Format for submitting pursuant to Article 8 of the Stockholm Convention the information specified in Annex E of the Convention

Introductory information	
Name of the submitting Party/observer	**Australia**
Contact details (name, telephone, e-mail) of the submitting Party/observer	**Lee Eeles** **Director** **Chemical Policy Section** **Department of the Environment and Heritage**
Chemical name (as used by the POPS Review Committee (POPRC))	**Lindane**
Date of submission	**(to be completed when submitted)**

(a) Sources, including as appropriate (provide summary information and relevant references)	
(i) Production data:	
Quantity	**Stocks (as of December 2005) = 4,500 litres of formulated product.**
Location	**Brisbane**
Other	**Imports (Solid at a concentration of 995 g gamma HCH/kg):** **1000kg from India in 1994** **2000kg from India in 1998** **2000kg from India in 1999** **2000kg from India in 2002** **2000kg from India in 2004** **Importers are required to have a permit from the Minister for Agriculture, Fisheries and Forestry before they can import lindane. Also the importer is required to provide quarterly updates on stock quantities and locations to the Department of Agriculture, Fisheries and Forestry.**
(ii) Uses	**Lindane is currently the only pesticide registered for use in Australia against symphylids in pineapples. Symphylids are a ground dwelling pest that attack and can severely damage the root system of the pineapple plant causing significant economic loss.** **Approximately 1000 hectares are treated annually with 10,000 litres of formulated product to control these pests. No other uses of lindane are authorised in Australia.** **Previously the application of ethylene dibromide (EDB) for the control of nematodes also kept symphylids under control in most cases. However since EDB was removed from registration a few years ago the damage caused by symphylids has become widespread and is a significant issue.** **Some research has been done on alternative pesticides for the control of symphylids in pineapple but at this stage no other chemical is registered.**
(iii) Releases:	
Discharges	
Losses	
Emissions	
Other	

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(b) Hazard assessment for endpoints of concern, including consideration of toxicological interactions involving multiple chemicals (provide summary information and relevant references)
The toxicology of lindane was reviewed in Australia in 1986 by the Toxicology Evaluation Section of the Department of Health. This review noted that there was little worthwhile human toxicology data available for this chemical. This situation has not significantly changed to date. **In the US the Toxic Exposure Surveillance System reported 857 symptomatic cases of unintentional lindane ingestion between 1998 and 2003 – none led to death. In 91% of cases severity of the poisoning was low, moderate in 8% of cases, and high in 1% of cases – Reference: Centre for Disease Control and Prevention. Morbidity and Mortality weekly Report 54 (21); 533-535 June 3, 2005.**

(c) Environmental fate (provide summary information and relevant references)	
Chemical/physical properties	
Persistence	**Data generated in Australian soils for the persistence of lindane showed that after 43 months 3-14 % lindane remained in four different soils. The same experiment also showed that lindane persisted longer in soils when present with other organochlorines (not BHC isomers) present in the crude BHC formulations.** **For pure lindane, half life in soil ranged from 2-7 months depending on soil type with a mean value of 6 months. When the persistence of the gamma isomer of BHC was measured in the presence of other BHC impurities, it was found that the half life ranged from 7-12 months with a mean value of 9 months.** **Reference:** Bureau of Sugar Experimental Stations: Technical Communications Year 1972, No. 1. Studies on the Persistence of Aldrin, Dieldrin, Heptachlor, Lindane and Crude BHC Formulations in Four Queensland Soils. B.D.A. Stickley
How are chemical/physical properties and persistence linked to environmental transport, transfer within and between environmental compartments, degradation and transformation to other chemicals?	
Bio-concentration or bio-accumulation factor, based on measured values (unless monitoring data are judged to meet this need)	**Australia has concerns regarding the assessment of lindane against the bio-accumulation criterion. Having evaluated the information utilised by the POPRC in its assessment of lindane against the Annex D screening criteria, Australia submits further comments on bioaccumulation of lindane in Appendix A.**

