appropriate risk models and providing peer-review.

Areas of expertise include human and eco-toxicological review and evaluation of chemicals in line with Australian regulatory requirements, human health and ecological risk assessment, exposure modelling, indoor air quality assessment, fate and transport assessment, air dispersion modeling, environmental chemistry, environmental monitoring, and the assessment of air emissions and air toxics. Human health assessments have included a wide range of sites that involve the evaluation of emissions to air, waste sites, residential and recreation areas, operating industrial plants as well as other industrial plants that have been closed and are in the process of property sales or redevelopment and remediation. Ecological assessments have included screening level and detailed assessments of contamination, potential for contamination and remediation of contamination in soil and the aquatic environment. Risk assessments, ecological and human health, have been conducted for review by regulatory agencies (including Contaminated Land Auditors), with Jackie also providing expert support on both human health and ecological risk assessments (including detailed aquatic eco-toxicological assessments) for a number of Auditors in NSW, Victoria, South Australia, Western Australia and Queensland.

In addition, she has extensive experience in the assessment of vapour migration and intrusion, detailed evaluation of exposure by occupational, residential and recreational groups including the application of probability distributions to human health risk assessments. Jackie also been involved in a number of key projects that require regular risk communication with interest groups, including resident action groups.

- Toxicological (human and ecological) Review and Assessment
- Human Health Risk Assessment
- Environmental Risk Assessment
- Exposure Assessment and Modelling
- Occupational Exposure Assessment
- Environmental Chemistry, Fate and Transport
- Vapour Intrusion
- Indoor Air
- Risk Communication
- Air Dispersion Modelling

Jackie Wright Jackie@enRiskS.com

Professional Accomplishments

Toxicology and Risk Assessment

- 2009 to 2013 – provided detailed toxicological review, determination of appropriate dose-response values, and derivation of proposed 2013 NEPM Soil Health Investigation Levels (HILs), including the interim soil gas HILs, and input into the petroleum Health Screening Levels (HSLs). The review included significant update and revision to Schedules B4 and B7 and involved incorporation of all comments from regulators, industry and the public.
- 2010 – provided detailed review of toxicological interactions, biomonitoring data and human exposure to metals (and metal mixtures) for a site in Tasmania.
- 2005 to 2013 (ongoing process of development and revision) - Prepared over 50 toxicity summaries for a range of chemicals relevant to the inclusion and assessment of these chemicals within human health and ecological risk assessments in accordance with Australian guidance. Toxicity summaries prepared provide detail on the chemical use, sources, exposures, chemical properties, ecotoxicity (terrestrial and aquatic), environmental fate and transport, health effects, review and identification of appropriate data relevant to acute and chronic exposures by the inhalation, oral and dermal routes, including assessment of carcinogenicity and genotoxicity. Range of compounds assessed includes particulate matter, petroleum compounds, chlorinated compounds, metals and more obscure industry-specific compounds. More specific, detailed review of arsenic dose-response has been undertaken based on current studies.
- 2006 to 2013 (and ongoing) - Presentation and collaboration with regulatory bodies in Australia (New South Wales Environmental Protection Authority [EPA], New South Wales Department of Health and Victorian EPA) with regards to the approach adopted and information presented with toxicity summaries (addressing human health and aquatic toxicity where required) for key, high profile assessments.

Exposure and Risk Assessment (Human Health and General Environmental)

- 2011-2013 – Conduct of human health risk assessment and on-going advice in relation to the remediation of gasworks waste from HMAS Platypus site in Sydney.
- 2012-2013 - Conduct of human health risk assessment and health impact assessment for a major transport infrastructure project in Sydney southwest.
- 1995 to 2013 (ongoing) - Detailed assessment and ongoing evaluation of risks to human health associated with contamination issues derived from the Orica Botany site in Sydney. A number of assessments have been undertaken over a period of 17 years and has involved detailed review of risks to residents (including groundwater extraction and use), workers and recreational users of a large area affected by the discharge of contamination in shallow and deep groundwater to surface water within a drain and an estuary, historically deposited sediments and volatile chlorinated compounds in air. The assessment of risk has been tied closely with ongoing monitoring with detailed exposure reviews, including the collection of additional data and ongoing review of methods, being undertaken for many key aspects of the project. The process required evaluation within context of the NEPM (1999) and enHealth (2002)

guidance with regular liaison with the NSW OEH, NSW Department of Health and independent reviewers.

- 2009 to 2013 (ongoing) - Derivation of national guidelines for the investigation and remediation of clandestine drug laboratories in Australia. The work involved the derivation of investigation levels, protective human health and the environment (terrestrial and aquatic), associated with former clandestine drug laboratories in Australia. Project required identification of key indicator compounds from over 200 base, intermediate and waste products that may be associated with over 20 different drug manufacturing methods. This required consideration of human health and environmental toxicity, behaviour/fate and transport in the environment and manufacturing methods. Guidelines were derived for indoor surface residues, indoor air, outdoor soil and the environment (local waterways and soil) for residential, commercial and recreational areas. The guidelines developed have been published by the Australian Government in April 2011.
- 2010 to 2013 – Detailed evaluation of community exposures and risks to PM10 and PM2.5 derived from urban (combustion) sources as well as crustal (mining) sources. A number of urban projects have also considered community exposures and risks to other criteria pollutants that include ozone, nitrogen oxides and sulphur dioxide. Projects have involved detailed review of current literature in relation to the health effects and appropriate dose-response relationships relevant to the quantification of relevant health endpoints, with consultation conducted with stakeholders, including state health departments.
- 2008 to 2013 (and ongoing issues associated with remediation) - Detailed evaluation of human health and environmental issues associated with a former chlor-alkali plant. The assessment involved detailed evaluation of mercury fate and transport with use of specialised data collected and analysed by CSIRO and liaison with experts on mercury issues from the CSIRO. Assessment considered environmental issues associated with the presence of mercury in groundwater and discharge to an urban (highly modified) environment, as well as issues associated with mercury (elemental and inorganic) in soil and groundwater with respect to fate and transport, human health and environmental issues.
- 2011 – Quantitative assessment of risks to human health associated with the placement of remediated soil that contains residual levels of radiological contamination, beneath a proposed commercial/industrial development in South Australia.
- 2011to 2013 – conduct of health impact assessment and detailed evaluation and development of chemical risk assessments for a range of products/compounds utilised during coal seam gas operations in NSW and Queensland.
- 2009 to 2013 (and ongoing) – Expert support for contaminated land Auditors located in New South Wales, Victoria, Queensland, South Australia and Western Australia. Expert support has included review of human health and ecological risk assessments for a range of projects and issues.
- 2011 – Development of a detailed scope of works for the assessment and remediation of an abandoned asbestos mine in NSW. The works required collaboration between key stakeholders including NSW Health and the NSW EPA with the focus of the works on the protection of off-site community health.
- 2010 – Detailed assessment of risks (including detailed assessment of toxicity of individual compounds and mixtures) to human health associated

with the presence of nitrate, nitrite and perchlorate contamination in drinking water (international project).

- 2000 to 2011 - Detailed evaluation of risks to human health and the environment associated with redevelopment of large a number of gasworks sites in New South Wales and Victoria. Projects have involved the evaluation of the vapour migration pathway, including the collection of relevant soil gas and vapour emissions data to quantify exposure consistent with the proposed developments. The process required liaison with relevant site auditors, Vic EPA, SA EPA, NSW EPA and NSW Department of Health as required.
- 1995 to 2008 - Detailed evaluation, modelling and risk assessment of a number of landfill and waste depots in Australia (in New South Wales, Australian Capital Territory, Queensland and Victoria). This includes proposed waste destruction technologies, proposed waste depots and landfills, operational landfills, composting operations and closed landfills with assessments considering workers, residents and recreational users of the site and surrounding areas. Assessments undertaken have considered issues associated with the presence of a wide range of chemicals, landfill gas emissions, bioaerosols and other pathogens and bacteria.
- 1995 to 2013 (ongoing process as vapour issues are relevant for many projects) - Evaluation of vapour migration (and vapour intrusion) from numerous sources including contaminated soils and groundwater (dissolved phase and free phase) for many different chemicals, and subsequent assessment of human health risks associated with the estimated vapour concentrations. In addition, Jackie has developed and managed various techniques for the direct measurement of vapour migration in residential, recreational and industrial settings as part of the risk assessment process.
- 2010 – Air dispersion modelling conducted for the assessment of exposures (and risks to human health) to grain fumigants, hydrogen sulphide, chlorinated compounds, silica and dust (particulate) emissions from a range of facilities. Modelling has been conducted using Ausplume and Calpuff dispersion modelling packages.
- 2009 - Detailed evaluation of public health issues associated with recreational exposures to arsenic and PAHs in surface soil in sporting areas and children's playgrounds. Provision of technical advice along with appropriate general advice relevant for presentation to the public and responses to questions from the general public.
- 1995 to 2000 - Evaluation of human health risks associated with potential exposure to emissions from coal mining activities, including the assessment of potential risks and health effects associated with exposure to fine particulates.
- 1992 to 2013 (ongoing) - Project management and evaluation of human health and environmental risks associated with over 300 contaminated sites in all states of Australia utilising national guidance that include NEPM, enHealth, ANZECC and NH&MRC guidance. Sites include operational sites as well as other industrial areas proposed for redevelopment for industrial, recreational or residential use. Most (90%) of the sites assessed are associated with petroleum contamination, chlorinated hydrocarbons and metals (lead, arsenic and chromium).
- 1998 to 2009 - Evaluation of human health risks associated with the existence of and potential remediation of encapsulated scheduled waste materials located near residential and recreational areas. The assessment has involved ongoing monitoring, review of toxicity and exposures on an