(d) Monitoring data (provide summary information and relevant references)
Lindane is one of 10 organochlorines that are monitored for residues in Australian grains and beef produce through the National Residue Survey. In 2004-05 none of the 2,464 meat and 4,974 crop samples tested contained detectable lindane residues. **Reference** National Residue Survey Annual Report 2004–2005, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra. http://www.daff.gov.au/ **In a study looking at organochlorine pesticides and polybrominated diphenyl ethers (PBDEs) in human milk, 173 samples of breast milk were collected from 12 regions of Australia during the period March 2002 and September 2003. These samples were pooled into 17 samples for analysis. Lindane was detected in all samples, ranging from 0.08-0.47 ng g-1 lipid with a mean of 0.23 ng g-1 lipid.** **Reference** Harden F, Müller J & Toms L 2005, *Organochlorine Pesticides (OCPs) and Polybrominated Diphenyl Ethers (PBDEs) in the Australian Population: Levels in Human Milk*, Environment Protection and Heritage Council of Australia and New Zealand http://www.ephc.gov.au/ephc/ocp_pbde_human_milk.html

(e) Exposure in local areas (provide summary information and relevant references)	
- general	
- as a result of long-range	**The physico-chemical properties indicate a potential for long-range transport, but there is no evidence suggesting this is happening in Australia, because its**

environmental transport **- information regarding bio-availability**	**levels have declined since the 1980s (when most uses were de-registered) to the point where it is rarely detected in places where it was once ubiquitous. This suggests that lindane is not coming into the Australian environment by means of long-range transport.** **Reference:** Personal communication Dr M.R. Mortimer Queensland Environmental Protection Authority.

(f) National and international risk evaluations, assessments or profiles and labelling information and hazard classifications, as available (provide summary information and relevant references)

The following information is found on the label of lindane products sold in Australia:

FLAMMABLE
Do not handle near naked lights or flame

PROTECTION OF LIVESTOCK
DO NOT graze any treated plants or cut for stock food.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT
Dangerous to fish. DO NOT contaminate streams, rivers or waterways with the chemical or used containers.

STORAGE, DISPOSAL AND PROTECTION OF OTHERS
Store in the closed, original container in a cool, well-ventilated area. Do not store for prolonged periods in the direct sunlight. Store in a locked room or place away from children, animals, food, feedstuffs, seed and fertilizers.
Triple or preferable pressure rinse containers before disposal. Add rinsings to spray tank. Do not dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point.
If not recycling, break, crush or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500mm in a disposal pit specifically marked and set up for this purpose, clear of waterways, desirable vegetation and tree roots. Empty containers and product should not be burnt.

SAFETY DIRECTIONS
General
Product is poisonous if absorbed by skin contact, inhaled or swallowed. Will irritate the eyes and skin.
Preparation and Use
Avoid contact with eyes and skin. Do not inhale spray mist. When preparing spray, wear elbow-length PVC gloves and face shield. If product on skin, immediately was area with soap and water. If product in eyes, wash it out immediately with water.
After use
After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, face shield and contaminated clothing.

FIRST AID
If poisoning occurs, get to a doctor or hospital quickly. Contact the Poisons Information Centre – Phone 131126. If swallowed do NOT induce vomiting. Give a glass of water. Avoid giving milk or oils. If skin contact occurs, remove contaminated clothing and wash skin thoroughly. Remove from contaminated area. Apply artificial respiration if not breathing. If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

(g) Status of the chemical under international conventions

Lindane is listed in Annex III of the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.

Chemicals listed in Annex III of the Rotterdam Convention are subject to the Prior Informed Consent Procedure, where Parties can choose whether they want to receive imports of that chemical. Exporting Parties are required to prevent exports of chemicals listed in Annex III to Parties that do not consent to imports of a listed chemical.

Appendix A

Australian comments on evaluation of lindane under Annex D criteria by the POPRC.

Introduction

The Australian Government understands that an important function of the Annex E evaluation is for the risk profile to be developed in such a way that it "further elaborates on, ***and evaluates***, the information referred to in Annex D…" (emphasis added). To this end the Australian Government submits the following comments regarding the Annex D evaluation of lindane by the POPRC to assist the committee when developing the risk profile for lindane.

Section 3b – Persistence

Paragraph 3b(i)

The World Health Organization Environmental Health Criteria (WHO, 1991) for lindane states:

"When lindane undergoes environmental degradation under humid or submerged conditions and in field conditions, its half-time varies from a few days to three years, depending on type of soil, climate, depth of application and other factors. In agricultural soils common in Europe, its half-time is 40-70 days".

Under Australian conditions the half life in soil ranges from 2-7 months and averages about six months. (Stickley, 1972). It was also found that the half life of lindane varies depending on the presence of impurities (other than BHC isomers) found in the crude BHC formulation (Stickley 1972). This may explain some of the variation that has been observed with lindane half-lives.

Section 3c – Bioaccumulation

Paragraph 3c(i)

Australia notes that none of the bioaccumulation or bioconcentration values in this paragraph, with the exception of the figure attributed to the Mexican proposal, exceed the number 5,000 as required by paragraph (c)(i) in Annex D.

Australia could find no reference to a bioconcentration value of 12,500 in the Mexican proposal provided by the secretariat in **UNEP**/POPS/POPRC.1/8.

Australia believes a log K_{ow} value of 3.5 is accurate for lindane. However, Australia notes that this is significantly lower (more than 30 times lower) than a log K_{ow} of 5 as stated by paragraph (c)(i) in Annex D.

Paragraph 3c(ii)

Australia would like to present the following information for consideration by the Committee when exploring the concerns relating to ecotoxicity/toxicity of lindane.

Toxicity in the environment
According to the WHO(1991):

> "Lindane is not very toxic for bacteria, algae, or protozoa: 1mg/litre was generally the no-observed effect level (NOEL). Its action on fungi is variable, with NOELs varying from 1 to 30 mg/litre depending on the species. It is moderately toxic for invertebrates and fish, the L(E)C 50 values for these organisms being 20-90 µg/litre. In short-term and long-term studies with three species of fish, the NOEL was 9 µg/litre; no effect on reproduction was seen with levels of 2.1-23.4 µg/litre. The LC50 values for both freshwater and marine crustacean varied between 1 and 1100 µg/litre. Reproduction in *Daphnia manga* was depressed in a dose-dependent fashion; the NOEL was in the range 11-19 µg/litre. Reproduction of molluscs was not adversely effected (*sic*) by a dose of 1 mg/litre."

Lindane was detected in 27% of over 4,500 surface water samples collected in the United States at a median concentration of 0.020 µg/L (ATDSR, 2003). Lindane continues to be used in the United States. **Australia notes that this level is significantly lower than the NOEL for even the most sensitive aquatic species.**

Human/Vertebrate toxicity
According to (WHO, 1991)

> "The acute oral toxicity of lindane is moderate: The LD50 for mice and rats is in the range 60-250 mg/kg body weight, depending on the vehicle used. The dermal LD50 for rats is approximately 900 mg/kg body weight."

In humans some short term studies have established that lindane does not cause any adverse effects at a dose of approximately 1.0 mg/kg body weight, but at 15-17 mg/kg body weight severe toxic symptoms were observed (WHO, 1991). In clinical reports of lindane poisoning, toxic symptoms are typically short lived indicating that **lindane is rapidly metabolised in the body and rapidly excreted**.

The majority of ingested lindane is excreted in urine (ATSDR, 2003), small amounts leave the body via the faeces and expired air. For example, when goats were fed lindane at the rate of 6mg/kg body weight orally for five consecutive days no clinical evidence of toxicity was found (Mosha et. al, 1986). Ten days after dosing the levels of lindane in the goats had fallen to approximately 5% of the level during dosing – indicating rapid excretion from the body. After day 20, lindane was no longer detected in blood. This is in line with studies that found that mice given an oral dose of 5mg/kg eliminate about 80% of the lindane in 3-6 hours (Mosha et. al, 1986).

In the US the Toxic Exposure Surveillance System reported 857 symptomatic cases of unintentional lindane ingestion between 1998 and 2003 – none led to death. In 91% of cases severity of the poisoning was low, moderate in 8% of cases, and high in 1% of cases. (CDCP, 2005)

According to WHO surveys, more than 90% of human intake of pesticides originates from food (cited in Labana et. al, 1997). Despite continuing use of lindane in the US, levels of lindane detected in food by the FDA total diet study (2003) were typically low ranging from 0.0001 parts per million to 0.016 parts per million. 73.5 per cent of commodities had mean sample concentrations below 0.001 parts per million. Estimated dietary intakes of lindane in the US range from about 0.5 to 1.0 ng/kg/day (ATDSR, 2003).