ongoing basis, review of remediation options and risks derived from the application of preferred remediation options. The encapsulation has now been remediated.

- 2007 – Assessment of risks to human health and the environment associated with the re-use of water (including irrigation uses) from a groundwater treatment plant located in Sydney.
- 2000 to 2005 - Evaluation of human health risks associated with a number of contaminated sites located in Abu Dhabi, Spain and Azerbaijan. These risk assessments involved assessment of human health risks using USEPA guidance as well as WHO guidance.
- 2005 - Project management of large human health risk assessment associated with the redevelopment of explosives and munitions factories and firing ranges within various areas of NSW.
- 1995 to 1998 - Evaluation of human health risks associated with off-site accumulation of lead from historical deposition associated with a former operating lead paint site located within a residential area in Sydney. Project involved the review of lead exposure and toxicity, identification and agreement to lead action levels relevant for residential properties located close to and further away from the former source.
- 1995 - Evaluation and coordination of a multi-pathway health risk analysis for a large contaminated site in Sydney involving the use of probabilistic risk assessment methodology.
- 2000 to 2005 - Conducting a feasibility assessment for a waste destruction facility in Sydney, using a probabilistic risk assessment methodology. Conduct of a detailed health risk assessment associated with the operation of the selected technology, including presentation to the Commission of Enquiry. Subsequent review of the process and exposures in relation to placing the facility within a rural area (as opposed to an urban area) and consideration of other multi-pathway exposures.
- 1993 - Assessment of risks to human health and the environment associated with sewage sludge incinerators at North Head and Malabar Sewage Treatment Plants.
- 1992 to 2012 (and ongoing) - Determination of preliminary remediation goals for numerous contaminated sites based on risk criteria.
- 1995 to 2012 (and ongoing) - Development of air sampling procedures and techniques to collect air data relevant to the further assessment of vapour migration pathways in a range of areas. This includes the collection of ambient air, soil gas data (active and passive and sub slab) and flux emissions.

Ecological Risk Assessment

- 2009 to 2013 (ongoing) – Identification and derivation of investigation levels protective the terrestrial and aquatic environments associated with former clandestine drug laboratories in Australia. Ecological Tier 1 levels (based on available ecotoxicological data primarily from overseas studies) were identified and proposed for use in remediation guidelines with additional guidance provided in relation to sites where more detailed assessments of environmental risk issues needs to be conducted.
- 2010, 2011 and 2012 – Conduct (co-presenter) of lectures at the University of Sydney for the Risk Assessment (Human Health and Ecological) module for undergraduates, School of Geosciences. Ecological risk assessment lectures addressed basic principles and frameworks, stressors, fate and transport, bioaccumulation, uptake, derivation of ANZECC Guidelines, reviewing available ecotoxicological studies and conduct of statistical

analysis using the CSIRO Burrlioz software for establishing water guidelines.