Lindane levels in human fat have been measured in some cities. The lowest levels were found in Germany at 0.009 ppm. The highest levels were found in Spain at 0.68 ppm. The researchers who measured the Spanish lindane concentrations hypothesised that the high concentration was the result of the continuing widespread use of lindane in Spain (Molina et. al, 2005).

Paragraph 3c(iii)

Paragraph 3 c(iii) discusses the presence of lindane in seabirds, fish and mammals in the Arctic.

Australia does not believe that the detection of lindane in Arctic animals of itself provides any additional proof of bioaccumulation. According to the Mexican proposal, 13 tonnes of lindane is being transported to the Arctic every year, hence it is hardly surprising that lindane has been detected in animals living in this environment. Whether or not this indicates bioconcentration/bioaccumulation/biomagnification is not immediately clear without data on the concentrations in seabirds, fish and mammals relative to each other and to concentrations present in environmental media.

The paragraph also claims that "lindane concentrations in marine mammals are found at equivalent or even higher levels than some of the more hydrophobic contaminants such as polychlorinated biphenyls (PCBs) and DDT." This sentence is referenced to the Mexican proposal, but Australia could find no evidence of such a statement in the Mexican proposal. Australia notes that lindane has been found in the ice core of the Arctic at higher concentrations than the more hydrophobic chemicals (AMAP, 2002), but this is to be expected (i.e. one would expect the more hydrophilic chemicals to be found in ice at higher concentrations than more hydrophobic chemicals).

The final statement indicates that lindane has been found in breast milk of Inuit populations and in other mammals. Australia believes that this does not necessarily constitute evidence of bioaccumulation due to the continuing presence of lindane in these environments. As noted when discussing toxicological concerns in 3c(ii), lindane appears to be both rapidly absorbed and rapidly excreted from the body.

Concluding remarks

Australia believes that insufficient evidence has been provided to indicate that lindane adequately satisfies the bioaccumulation criteria (Annex D, (c) of the Stockholm Convention. Australia requests that the POPRC considers the information in this paper when evaluating information related to environmental fate as specified in paragraph (c) of Annex E.

References:

Agency for Toxic Substances and Disease Registry (2003) *Draft toxicological profile for alpha-, beta-, gamma- and delta-hexachlorocyclohexane* US Department of Health and Human Services. Atlanta.

AMAP (2002) Arctic Monitoring and Assessment Programme. Norway. Available at: http://amap.no/documents/index.cfm?action=getfile&dirsub=%2FArctic%20Pollution%202002&filename=AP2002POPs%2Drevised%2Epdf&CFID=374426&CFTOKEN=69424749&sort=default

Centre for Disease Control and Prevention (2005) *Morbidity and Mortality weekly Report* **54** (21); 533-535.

Food and Drug Administration (2003) *FDA and Drug Administration. Total Diet Study. Summary of residues found ordered by pesticide*. Available at: http://www.cfsan.fda.gov/~acrobat/tds1byps.pdf.

Labana S., Bansal R.C. and Mahmood, A. (1997) "Differential effects of lindane on intestinal functions in normal-fed and malnourished rats" *Pesticide biochemistry and physiology* **57**, 192-199.

Molina C., Falcon M., Barba A., Camara M.A., Olica, J. and Luna A. (2005) "HCH and DDT residues in human fat in the population of Murcia (Spain)" *Annals of Agricultural and Environmental Medicine* **12**:133-136.

R.D. Mosha, N. Hyrd-Hansen and I Kraul (1986) "Distribution and Elimination of Lindane in Goats" *Bulletin of Environmental Contaminants and Toxicology* **36**:518-522.

Stickley, B.D.A. (1972) *Studies on the Persistence of Aldrin, Dieldrin, Heptachlor, Lindane and Crude BHC Formulations in Four Queensland Soils* Bureau of Sugar Experiment Stations, Brisbane.

World Health Organization (1991) *Environmental Health Criteria 124. Lindane.* Geneva.