- 2010 to 2011 – Expert witness in relation to ecotoxicological impacts of initial works proposed for the Barangaroo site in NSW.
- 2010 - Assessment and derivation of water criteria for petroleum hydrocarbons relevant to the protection of the terrestrial and aquatic environments from the reuse of urban run-off for irrigation or a public park and associated runoff into a lake. Assessment required a detailed assessment of not only phytotoxicity, but levels at which grass growth would be affected to the extent by which grass cover on an important AFL playing field would be affected.
- 2009 to 2011 – Detailed review of screening level risk ecological assessment (supporting studies and outcomes) for the discharge of contaminated groundwater into a sensitive marine environment in South Australia. Review required detailed consideration of the local environment, consideration that appropriate ecological indicator species have been selected, consideration of the range of urbanisation stressors within the environmental and potential for groundwater discharges to result in adverse effects to the aquatic environment, over and above those from urbanisation.
- 1998 to 2013 (ongoing) - Derivation of risk-based criteria for a range of projects that are based on the protection of the aquatic environment. Evaluations have considered the potential for contaminants (principally metals, polycyclic aromatic hydrocarbons [PAHs], petroleum compounds and chlorinated compounds) to leach from soil, migrate to groundwater and potentially discharge to a receiving environment (considered both marine and freshwater [including ephemeral] systems). The assessments have required review and consideration of fate and transport modelling.
- 2008 to 2010 - Detailed evaluation of environmental fate and transport issues associated with a former chlor-alkali plant. The assessment involved detailed evaluation of mercury fate and transport with use of specialised data collected and analysed by CSIRO and liaison with experts on mercury issues from the CSIRO. Assessment considered ecotoxicological risks associated with the presence of mercury in groundwater and discharge to an urban (highly modified) environment.
- 1992 to 2013 (and ongoing) - Determination of preliminary remediation goals for numerous contaminated sites based on risk criteria. In relation to environmental risk issues, this has included the identification of appropriate and screening level criteria that are protective of fresh and marine environments and phytotoxic effects. Where necessary more detailed evaluations of ecotoxicological effects have been considered. This has included the design of suitable surveys and sampling programs (including microtox, microalgae, fish, crustacean, amphipod (sediments), plant and earthworm), interpretation of information and data from these studies, discussion of results with relevant regulatory parties, uncertainty analysis and reporting. These studies have been conducted for the assessment of petroleum hydrocarbon, cyanide, inorganics, ammonia, chloride, phosphorous and nitrate concentrations in soil and discharges from groundwater.
- 2000 to 2008 - Detailed evaluation of risks to human health and the environment (particularly aquatic species and sediments) associated with redevelopment of large a number of gasworks sites in New South Wales and Victoria. The project in NSW involved collaboration with sediment experts to determine the nature and extent of sediment contamination,

potential for adverse ecotoxicological effects and requirements for remediation. The process required liaison with relevant site auditors and the DECCW (formerly NSW EPA) as required.

- 2007 - Assessment of risks to terrestrial and aquatic (marine water) environments associated with the re-use of water from a groundwater treatment plant located in Sydney. Water is proposed to be reused for a range of proposes that include industrial water (where it may be directly discarded to the marine environment) and irrigation where the water may affect terrestrial species and runoff may enter local water ways. The assessment considered available ecotoxicological data and guidelines available from Australian and International studies (where relevant to Australian species).

Contaminant Transport

- All of the projects listed above have involved the assessment of contaminant transport in at least one media. More specific examples are listed below:
- Vapour partitioning and transport assessed for petroleum compounds, including the development of a national database of petroleum vapour data, related to over 300 petroleum impacted sites, and detailed review of the database in conjunction with technical specialists from the USEPA;
- Vapour partitioning and transport assessed for chlorinated compounds at numerous contaminated sites, including the assessment of vapour risk issues at the Orica Botany site from 1994 to 2012;
- Review and use of groundwater fate and transport modelling conducted in support of numerous detailed risk assessment outcomes. Reviews have been conducted for the purpose of ensuring these models adequately address the potential movement of contaminants from a source to a point of discharge, utilising appropriate inputs and site data;
- 2008 to 2013 (and ongoing issues associated with remediation) - Detailed evaluation of mercury fate and transport in groundwater and air (mercury vapour) with use of specialised data collected and analysed by CSIRO and liaison with experts on mercury issues from the CSIRO. Assessment considered environmental issues associated with the presence of mercury in groundwater and discharge to an urban (highly modified) environment, as well as issues associated with mercury (elemental and inorganic) in soil and groundwater with respect to fate and transport, human health and environmental issues.
- 2010 to 2013 - Air dispersion modelling conducted for the assessment of exposures (and risks to human health) to grain fumigants, hydrogen sulphide, chlorinated compounds, silica and dust (particulate) emissions from a range of facilities. Modelling has been conducted using Screening level and mode detailed Ausplume and Calpuff dispersion modelling packages.

Air Emissions and Vapour Assessment

- Jackie Wright is experienced in all aspects of determining air quality, including monitoring, assessing and modelling soil gas, vapour emissions and emissions from stacks and other fugitive sources. Projects include analysing dust emissions from a number of quarries and coal mines, motor vehicle emissions; modelling vapour emissions from motor vehicles and sources such as creeks, ponds and waste areas; and assessing odour emissions from sewage treatment plants.
- 2012 to 2013 – Development of petroleum vapour intrusion guidance for Australia in conjunction with CRC CARE. The project has involved the development of clear, prescriptive guidance that incorporates current science on the assessment of petroleum vapour intrusion. The guidelines being developed have been presented at a series of PVI training workshops (supported by ALGA and CRC CARE) run in Sydney, Melbourne and Perth.
- 2009-2013 (ongoing) - Development of a petroleum vapour database to assist in the interpretation and understanding of the behaviour of petroleum vapours in the subsurface environment. The database is unfunded and independent and has been interpreted by Jackie as well as industry experts in Australia and the US. The database has been peer-reviewed by the USEPA, and incorporated into the USEPA publication on the use of field data (from the US, Canada and Australia) to support and develop vertical exclusion/separation distances (refer to the following website for the USEPA review and access to the database developed: http://www.epa.gov/oust/cat/pvi/). This data is being used to support the development of screening distances that are being incorporated into guidance being developed in Australia and the US.
- 2005 to 2013 (ongoing) - Preparation of conceptual site models and completing screening level modelling (using published models such as Johnson & Ettinger) for the assessment of vapour migration and intrusion issues on a wide range of sites (over 200) affected by petroleum and chlorinated hydrocarbons.
- 2010 to 2013 – Detailed evaluation of community exposures and risks to PM10 and PM2.5 derived from urban (combustion) sources as well as crustal (mining) sources. A number of urban projects have also considered community exposures and risks to other criteria pollutants that include ozone, nitrogen oxides and sulphur dioxide. Projects have involved detailed review of current literature in relation to the health effects and appropriate dose-response relationships relevant to the quantification of relevant health endpoints, with consultation conducted with stakeholders, including state health departments.
- 1995 to 2013 (ongoing) - Development of methods and approaches for the sampling and assessment of vapour (e.g. soil gas, flux emissions, indoor and ambient air). Works conducted has involved the conduct of field activities for the purpose of collecting this data.
- 1995 to 2013 (ongoing) - Interpretation and assessment of vapour data for the purpose of characterising inhalation exposures in a range of scenarios. These include existing buildings and proposed developments.

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Expert Evidence

- Expert evidence to Victorian Panel Enquiry – Long Term Containment Facility, Nowingi (2006) – expert evidence report and attendance in relation to human health risk assessment aspects.
- Expert evidence report (2010) Lend Lease (Millers Point) Pty Ltd and Ors ats Australians for Sustainable Development Inc. Land and Environment Court Proceedings 40965 of 2010. Provided expert evidence report and joint report (associated with mediation) in relation to human health and ecological risk issues. Aspects associated with my expert evidence resolved in mediation.
- Expert evidence report (confidential 2011) – expert evidence researched and evaluated in relation to mercury exposure and harm. Matter resolved prior to court.
- Expert review of risk issues (confidential, 2013) – expert review of contamination risks and potential for exposure to chlorinated solvents. Aspects associated with my review did not proceed to court.

Risk Communication

- 2000 to 2013 (ongoing) - Jackie Wright has experience in the preparation and presentation (communication) of risk outcomes from a number of key projects across Australia to a range of community groups. These groups include workers and unions, residents and community action groups.

Teaching

- 2010 to 2012 – Conduct of lectures at the University of Sydney for the Risk Assessment (Human Health and Ecological) module for undergraduates, School of Geosciences.
- 2009, 2010 and 2012 – Conduct of lectures at the University of Technology Sydney as part of the Contaminated Site Assessment and Management (CSARM) Professional Development Short Course, Risk Based Site Assessment.

Work History

Principal/Director/ Owner	Environmental Risk Sciences Pty Ltd	2008 (current)
Principal Environmental Scientist	URS Australia, North Sydney, NSW (formerly Woodward-Clyde)	1992 to 2008
Project Engineer	Sydney Water, Sydney, NSW	1991-1992
Environmental Scientist	Nigel Holmes & Associates, Sydney NSW	1990-1992
Assistant	Dames & Moore, Crows Nest, NSW	1988-1990

Education

BE (Hons)	University of Sydney, Bachelor of Engineering (Hons)	1989

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Professional Accreditation

Fellow of the Australasian College of Toxicology and Risk Assessment (ACTRA)

Professional Development

PhD Research (under scholarship) at Flinders University, Department of Environmental Health (full time degree, 2011-2013 [current])

Clandestine laboratory safety and investigator training and synthesis run by the Clandestine Laboratory Investigators Association (8 hour course, 2011)

Ecological Risk Assessment Course run through AEHS and credited by University of Massachusetts Boston (2010)

Mid-America Toxicology Course (35 hours, 2010)

Dose-Response Boot Camp run by Toxicology Excellence for Risk Assessment (TERA) (5 day course, 35 hours, 2008)

Vapor Intrusion Assessment and Mitigation Short Course run by Air & Waste Management Association (4 hours, 2006)

USEPA Human Health Risk Assessment Short Course (24 hours, 1995)

Affiliations

Member (former committee member, remains co-opted committee member), Australasian College of Toxicology and Risk Assessment (since 2007).

Member (technical committee position for toxicology and risk assessment), Australian Land and Groundwater Association (since 2010).

Member, Environmental Health Australia (since 2011).

Member, SETAC (Asia Pacific) (rejoined 2011).

Member, Air & Waste Management Association (since 2006).

Member, Society for Risk Analysis (since 1997).

Member, Association for Environmental Health and Sciences (since 1997).

Publications

Journal Articles:

Lahvis, M.A., Hers I., Davis, R.V., Wright, J. and DeVaull G.E., 2013. Vapor Intrusion Screening at Petroleum UST Sites. Groundwater Monitoring & Remediation.

Wright J. and Howell M., 2003. “Volatile Air Emissions from Soil or Groundwater – Are They as Significant as Model Say They Are?”. In Contaminated Soils, Volume 8, Edited by Edward J. Calabrese, Paul T. Kostecki and James Dragun, p375-393.

Gorman J., Mival K., Wright J. and Howell M., 2003, “Developing Risk-Based Screening Guidelines for Dioxin Management at a Melbourne Sewage Treatment Plant”. Water, Science and Technology, Vol 47 No 10, pp 1-7.

Wright J., and Howell M., 1995, "Health Risk Assessment - Practical Applications related to Air Quality Issues". Clean Air, Volume 29, No. 2, May 1995.

Government and Industry Publications:

Wright J., 2013. Petroleum Vapour Intrusion (PVI) Guidance. CRC Care Technical Report No 26, CRC for Contamination Assessment and remediation of the Environment, Adelaide, Australia (in publication).

NEPM 2013 Revision (to be released in 2013), Schedule B4 (Guideline on Site-Specific Health Risk Assessment Methodology) and Schedule B7 (Guideline on Derivation of Health-Based Investigation Levels). Primary author of toxicological evaluations and derivation of health investigation levels and contributing author to the Schedules (conducting full revision/rework of both Schedules, including responding to public comments and comments from state health agencies).

Australian Government, 2011. Guidelines for Environmental Investigations, Remediation and Validation of former Clandestine Drug Laboratory Sites [Guiedlines], April 2011. Primary author of toxicological evaluations and derivation of remeidation guidelines using risk based approach and listed contributor to main document.

Davis G.B., Wright J. and Patterson B.M., 2009. Field Assessment of Vapours, CRC CARE Technical Report no. 13, CRC for Contamination Assessment and remediation of the Environment, Adelaide, Australia.

Invited Lectures

Wright, J., 2013. Petroleum Vapour Intrusion Guidance in Australia. AEHS 23rd Annual International Conference on Soil, Water, Energy, and Air and AEHS Foundation Annual Meeting, March 18-21, 2013, Mission Valley Marriott, San Diego, California. Invited lecture

Wright, J., 2012. Evaluation of the Australia Hydrocarbon VI Data Base: Exclusion Criteria. AEHS 22nd Annual International Conference on Soil, Water, Energy, and Air and AEHS Foundation Annual Meeting, March 19-22, 2012, Mission Valley Marriott, San Diego, California. Invited lecture.

Conference Proceedings (Oral Presentations):

Wright, J., 2012. Exposure and Risk Issues associated with Clandestine Drug Laboratories – development of guidelines. British Occupational Hygiene Society (BOHS), Occupational Hygiene 2012 Conference, 24-26 April 2012, Mercure Holland House Hotel, Cardiff.

Wright, J., 2012. Risks of Not remediating Clandestine Drug Laboratories. 66th Annual Western Australian Environmental Health Australia (WA) State Conference Environmental Health: Imagine Life Without Us, 28-30 March 2012.

Wright, J, 2011. Establishing exclusion criteria from empirical data for assessing petroleum hydrocarbon vapour intrusion. CleanUp 2011: Proceedings of the 4th International Contaminated Site Remediation Conference, 11-15 September, Adelaide, Australia.

Wright, J., 2010. Review of Petroleum Vapour Data from Australia. Abstract presented at Ecoforum 2010, 3rd ALGA Annual Conference 23-24 February 2010.

Wright, J., 2010. Interpretation and Use of Soil Gas and other Vapour Data. Abstract presented at Ecoforum 2010, 3rd ALGA Annual Conference 23-24 February 2010.

Weaver T., Hassell T., Wright J., Stening J. and Apte S., 2009. Speciation and Geochemical Modelling as a Tool to Refine a Risk Assessment for Mercury in Groundwater. Presented at EcoForum, Sydney 28-30 April 2009.

Wright J. and Robinson C., 2009. The Reality of Sampling and Assessing Vapour Intrusion on Petroleum Sites. Presented at Air &Waste Management Association's Vapor Intrusion 2009, January 27-29 2009, San Diego CA.

Wright J., Lee A. and Howell M., 2008. Role of Risk-Based Concentrations in Assessment and remediation of Contaminated Sites. Presented at EcoForum, Gold Coast, 27-29 February 2008.

Wright J., Howell M. and Barnes J., 2006. Risk Assessment – Important Tool for Managing Issues on Contaminated Sites or Just a Task. Presented at Enviro06, Melbourne 2006.

Hall, A, Wright J. and Calabrese N, 2006. Ray Street Landfill – Audit Acceptance Levels for CO_2 in Redeemed Soils. Presented at Enviro06, Melbourne 2006.

Wright J. and Howell M., 2004. "Evaluation of Vapour Migration Modelling in Quantifying Exposure". Presented at Enviro04, Sydney March 2004.

Lee A., Howell M., and Wright J. 2004. "TPH – Analysis, Guidelines and Risk Assessment" Presented at Enviro04, Sydney March 2004.

Pershke D., van Merwyk T., Graham-Taylor S., Wright J., Mitchell T., and Elliot P., 2004. "Health Risk Assessment: Broadening the Horizons of the Traditional Health and Safety Approach", Presented at Enviro04, Sydney March 2004.

Wright J., Buchanan V., and Howell M., "Health Risk Assessment using Probability Density Functions". Presented at the AWWA Waste and Wastewater Conference, Brisbane 1998.

Wright J. and Buchanan V., 1996, "Uptake of Organics and Inorganics into Edible Fruit and Vegetable Crops". Presented at Intersect-96 International Symposium on Environmental Chemistry and Toxicology, Royal Australian Chemical Institute and the Australian Society for Ecotoxicology, 14-16 July 1996.

Wright J. and Howell M., 1995, "Risk Based Approach to Assessment and Management of Air Quality Issues Associated with Contaminated Sites and Hazardous Waste". Presented at Waste Management Institute (New Zealand) Inc., 7th Annual Conference and Exhibition, 31 October - 3 November, 1995.

Harrington J F, Clark L T and Wright J, 1994, "The Incineration of Sludge and its Effect on Ambient Air Quality in the Evaluation of Risk Factors for Primary School Children". Presented at Australia and New Zealand Clean Air Conference, Perth 1994.

Royston D, Clark L T and Wright J, 1993, "Chlorinated Dioxins and Furans from Combustion Sources: A review". Poster presented at the Sixth Conference of Asia Pacific Confederation of Chemical Engineering, Melbourne, 1993.